Proceedings of a Conference

MONETARY POLICY AND INFLATION TARGETING

Economic Group
Reserve Bank of Australia

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Introduction

Philip Lowe

Medium-term price stability is widely accepted as the appropriate ultimate goal for monetary policy. This reflects two ideas. The first is that high rates of inflation distort decision-making, ultimately leading to slower economic growth. The second is that monetary policy is the most effective instrument in influencing medium-term inflation outcomes. By pursuing a strategy that ensures that inflation does not distort decisions concerning investment, production and savings, monetary policy is best able to contribute to sustainable improvements in living standards.

A variety of monetary-policy frameworks is consistent with achieving this objective, although there has been a shift over recent years to forms of inflation targeting. Even in countries without an explicit inflation target, there is often a strong commitment to an implicit medium-term inflation objective. Further, countries that have chosen to fix their exchange rate have typically done so against a country with some form of implicit or explicit inflation objective.

While the move to inflation targets has made the ultimate goal of monetary policy more transparent, it has not meant that central banks have eschewed all attempts to mitigate cyclical fluctuations in output and employment. Indeed, most central banks aim to reduce the amplitude of the business cycle, not only because this often helps the task of inflation control, but also because steady, sustained growth is likely to lead to better medium-term outcomes than is a process of ‘stop-go’ growth.

The focus of monetary policy on price stability has contributed to a remarkable convergence of inflation rates; most OECD countries now have inflation rates of around 3 per cent or less, with the differences between countries currently smaller than at any time since the early 1960s. This convergence of outcomes has also been helped by the generally benign international economic environment over recent years and the processes of international integration and product- and labour-market reform. However, while these developments have contributed to the recent low inflation outcomes, they do not by themselves ensure a continuation of low inflation. This remains the responsibility of monetary policy.

The papers in this volume were commissioned by the Bank to examine how this responsibility may best be met. The papers in Part I examine the arguments for and against various operational frameworks for monetary policy, including a fixed exchange rate, a money-supply target, and implicit and explicit inflation targets. The papers in Part II examine in more detail the history of the Australian monetary-policy framework, as well as discuss a number of specific proposals for reform of the current arrangements. Finally, the papers in Part III examine how short-term interest rates should be changed in response to various events.

Monetary-policy Frameworks

Most monetary-policy frameworks, or systems, are underpinned by some form of inflation objective. The most obvious case is a system in which the central bank’s only objective is to ensure that the annual inflation rate remains within a narrow band. But other systems also have (sometimes implicit) inflation objectives. For example, in a system based on monetary aggregates, there is a target for inflation implicit in the allowable growth rate of money. Also, fixed-exchange-rate systems are often used by countries to achieve a similar inflation rate as that applying in the country against which they are fixing. Finally, in systems in which the central bank uses some form of Taylor rule (or more accurately a Bryant-Hooper-Mann rule[1]) to guide the setting of short-term interest rates there is a specific inflation target which the central bank expects to achieve on average.

In evaluating these systems, two issues are important:

- Does the system achieve the inflation objective without unduly adding to output and employment fluctuations?
- Is the system transparent, and does it make the central bank sufficiently accountable?

The answers to these questions will vary from country to country, depending upon the structure of the economy, the type of shocks that occur, the nature of the financial system and the public's perception of monetary policy. For example, given Australia's relatively large terms-of-trade changes, a fixed-exchange-rate system is likely to generate greater output fluctuations than those currently experienced. Similarly, while a system based on monetary targets might be able to tie down the medium-term inflation rate, the relatively high frequency of large, unexpected changes in the demand for money mean that a fixed-money-growth rule could generate instability in output. The same result is likely in an inflation-targeting system in which the inflation rate must be controlled within a very narrow band.

These considerations point to the adoption of a medium-term inflation target, of which the Australian system is one example. A medium-term target ties down the expected average inflation rate, but in a way that does not exacerbate the amplitude of the business cycle. The framework acknowledges a trade-off between the variability of inflation and the variability of output, and implicitly recognises that the benefits of medium-term price stability are not sacrificed by some degree of variability in the annual inflation rate. This allows monetary policy some scope to be directly concerned with the size of the swings in output and employment, independent of their effect on inflation. To some extent, these swings can be moderated without prejudicing the ultimate goal of monetary policy.

The adoption of inflation targets has played an important role in anchoring inflation expectations. Also, inflation targets have provided central banks and governments with a vehicle for clearly communicating and justifying monetary-policy decisions. This may have reduced some of the political-economy problems that are sometimes associated with monetary policy and has made policy more transparent and central banks more accountable. The adoption of inflation targets has also helped institutionalise the commitment to low inflation, making it less likely that monetary-policy decisions are driven by the objectives of particular individuals.

The current debates about the design of inflation-target systems have centred on the issues of what degree of variability in inflation is acceptable, and what, if any, procedures

1. By this rule, interest rates are raised above the estimate of 'neutral' when inflation is above target or output above potential.

should be implemented if inflation moves too far away from target. In some countries, governments have specified review procedures which are triggered when inflation moves outside specified bands, while in others, the emphasis is on a process of ongoing review.

The type of review mechanism that delivers the best results will only become evident in time. Some see triggered reviews as critical in ensuring that the central bank is not tempted to tolerate higher inflation to obtain faster short-run employment growth. Others argue that such reviews are likely to be ineffective as the public is unlikely to criticise, or penalise, the central bank for not having had higher interest rates. Some go a step further, and argue that triggered reviews are unnecessary since a competent forward-looking central bank with a medium-term inflation objective knows that tolerating higher inflation, and allowing a rise in inflation expectations, will inevitably require a period of slow growth and rising unemployment to get inflation back to target.

Australian Monetary Policy

Over the past decade and a half, the monetary-policy framework in Australia has evolved through three stages. First there was a loose form of monetary targeting. This was abandoned in the mid 1980s and replaced with a system without explicit intermediate targets or objectives, with monetary policy often playing a supporting role to other policy instruments. Then from the late 1980s the system evolved into one with a much sharper focus on price stability, with an explicit inflation target being adopted in 1993.

Unlike in some other countries, the Australian inflation target was implemented only after inflation had been reduced. While it is sometimes argued that announcing an inflation target reduces the cost of disinflation, the real benefit of an inflation target appears to be that it makes it easier to maintain low inflation once it has been achieved. By anchoring inflation expectations and improving the public's understanding of how monetary policy works, inflation targets reduce the risk of events that cause surges in inflation. Also, when these events occur, their effect on inflation should be smaller and their propagation weaker.

Experience suggests that a reduction in inflation expectations takes a long time to occur, with a track record of good performance the critical ingredient. In Australia, despite an average inflation rate over the past seven years of around $2^1/_2$ per cent, it is only recently that many people have recognised that low inflation is once again an important part of the economic landscape. This slow adjustment of expectations has made the task of monetary policy more difficult than it otherwise would have been. But substantial progress in reducing inflation expectations has been made, and continues to be made, with public recognition of the inflation target playing an important role.

To some extent, the recent success of inflation targets in Australia and elsewhere has been helped by the absence of events on the supply side that push up inflation; if anything, supply-side factors have been working in the opposite direction. It cannot be assumed that this favourable situation will continue indefinitely; at some future point there is a significant likelihood that an event will cause inflation to rise and output to fall. Such an outcome would be a challenge for all monetary-policy frameworks, as the higher interest rates needed to reverse the rise in inflation would exacerbate the decline in output.

However, by anchoring inflation expectations, an inflation-targeting system may help in the adjustment.

The critical question here is how quickly inflation is brought back to the target. A system based on a narrow target band would likely require either a rapid return, probably at the cost of a large decline in output, or a temporary suspension of the target. The system of inflation targeting as practised in Australia would permit a more moderate return. In assessing how quick that return should be, the behaviour of inflation expectations is crucial. If inflation expectations increase by only a small amount, a relatively slow decline in inflation may be possible. However, if medium-term expectations look to be moving up in line with actual inflation, a more rapid response may be required. The appropriate speed of adjustment is a matter of judgment; having a medium-term inflation objective should help anchor expectations and allows this judgment to be made in such a way that price stability can be restored without unnecessarily amplifying the business cycle.

Some commentators on the Australian framework view this flexibility as undesirable. They seek more rigid rules that reduce the discretion of policy-makers to tolerate deviations of inflation from a target range. Others make a broader criticism, seeing an increased role for fiscal policy in the management of output fluctuations, and thus implicitly in the control of inflation; the argument is that this would allow *aggregate* price stability to be achieved, and at the same time reduce *relative* price variability and interest-rate volatility. Whether or not such an outcome is possible in practice is an interesting area for future research.

Setting Short-term Interest Rates

Unlike some other monetary-policy regimes, an inflation-target regime does not specify the monetary-policy instrument or how it should be set, although in most countries with an inflation target the instrument is the overnight interest rate. Exactly how central banks should determine the appropriate level of this interest rate, and how frequently it should be changed, are areas of ongoing research.

This research has generated a number of simple suggestions that have become known as interest-rate ‘rules’. These rules have interest rates changing in response to actual or expected inflation and actual or expected deviations of output from full capacity (the output gap). A number of points stand out from this research.

First, if interest rates respond to *expected* inflation and the output gap, the variability of inflation and output will be considerably less than if policy responds only to current values of these variables. Good policy needs to be forward-looking. If policy is restricted to reacting only to current-dated variables, then any variable which provides information about future inflation – such as wages or the exchange rate – should enter the policy-makers’ reaction function.

Second, there is a trade-off between the variability of output and the variability of inflation. If the central bank wishes to keep inflation within a narrow range, it is likely that this will come at the cost of larger fluctuations in output.

Third, if monetary policy is credible, with inflation expectations anchored by the central bank’s inflation target, both the variability of output and inflation can be reduced.

Fourth, even if the central bank cares only about the variability of inflation (and does not care about the variability of output), it should still attempt to offset some of the variability in output. The reason is that the shape of the business cycle has a major influence on the evolution of inflation. By reducing fluctuations in output, the central bank can mitigate the inflation cycle.

Some economists have proposed a much more complicated procedure for setting interest rates than these simple rules. They suggest that the central bank should map out a complete path of future interest rates, with this path minimising some combination of the expected variability of inflation and the output gap. Having done this it should implement the first interest rate on that path and then repeat the procedure each month. One interesting feature of this approach, and of the simple interest-rate rules, is that it generates considerably greater variability in short-term official interest rates than has been seen in practice.

In practice, central banks appear to be averse to large changes in official interest rates. While the trend towards announcing and explaining changes in official rates may have strengthened this preference, the reasons for it are rarely articulated. In part, it can be explained by the combination of uncertainty and the perception that large changes in official interest rates, and frequent directional changes, are costly. It appears that central banks avoid making interest-rate changes that they expect might be reversed within a short period of time. If interest rates were to be moved in larger steps than is currently the case, directional changes would become more common. This could make it more difficult for financial markets and the public to understand the central bank's strategy. By moving interest rates in small steps, the probability of having to make a near-term reversal is reduced. It is also possible that infrequent and relatively small changes in official interest rates make the transmission mechanism more effective, although there is little empirical evidence either in support of, or in conflict with, this view.

One final question is whether the setting of monetary policy should be influenced by changes in asset prices. The most frequent answer is no. It is possible, however, that rising asset prices lead to an increase in expected future inflation in the prices of goods and services, and thereby indirectly cause an increase in interest rates. But in this case, policy would be reacting to expected future inflation, not to current asset-price inflation.

The one major qualification to this answer arises from the interaction of asset prices and the financial system. Rising asset prices create collateral for additional loans. This is exactly as it should be if the asset-price increases are based on fundamentals. But if the increases are not driven by fundamentals, financial institutions can incur substantial losses when the inevitable correction in prices occurs. These losses can amplify any downturn in the business cycle. The end result is that rises in asset prices that are not sustainable can set in train deflationary pressures that might only be felt some years down the track. Whether or not monetary policy can resolve this problem is an area of ongoing research; the current consensus is that these are mostly issues for prudential policy.

The Conference

The Conference was held at the Bank's H.C. Coombs Centre for Financial Studies at Kirribilli on 21 and 22 July 1997. The papers were commissioned by the Bank and the

40 invited participants came from Australian academia, the public sector and private business, as well as overseas central banks, international institutions and the Reserve Bank of Australia.

The papers by both Rick Mishkin and Malcolm Edey examine various monetary-policy frameworks, and conclude that, for most countries, some form of inflation targeting represents the best method for achieving the goal of medium-term price stability. The paper by Andy Haldane discusses a number of design features of inflation-targeting systems; in particular, the appropriate level of an inflation target, the choice of targeting horizon and the need for transparency.

The paper by Stephen Grenville examines the evolution of the Australian monetary-policy framework over the past decade and a half, tracing the move from monetary targets to inflation targets. Various perspectives on the current framework are then presented in the papers by Warwick McKibbin, John Quiggin and Peter Stemp. Warwick McKibbin makes the case that policy-makers need to be able to respond flexibly to different events, while John Quiggin argues that fiscal policy should play a more active role in the management of the business cycle and that real interest rates should be more stable than they have been in the past. In his paper, Peter Stemp calls for a more precisely defined inflation objective with clearer definitions of success and failure.

The paper by Frank Smets examines the implications for the setting of short-term interest rates of changes in asset prices. In particular, it examines how movements in asset prices might affect forecasts of inflation. The papers by Gordon de Brouwer and James O'Regan and by Philip Lowe and Luci Ellis examine various 'rules' for setting interest rates. The first of these papers examines the degree to which policy should respond to deviations of output from potential and inflation from its target, as well as looking at the benefits of forward-looking policy, while the second paper examines the causes and effects of interest-rate smoothing.

Discussants' comments and summaries of the conference discussions are included after each paper, while summaries of the papers themselves are at the back of this volume.

Strategies for Controlling Inflation

Frederic S. Mishkin

1. Introduction

In the past fifteen years, an extraordinary development has occurred in economies throughout the world: inflation has fallen dramatically in many industrialised as well as emerging-market countries, to the point where many of them have reached what might arguably be called price stability. Why did this happen and how did policy-makers achieve this feat?

This paper examines these questions by first outlining why a consensus has emerged that inflation needs to be controlled. Then it examines different strategies for controlling inflation and highlights the advantages and disadvantages of these different strategies. The discussion should shed light not only on how disinflation might best be achieved, but also on how the hard-won gains in lowering inflation can be locked in, so that inflation is less likely to rear its ugly head in the future.

2. The Growing Consensus for Inflation Reduction

An important reason why so many countries have reduced their inflation rates in recent years is that there has been a growing consensus, particularly among central bankers and even in the public at large, that inflation reduction and price stability should be the primary or overriding long-term goal of monetary policy. This consensus has emerged from economic research and actual economic events over the past thirty years, as is discussed in this section.

The rationale for pursuing price stability as the primary long-term goal for monetary policy rests on two basic propositions. First is that activist monetary policy to reduce unemployment in the short run might be undesirable because it can lead to higher inflation but not lower unemployment. Second is that price stability in the long run promotes a higher level of economic output and more rapid economic growth. The corollary of these two propositions is that price stability is the appropriate overriding, long-run goal of monetary policy because it will produce better economic outcomes.

2.1 The case against monetary-policy activism

Thirty years ago, both the public and the majority of the economics profession supported a so-called activist monetary policy: i.e., the taking of active steps to reduce unemployment with expansionary monetary policy whenever unemployment rose above a ‘full-employment level’. In the 1960s this level was defined to be around 4 per cent in the United States. Support for activism was based on two principles. First was that macroeconometric models, particularly large ones with many equations, had become sufficiently advanced to accurately predict the impact of changes in both monetary and fiscal policy on the aggregate economy. Thus, manipulation of monetary and fiscal policy levers could be used to dampen fluctuations in the business cycle.

The second principle supporting an activist monetary policy was popularised by Paul Samuelson and Robert Solow in their famous paper in 1960. They suggested that there was a long-run Phillips-curve trade-off which could be exploited. A simple linear version of this Phillips curve can be written as follows:

$$\pi_t = k - \alpha(U_t - U_t^n) \tag{1}$$

where: π_t = inflation at time t;

k = constant;

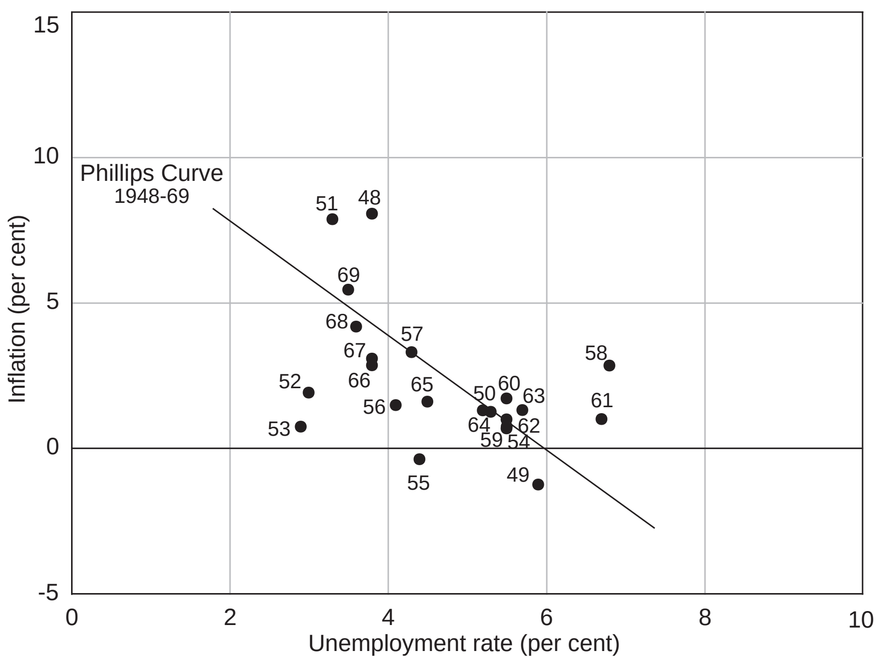
α = the slope of the Phillips curve, i.e. how much inflation changes for a given change in $U_t - U_t^n$;

U_t = the unemployment rate at time t; and

U_t^n = the natural rate of unemployment at time t, i.e. the rate of unemployment consistent with full employment at which the demand for labour equals the supply of labour.

Figure 1 shows what the Phillips-curve relationship looked like for the United States before 1970. As we can see from Figure 1, the relationship worked well before 1970 and seems to suggest that there was a trade-off between unemployment and inflation: if

Figure 1: Phillips Curve 1948–1969



Source: Economic Report of the President.

policy-makers wanted to have lower unemployment, they could ‘buy’ it by accepting a higher rate of inflation. Combining this view with confidence in the ability of large-scale macroeconometric models to evaluate the effects of policy, naturally led many economists in the 1960s to advocate activist policy measures to keep the economy at a target unemployment level.

However, there are three powerful arguments against monetary activism: there are long and variable lags in the effects of monetary policy on the economy; there is no long-run trade-off between output (unemployment) and inflation; and the time-inconsistency problem. These three arguments have so strongly undercut the case for monetary-policy activism that support for it is now held by only a minority of economists. We look at each of these arguments in turn.

Long and variable lags. The first salvos that had a major impact against activism came from the monetarists led by Milton Friedman. Monetarists pointed out some serious flaws in Keynesian macroeconometric models. They also noted that the effects of macro policy were highly uncertain. Indeed, Milton Friedman staked out his famous position that activist policy would be counterproductive because policy, and particularly monetary policy, affects the economy only with ‘long and variable lags’.

Although long lags, in and of themselves, do not rule out successful activism, there is a political-economy argument why they make activist policy counterproductive. The public, and particularly politicians, often have a very myopic view of policy: that is, they only focus on the short run and cannot understand that policy lags may be very long and indeed may be longer than the time it takes for the problem to correct itself. Therefore, politicians have a tendency to want immediate results and often fall into the trap of overmanipulating policy levers. In the case of monetary policy, this may lead policy-makers to try to solve a problem such as too high unemployment using expansionary monetary policy, but by the time the expansionary policy is effective because of long lags, self-correcting mechanisms may have already returned the economy to full employment. The result is that activist monetary policy may lead to an overheated economy, which in turn leads either to inflation or to an attempt by policy-makers to reign in the economy by reversing course, which can generate further economic instability. Monetarists therefore saw activist policy as having only a negative impact on the economy and instead advocated nonactivist policy such as a rule in which the money supply grows at a constant rate.

The view that the effects of monetary policy are variable and that this variability makes activist policy less attractive has been accepted not only by monetarists, but also by the large majority of the economics profession, who do not necessarily accept the monetarist position that macroeconomic policy should focus on the money supply and a monetary-policy rule involving the growth rate of the money supply. Economists are no longer confident that macroeconometric models can accurately predict the impact of changes in both monetary and fiscal policy on the aggregate economy and, therefore, accept the view that the design of successful activist monetary policy is very difficult.

There are two primary reasons why the majority of the economics profession has come to doubt the usefulness of macroeconometric models to evaluate the impact of policy. One reason is that the performance of large macroeconometric models in both forecasting the economy and predicting the effect of policy has not been as good as the model builders once hoped. The second and more important reason is the so-called 'Lucas critique' developed in Lucas' famous paper, 'Econometric Policy Evaluation: A Critique', which already had become very influential by the time I left graduate school in 1973, but was not published until 1976 (Lucas 1976). Lucas's challenge to policy evaluation using econometric models was based on a simple principle of rational-expectations theory:

> 'The way in which expectations are formed (the relationship of expectations to past information) changes when the behaviour of forecasted variables changes'.

So when policy changes, the relationship between expectations and past information will change, and because expectations affect economic behaviour, the relationships in the econometric model will change. The econometric model which has been estimated with past data will then no longer be the correct model for evaluating the response to this policy change and may consequently prove highly misleading.

Along with the earlier monetarist criticisms of Keynesian macroeconometric models, the theoretical argument in the Lucas critique, when combined with a mixed performance of macroeconometric models in their ability to forecast and predict the effects of policy, dealt a body blow to the earlier optimism of the profession and the public that macroeconometric models could be used to design effective, activist stabilisation policy.

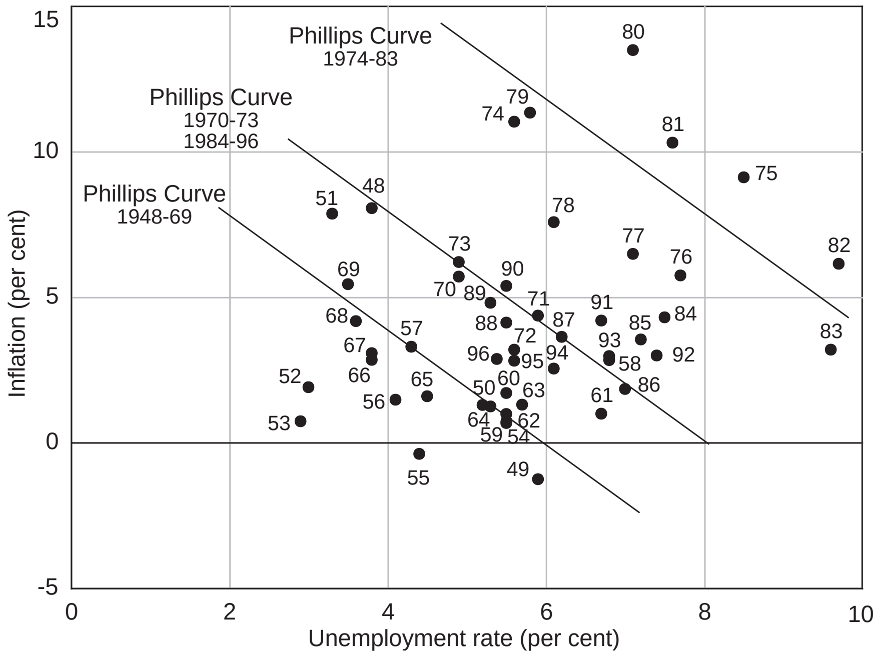
No long-run trade-off between unemployment and inflation. The second blow to policy activism was delivered by Milton Friedman in his famous presidential address to the American Economic Association in 1967 (Friedman 1968). There, Milton Friedman pointed out that the second principle supporting activist policy, the Phillips-curve trade-off between unemployment and inflation, was incorrect. He pointed out a severe flaw in the Phillips-curve analysis: it left out an important factor that affects wages and price inflation – expectations of inflation.

Friedman noted that firms and workers are concerned with real variables, such as real wages, and are thus concerned with wages and costs of production that are adjusted for any expected increase in the price level. Workers and firms, therefore, take inflation into account when setting wages and prices, with the result that inflation will respond not only to tightness in the labour markets but also to expected inflation as well. This reasoning leads to an expectations-augmented Phillips curve in which the constant term in Equation (1) is replaced by expected inflation, π_t^e, expressed as:

$$\pi_t = \pi_t^e - \alpha(U_t - U_t^n). \tag{2}$$

The expectations-augmented Phillips curve implies that as expected inflation rises, the Phillips curve will shift upward. Friedman's modification of the Phillips-curve analysis was remarkably clairvoyant: as inflation increased in the late 1960s, the Phillips curve did indeed begin to shift upward, as we can see from Figure 2. An important feature of Figure 2 is that a long-run trade-off between unemployment and inflation no longer exists: as the points in the scatter diagram indicate, a high rate of inflation is no longer associated with a low rate of unemployment, or *vice versa*. This is exactly what the expectations-augmented Phillips curve predicts: a rate of unemployment below the natural rate of unemployment cannot be 'bought' permanently by accepting a higher rate of inflation.

Figure 2: Phillips Curve 1948–1996



Source: Economic Report of the President.

This prediction can be derived straightforwardly from the expectations-augmented Phillips curve as follows. When inflation is kept at a higher level for a substantial period of time, expected inflation would adjust upwards to a long-run value that would equal actual inflation. Substituting π_t for π_t^e in the expectations-augmented Phillips curve in Equation (2) then yields:

$$0 = -\alpha(U_t - U_t^n) \tag{3}$$

which implies that $U_t = U_t^n$. This implies that in the long run, for any level of inflation, the unemployment rate will settle to its natural-rate level: hence, the long-run Phillips curve is vertical, and there is no long-run trade-off between unemployment and inflation.

Indeed, if anything, the scatter plot in Figure 2 seems to suggest a slight tendency for unemployment and inflation to be positively correlated over the long run. In his Nobel prize address, Milton Friedman provided a rationale for why higher inflation might actually lead to higher, rather than lower, unemployment in the long run.[1] His position that the long-run Phillips curve may even be positively sloped therefore provides additional ammunition against the pursuit of output goals and supports the desirability of a price-stability goal.

1. See Friedman (1977). Recent research such as Groshen and Schweitzer (1996) also suggests that the long-run Phillips curve may have a slight positive slope, particularly at inflation rates above 10 per cent.

The time-inconsistency problem. The third intellectual development that argues against activist policy was developed in papers by Kydland and Prescott (1977), Calvo (1978) and Barro and Gordon (1983), and is commonly referred to as the *time-inconsistency problem* of monetary policy. The time-inconsistency problem stems from the view that economic behaviour is influenced by expectations of future policy. A common way for making policy decisions is to assume that, at the time that policy is made, expectations are given. In the case of monetary policy, this means that with expectations fixed, policy-makers know that they can boost economic output (or lower unemployment) by pursuing monetary policy that is more expansionary than expected. Thus, as a result, policy-makers who have a high output objective will try to produce monetary policy that is more expansionary than expected. However, because their decisions about wages and prices reflect expectations about policy, workers and firms will not be fooled by the policy-makers' expansionary monetary policy and so will raise not only their expectations of inflation but also wages and prices. The outcome is that policy-makers are actually unable to fool workers and firms, so that, on average, output will not be higher under such a strategy, but unfortunately inflation will be. The time-inconsistency problem shows that a central bank may end up with a suboptimal result of a bias to high inflation with no gains on the output front, even though the central bank believes that it is operating in an optimal manner.

Although the analysis of the time-inconsistency problem sounds somewhat complicated, it is actually a straightforward problem that we encounter in our every day life. Anyone who has children has had to deal with this problem continually. It is always easy to give in to children in order to keep them from acting up. However, the more the parent gives in, the more demanding a child becomes. The reason, of course, is that a child's expectations about the parent's policy changes depending on the parent's willingness to stand up to the child. Thus, giving in, although seemingly optimal based on the assumption that a child's expectations remain unchanged, leads to suboptimal policy because the child's expectations are affected by what the parent does. Similar reasoning applies to the conduct of foreign policy or any type of negotiation: it is very important not to give in to an opponent even if it makes sense at the time, because otherwise the opponent is more likely to take advantage of you in the future.

McCallum (1995) points out that the time-inconsistency problem by itself does not imply that a central bank will pursue expansionary monetary policy which leads to inflation. Simply by recognising the problem that forward-looking expectations in the wage- and price-setting process create for a strategy of pursuing unexpectedly expansionary monetary policy, central banks can decide not to play that game. Although McCallum's analysis is correct as far as it goes, it suggests that the time-inconsistency problem is just shifted back one step: even if the central bank recognises the problem, there still will be pressures on the central bank to pursue overly expansionary monetary policy, with the result that expectations of overly expansionary monetary policy are still likely.

2.2 The gains from price stability

The analysis above indicates that attempts to use monetary policy to pursue real output objectives are likely to be counterproductive. But it still leaves open the question of why price stability is the appropriate long-term goal for monetary policy. The answer is that price stability promotes an economic system that functions more efficiently.

If price stability does not persist, that is, inflation occurs, there are several economic costs to the society. While these costs tend to be much larger in economies with high rates of inflation (usually defined to be inflation in excess of 30 per cent a year), recent work shows that substantial costs of inflation arise at low rates of inflation as well.

The cost that first received the attention of economists is the so-called 'shoe leather' cost of inflation, namely, the cost of economising on the use of non-interest-bearing money (Bailey 1956). The history of pre-war central Europe makes us all too familiar with the difficulties of requiring vast and ever-rising quantities of cash to conduct daily transactions. Unfortunately, hyperinflations have occurred in emerging-market countries within the past decade as well. Given conventional estimates of the interest elasticity of money and the real interest rate when inflation is zero, this cost is quite low for inflation rates less than 10 per cent, remaining below 0.10 per cent of GDP. Only when inflation rises to above 100 per cent do these costs become appreciable, climbing above 1 per cent of GDP.

Another cost of inflation related to the additional need for transactions is the overinvestment in the financial sector that inflation produces. At the margin, opportunities to make profits by acting as a middleman on normal transactions, rather than investing in productive activities, increase with instability in prices. A number of estimates put the rise in the financial sector's share of GDP on the order of 1 percentage point for every 10 percentage points of inflation up to an inflation rate of 100 per cent (English 1996). The transfer of resources out of productive uses elsewhere in the economy can be as large as a few percentage points of GDP, and can even be seen at relatively low or moderate rates of inflation.

The difficulties caused by inflation can extend to decisions about future expenditures as well. Higher inflation increases uncertainty both about relative prices and the future price level which makes it harder to make the appropriate production decisions. For example, in labour markets, Groshen and Schweitzer (1996) calculate that the loss of output due to inflation of 10 per cent (compared to a level of 2 per cent) is 2 per cent of GDP. More broadly, the uncertainty about relative prices induced by inflation can distort not only the attractiveness of real versus nominal assets for investment, but also short-term versus long-term contracting, risk premia demanded on savings, and the frequency with which prices are changed (as in menu-cost stories).[2]

The most obvious costs of inflation at low to moderate levels seem to come from the interaction of the tax system with inflation. Because tax systems are rarely indexed for inflation, a rise in inflation substantially raises the cost of capital, which lowers investment below its optimal level. In addition, higher taxation which results from inflation causes misallocation of capital to different sectors that both distorts the labour supply and leads to inappropriate corporate financing decisions. Fischer (1994) calculates that the social costs from the tax-related distortions of inflation amount to 2 to 3 per cent of GDP at an inflation rate of 10 per cent. In a recent paper, Feldstein (1997) views this

2. Briault (1995) gives a good summary of these effects.

cost to be even higher: he calculates the cost of an inflation rate of 2 per cent rather than zero to be 1 per cent of GDP per year.

The costs of inflation outlined here decrease the level of resources productively employed in an economy, and thereby the base from which the economy can grow. There is mounting evidence from econometric studies that at high levels, inflation also decreases the rate of growth of economies as well. While long time-series studies of individual countries and cross-national comparisons of growth rates are not in total agreement, there is a consensus that inflation is detrimental to economic growth.[3] The size of this effect varies greatly with the level of inflation, with the effects usually thought to be much higher at higher levels.[4] However, a recent study has presented evidence that inflation variability associated with higher inflation has a significant negative effect on growth even at low levels of inflation, in addition to and distinct from the direct effect of inflation itself.[5]

2.3 Bottom line

In view of the long and variable lags in the effects of monetary policy on the economy, the weakened confidence in the ability of macro models to evaluate the effects of active policy, the recognition that no long-run trade-off exists between unemployment and inflation, and the development of the theoretical literature on the time-inconsistency problem, both the economics profession and the public now doubt the efficacy of activist policies to eliminate unemployment. This case against monetary-policy activism, along with the recognition of the benefits of price stability in producing less uncertainty in the economy and a healthier economic environment and thereby leading to greater real activity and economic growth, have led to an emerging consensus that price stability should be the overriding long-run goal for monetary policy.

3. Strategies for Controlling Inflation

With the growing consensus that price stability should be the overriding long-run goal of monetary policy, many countries have taken active steps to reduce and control inflation. What strategies have they used to do this?

There are four basic strategies that central banks have used to control and reduce inflation:

- exchange-rate pegging;
- monetary targeting;
- inflation targeting; and

3. Although there is a wide range of estimates of the effect of inflation on growth, almost all of the many studies in the literature find a negative coefficient of inflation on growth (Anderson and Gruen 1995). In one of the more cited pieces in this literature, a one per cent rise in inflation costs the economy more than one-tenth of a per cent of economic growth (Fischer 1993).

4. Sarel (1996), for example, presents a strong argument that the growth costs of inflation are nonlinear and only become large when inflation exceeds 8 per cent annually.

5. Judson and Orphanides (1996). Hess and Morris (1996) also disentangle the relationship between inflation variability and the inflation level for low-inflation countries.

- inflation reduction without an explicit nominal anchor, which, for want of a better name, might best be referred to as 'just do it'.

Here, we will look at each of these strategies in turn and discuss the advantages and disadvantages of each in order to provide a critical evaluation.

3.1 Exchange-rate pegging

One commonly used method to reduce inflation and keep it low is for a country to peg the value of its currency to that of a large, low-inflation country. In some cases, this strategy involves pegging the exchange rate at a fixed value to that of the other country so that its inflation rate will eventually gravitate to that of the other country, while in other cases it involves a crawling peg or target in which its currency is allowed to depreciate at a steady rate so that its inflation rate can be higher than that of the other country.

3.1.1 Advantages

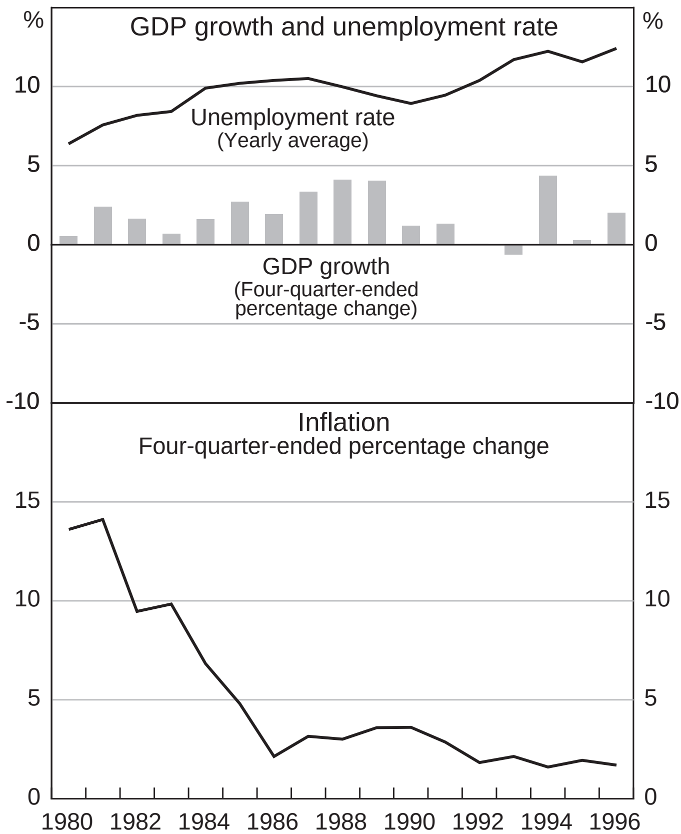
A key advantage of an exchange-rate peg is that it provides a nominal anchor which can prevent the time-inconsistency problem. As discussed above, the time-inconsistency problem arises because a policy-maker (or the politicians who have influence over the policy-maker) have an incentive to pursue expansionary policy in order to raise economic output and create jobs in the short run. If policy can be bound by a rule that prevents policy-makers from playing this game, then the time-inconsistency problem can be avoided. Indeed, this is what an exchange-rate peg can do if the commitment to it is strong enough. With a strong commitment, the exchange-rate peg implies an automatic monetary-policy rule that forces a tightening of monetary policy when there is a tendency for the domestic currency to depreciate, or a loosening of policy when there is a tendency for the domestic currency to appreciate. The central bank no longer has the discretion that can result in the pursuit of expansionary policy to obtain output gains which leads to time inconsistency.

Another important advantage of an exchange-rate peg is its simplicity and clarity, which makes it easily understood by the public: a 'sound currency' is an easy-to-understand rallying cry for monetary policy. For example, the Banque de France has frequently appealed to the 'franc fort' in order to justify tight monetary policy. In addition, an exchange-rate peg can anchor price inflation for internationally traded goods and, if the exchange-rate peg is credible, help the pegging country inherit the credibility of the low-inflation country's monetary policy. As a result, an exchange-rate peg can help lower inflation expectations quickly to those of the targeted country (Bruno 1991). This should help bring inflation in line with that of the low-inflation country reasonably quickly.

An exchange-rate peg to control inflation has been used quite successfully in industrialised countries. For example, in Figure 3, we see that, by tying the value of the franc closely to the German mark, France has kept inflation low. In 1987, when France first started tying the value of the franc closely to the German mark, its inflation rate was 3 per cent, two percentage points above the German inflation rate (Figure 4). By 1992, its inflation rate had fallen to 2 per cent and was below that in Germany. By 1996, the French and German inflation rates were nearly identical, slightly below 2 per cent. Similarly, by pegging to the German mark in 1990, the United Kingdom was able to lower its inflation rate from 10 per cent to 3 per cent when it was forced to abandon the Exchange Rate Mechanism (ERM) peg in 1992 (Figure 5).

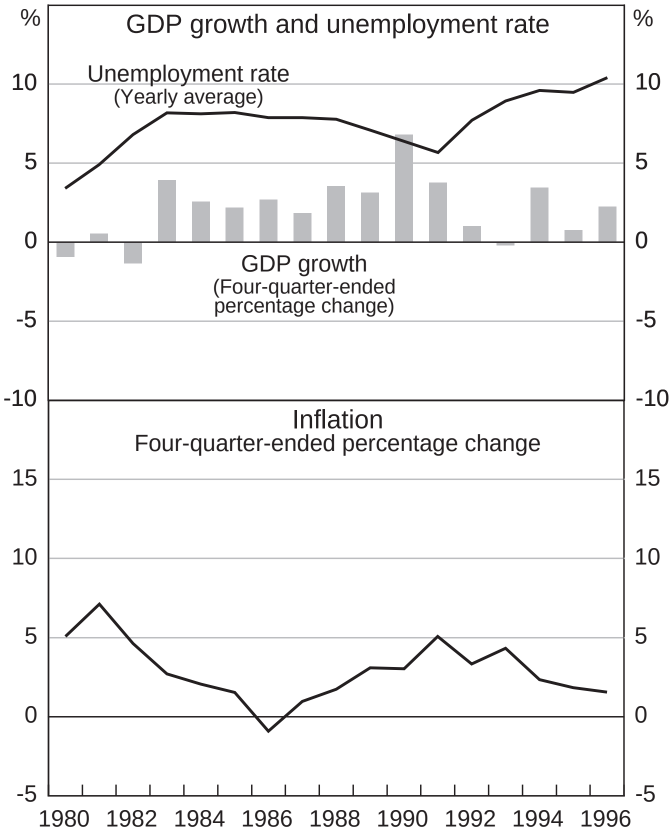
Exchange-rate pegging can be an especially effective means of reducing inflation quickly if there is a very strong commitment to the exchange-rate peg. A particularly strong form of commitment mechanism to a pegged exchange rate is a currency board. A currency board requires that the note-issuing authority, whether the central bank or the government, announces a fixed exchange rate against a particular foreign currency and then stands ready to exchange domestic currency for foreign currency at that rate whenever the public requests it. In order to credibly meet these requests, a currency board typically has more than 100 per cent foreign reserves backing the domestic currency and allows the monetary authorities absolutely no discretion. In contrast, the typical fixed or pegged exchange-rate regime does allow the monetary authorities some discretion in

Figure 3: France



Source: Bank for International Settlements.

Figure 4: Germany

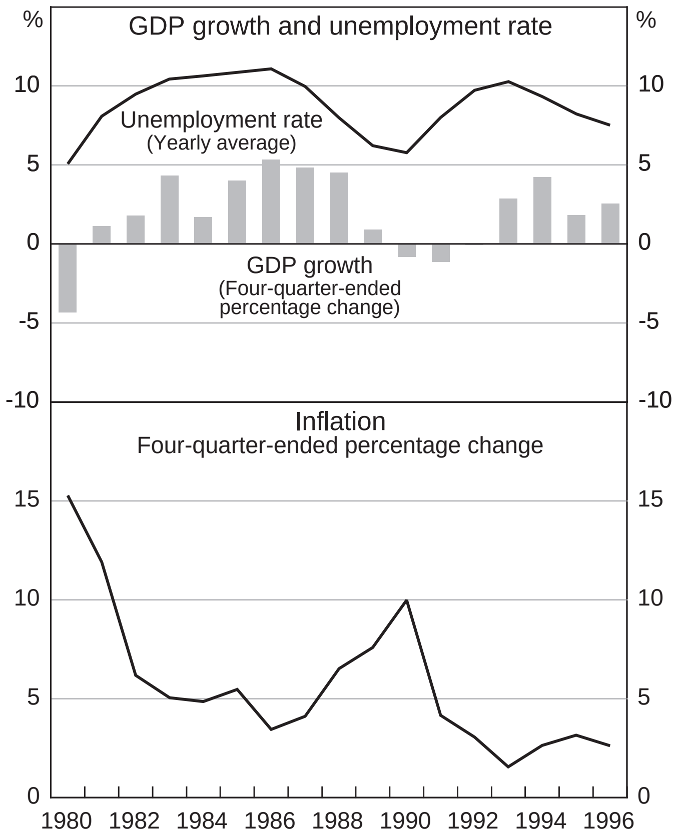


Source: Bank for International Settlements.

their conduct of monetary policy because they can still adjust interest rates or conduct open-market operations which affect domestic credit. The currency board thus involves a stronger commitment by the central bank to the fixed exchange rate and may therefore be even more effective in bringing down inflation quickly.

An important recent example in which a currency board was implemented to reduce inflation is Argentina. Because of continuing bouts of hyperinflation and previous past failures of stabilisation programs, the Argentine government felt that the only way it could break the back of inflation was to adopt a currency board, which it did in 1990 by passing the Convertibility Law. This law required the central bank to exchange US dollars for new pesos at a fixed exchange rate of 1 to 1. The early years of Argentina's currency board looked stunningly successful. Inflation which had been running at over a 1 000 per cent annual rate in 1989 and 1990 fell to well under 5 per cent by the end of 1994 and economic growth was rapid, averaging almost an 8 per cent annual rate from 1991 to 1994 (Figure 6).

Figure 5: United Kingdom

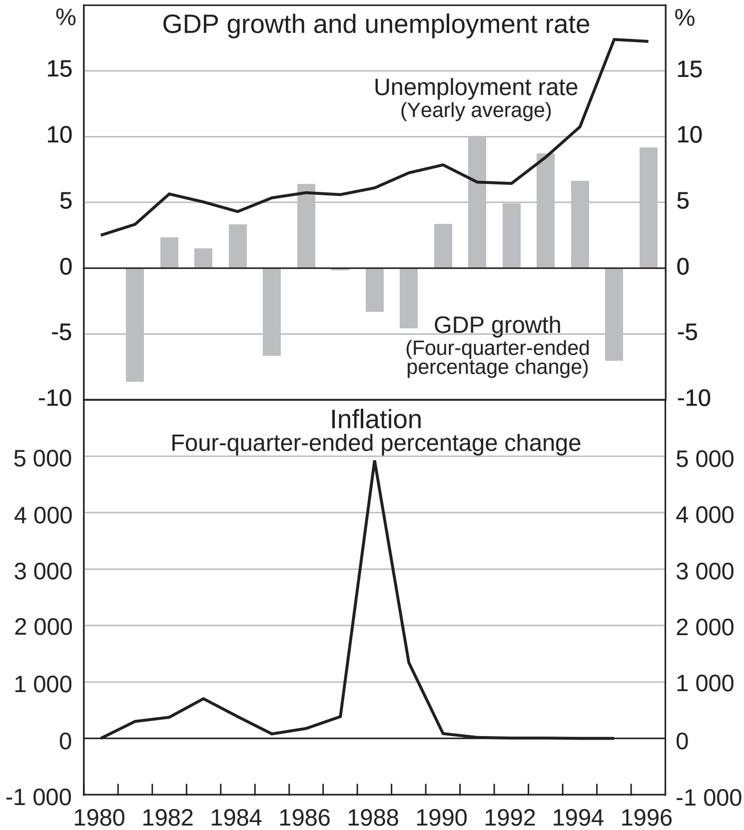


Source: Bank for International Settlements.

3.1.2 Disadvantages

However, there are some quite serious difficulties that arise from an exchange-rate peg. One of the key disadvantages stems from the loss of an independent monetary policy for the pegging country. As long as a country has open capital markets, interest rates in a country pegging its exchange rate are closely linked to those of the anchor country it is tied to, and its money creation is constrained by money growth in the anchor country. A country that has pegged its currency to that of the anchor country therefore loses the ability to use monetary policy to respond to domestic shocks that are independent of those hitting the anchor country. For example, if there is a decline in domestic demand specific to the pegging country, say because of a decline in the domestic government's spending or a decline in the demand for exports specific to that country, monetary policy cannot respond by lowering interest rates because these rates are tied to those of the anchor country. The result is that both output and even inflation may fall below desirable levels, with the monetary authorities powerless to stop these movements.

Figure 6: Argentina



Source: Datastream.

Furthermore, with a pegged exchange rate, shocks specific to the anchor country will be more easily transmitted to the targeting country. A clear-cut example of this occurred with German reunification in 1990. Concerns about inflationary pressures arising from reunification and the massive fiscal expansion required to rebuild East Germany, led to rises in German long-term interest rates until February 1991 and to rises in short-term rates until December 1991. Although German reunification was clearly a shock specific to Germany – the anchor country in the ERM – it was transmitted directly to the other countries in the ERM whose currencies were pegged to the mark because their interest rates now rose in tandem with those in Germany. The result was a significant slowing of economic growth in countries such as France, as illustrated in Figure 3.

Another important disadvantage of a pegged exchange-rate regime is that, as emphasised in Obstfeld and Rogoff (1995), it leaves countries open to speculative attacks on their currencies. Indeed, the aftermath of German reunification was a European exchange-rate crisis in September 1992. As we have seen, the tight monetary policy in Germany resulting from German reunification meant that the countries in the ERM were subjected to a negative demand shock that led to a decline in economic growth and a rise in unemployment. It was certainly feasible for the governments of these countries to keep their exchange rates fixed relative to the mark in these circumstances, but speculators began to question whether these countries' commitment to the exchange-rate peg would weaken because the countries would not tolerate the rise in unemployment and thus would not keep interest rates sufficiently high to fend off speculative attacks on their currencies.

At this stage, speculators were in effect presented with a one-way bet: the exchange rates for currencies such as the French franc, the Spanish peseta, the Swedish krona, the Italian lira and the British pound could only go in one direction, depreciate against the mark. Selling these currencies thus presented speculators with an attractive profit opportunity with potentially high expected returns and yet little risk. The result was that in September 1992, a speculative attack on the French franc, the Spanish peseta, the Swedish krona, the Italian lira and the British pound began in earnest. Only in France was the commitment to the fixed exchange rate strong enough, with France remaining in the ERM. The governments in Britain, Spain, Italy and Sweden were unwilling to defend their currencies at all costs and so devalued their currencies.

The attempted defence of these currencies did not come cheaply. By the time the crisis was over, the British, French, Italian, Spanish and Swedish central banks had intervened to the tune of an estimated $100 billion, and the Bundesbank alone had laid out an estimated $50 billion for foreign-exchange intervention. It is further estimated that these central banks lost $4 to $6 billion as a result of their exchange-rate intervention in the crisis, an amount that was in effect paid by taxpayers in these countries.

The different response of France and the United Kingdom after the September 1992 exchange-rate crisis (shown in Figures 3 and 5) also illustrates the potential cost of using an exchange-rate peg to control inflation. France, which continued to peg to the mark and thereby was unable to use monetary policy to respond to domestic conditions, found that economic growth remained slow after 1992 and unemployment increased. The United Kingdom, on the other hand, which dropped out of the ERM exchange-rate peg, had much better economic performance: economic growth was higher, the unemployment rate fell, and yet inflation performance was not much worse than France's.

The aftermath of German reunification and the September 1992 exchange-rate crisis dramatically illustrate two points: a fixed or pegged exchange rate does not guarantee that the commitment to the exchange-rate-based monetary-policy rule is strong; and the cost to economic growth from an exchange-rate peg that results in a loss of independent monetary policy can be high.

The September 1992 episode and its aftermath suggest that using exchange-rate pegs to control inflation may be problematic in industrialised countries. However, exchange-rate pegs may be an even more dangerous strategy for controlling inflation in emerging-market countries.

As pointed out in Mishkin (1996), in emerging-market countries, a foreign-exchange crisis can precipitate a full-scale financial crisis in which financial markets are no longer able to move funds to those with productive investment opportunities, thereby causing a severe economic contraction. Because of uncertainty about the future value of the domestic currency, many nonfinancial firms, banks and governments in emerging-market countries find it much easier to issue debt if the debt is denominated in foreign currencies. This was a prominent feature of the institutional structure in the Chilean financial markets before the financial crisis in 1982 and in Mexico in 1994. This institutional feature implies that, when there is an unanticipated depreciation or devaluation of the domestic currency, the debt burden of domestic firms increases. On the other hand, since assets are typically denominated in domestic currency, there is no simultaneous increase in the value of firms' assets. The result is that a depreciation leads to a substantial deterioration in firms' balance sheets and a decline in net worth, which, in turn, means that their effective collateral has shrunk, thereby providing less protection to lenders. Furthermore, the decline in net worth increases moral hazard incentives for firms to take on greater risk because they have less to lose if the loans go sour. Because lenders are now subject to much higher risks of losses, there is now a decline in lending and hence a decline in investment and economic activity.

Mexico's recent experience illustrates how dangerous using an exchange-rate peg to control inflation can be in emerging-market countries. After experiencing very high inflation rates, Mexico decided to peg the peso to the dollar in December 1987 and moved to a crawling peg in January 1989. Up until December 1994, this strategy appeared to be highly successful. Inflation fell from over 100 per cent in 1987 to below 10 per cent in 1993 and 1994, while economic growth averaged over 3.5 per cent from 1988 to 1994 (Figure 7).

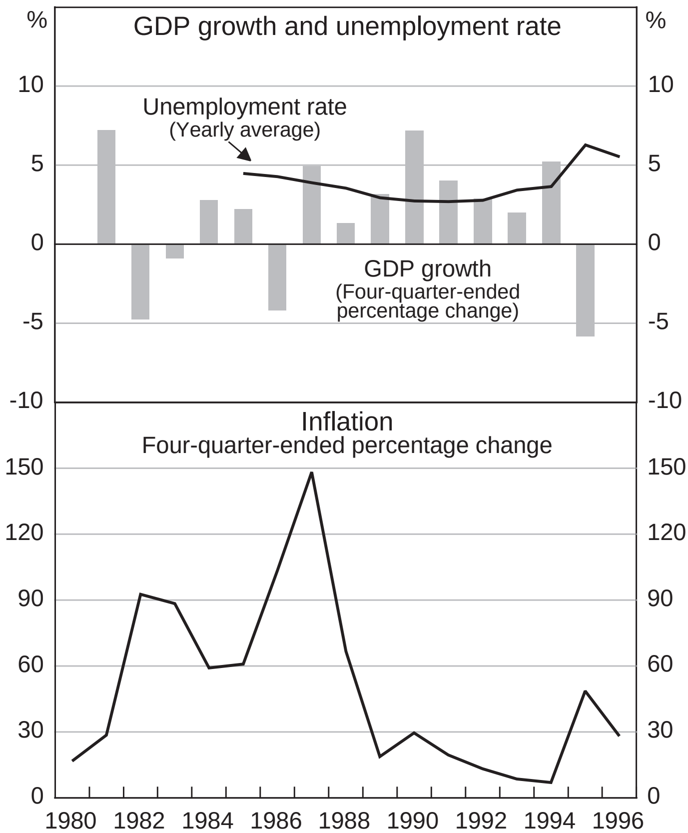
However, with the Colosio assassination and other political developments such as the uprising in Chiapas, the Mexican peso began to come under attack. Given the commitment to a pegged exchange rate, the Banco de Mexico intervened in the foreign-exchange market to purchase pesos, with the result that there was a substantial loss of international reserves, but because of the weakness of the banking sector, speculators began to suspect that the Mexican authorities were unwilling to raise interest rates sufficiently to defend the currency. By December, the speculative attack had begun in earnest, and even though the Mexican central bank raised interest rates sharply, the haemorrhaging of international reserves forced the Mexican authorities to devalue the peso on 20 December 1994.

By March 1995, the peso had halved in value. The depreciation of the peso starting in December 1994 led to an especially sharp negative shock to the net worth of private firms, which decreased the willingness of lenders to lend to these firms. In addition, the depreciation of the peso led to a deterioration in the balance sheets of Mexican banks; the banks had many short-term liabilities denominated in foreign currency which then increased sharply in value, while the problems of firms and households meant that they were unable to pay off their debts, resulting in loan losses on the assets side of the banks' balance sheets. The result of the deterioration in the balance sheets of both nonbanking and banking firms was a financial and banking crisis that led to a collapse of lending and economic activity (Figure 7).[6]

An additional danger from using an exchange-rate peg to control inflation in emerging-market countries is that a successful speculative attack can actually lead to higher inflation. Because many emerging-market countries have previously experienced

6. See Mishkin (1996) for a more extensive treatment of the mechanisms which produced a financial crisis and economic collapse in Mexico in the 1994–95 period.

Figure 7: Mexico



Source: Unemployment – Datastream; GDP and inflation – IMF International Financial Statistics.

both high and variable inflation, their central banks are unlikely to have deep-rooted credibility as inflation fighters. Thus, a sharp depreciation of the currency after a speculative attack that leads to immediate upward pressure on prices, is likely to lead to a dramatic rise in both actual and expected inflation. Indeed, as we see in Figure 7, Mexican inflation surged to 50 per cent in 1995 after the foreign-exchange crisis in 1994.

A rise in expected inflation after a successful speculative attack against the currency of an emerging-market country can also exacerbate the financial crisis because it leads to a sharp rise in interest rates. The interaction of the short duration of debt contracts and the interest-rate rise leads to huge increases in interest payments by firms, thereby weakening firms' cash-flow position and further weakening their balance sheets. Then, as we have seen, both lending and economic activity are likely to undergo a sharp decline.

A further disadvantage of an exchange-rate peg is that it can make policy-makers less accountable for pursuing anti-inflationary policies because it eliminates an important signal both to the public and policy-makers that too expansionary policies may be in place. The daily fluctuations in the exchange rate provide information on the stance of monetary policy, and this cannot happen with an exchange-rate peg. A depreciation of the exchange rate may provide an early warning signal to the public and policy-makers that policies may have to be adjusted in order to limit the potential for a financial crisis. Thus, like the long-term bond market, the foreign-exchange market can constrain policy from being too expansionary. Just as the fear of a visible inflation scare in the bond market that causes bond prices to decline sharply constrains politicians from encouraging overly expansionary monetary policy, fear of immediate exchange-rate depreciations can constrain politicians in countries without long-term bond markets from supporting overly expansionary policies.

Although the stronger commitment to a fixed exchange rate may mean that a currency board is better able to stave off a speculative attack against the domestic currency than an exchange-rate peg, it is not without its problems. In the aftermath of the Mexican peso crisis, concern about the health in the Argentine economy resulted in the public pulling their money out of the banks (deposits fell by 18 per cent) and exchanging their pesos for dollars, thus causing a contraction in the Argentine money supply. The result was a sharp contraction in Argentine economic activity with real GDP dropping by over 5 per cent in 1995 and the unemployment rate jumping to above 15 per cent (Figure 6). Only in 1996, with financial assistance from international agencies such as the IMF, the World Bank and the Inter-American Development Bank, which lent Argentina over $5 billion to help shore up its banking system, did the economy begin to recover. Because the central bank of Argentina had no control over monetary policy under the currency-board system, it was relatively helpless to counteract the contractionary monetary policy stemming from the public's behaviour. Furthermore, because the currency board does not allow the central bank to create money and lend to the banks, it limits the capability of the central bank to act as a lender of last resort, and other means must be used to cope with potential banking crises.

Although a currency board is highly problematic, it may be the only way to break a country's inflationary psychology and alter the political process so that the political process no longer leads to continuing bouts of high inflation. This indeed was the rationale for putting a currency board into place in Argentina, where past experience had suggested that stabilisation programs with weaker commitment mechanisms would not work. Thus, implementing a currency board may be a necessary step to control inflation in countries that require a very strong disciplinary device. However, as discussed here, this form of discipline is not without its dangers.

It is also important to recognise that emerging-market countries are far more vulnerable to disastrous consequences from a successful speculative attack on their currencies than industrialised countries. Industrialised countries have a history of low inflation and have much less debt denominated in foreign currencies. Thus, a depreciation of the currency does not lead to a deterioration of firms' balance sheets or a sharp rise in expected inflation. Indeed, as the performance of the United Kingdom after the September 1992 foreign-exchange crisis illustrates, an industrialised country that has its currency depreciate after a successful speculative attack may do quite well. The United Kingdom's economic performance after September 1992 was extremely good: inflation remained low and real growth was high. The different response to speculative attacks in industrialised versus emerging-market countries suggests that, although using an exchange-rate peg to control inflation in industrialised countries is not without severe problems, it may be even more dangerous to use such a peg to control inflation in emerging-market countries.

3.2 Monetary targeting

We have seen that using an exchange-rate peg to control inflation is not without its problems. However, in many countries, an exchange-rate peg is not even an option because the country (or block of countries) is too large or has no natural country to which to anchor its currency. Another strategy for controlling inflation is monetary-aggregate targeting. For example, the collapse of the fixed-exchange-rate Bretton Woods regime encouraged monetary targeting by many countries, especially Germany and Switzerland starting in the mid 1970s.

One way of pursuing monetary targeting is to follow Milton Friedman's suggestion for a constant-money-growth-rate rule in which the chosen monetary aggregate, say M2, is targeted to grow at a constant rate. In practice, even among the most avid monetary targeters, a quite different approach has been used. As pointed out in Bernanke and Mishkin (1992), no monetary-targeting central bank has ever adhered to strict, ironclad rules for monetary growth. Instead, monetary targeting is quite flexible: all monetary targeters deviate significantly from their monetary-growth targets in order to be responsive to short-term objectives such as real output growth and exchange-rate considerations, and are very explicit about their willingness to be flexible and pragmatic.[7]

3.2.1 Advantages

A major advantage of monetary targeting over exchange-rate pegging is that it enables a central bank to adjust its monetary policy to cope with domestic considerations. It enables the central bank to choose goals for inflation that may differ from those of other countries and allows some response to output fluctuations.

Monetary targeting also has several advantages in common with exchange-rate pegging. First is that a target for the growth rate of a monetary aggregate provides a nominal anchor that is fairly easily understood by the public. (However, the target may not be quite as easily comprehended as an exchange-rate target.) Also like an exchange-rate peg, information on whether the central bank is achieving its target is known almost immediately – announced figures for monetary aggregates are typically reported periodically with very short time-lags, within a couple of weeks. Thus, monetary targets can send almost immediate signals to both the public and markets about the stance of monetary policy and the intentions of the policy-makers to keep inflation in check. These signals then can help fix inflation expectations and produce less inflation. Second, monetary targets also have the advantage of being able to promote almost immediate accountability for monetary policy to keep inflation low and so constrain the monetary policy-maker from falling into the time-inconsistency trap.

7. This is particularly true of Germany, the quintessential monetary targeter. Besides Bernanke and Mishkin (1992), see Clarida and Gertler (1997) and Mishkin and Posen (1997).

The prime example of a monetary-targeting regime is that of Germany which has engaged in monetary targeting for over twenty years. A key feature of the German monetary-targeting framework is the strong commitment to transparency and communication of the strategy of monetary policy to the public. As is emphasised in Bernanke and Mishkin (1992) and Mishkin and Posen (1997), the calculation of target ranges is a very public exercise. First and foremost, a numerical inflation goal is prominently featured in the setting of the target ranges. Then with estimates of potential output growth and velocity trends, a quantity-equation framework is used to generate the desired monetary growth rate. The Bundesbank also spends tremendous effort, both in its publications (the *Monthly Report* and *Annual Report*) and in frequent speeches by members of its governing council, to communicate to the public what the central bank is trying to achieve. Indeed, given that the Bundesbank frequently has missed its monetary targets with both significant overshoots and undershoots, its monetary-targeting framework might be best viewed as a mechanism for transparently communicating how monetary policy is being conducted to achieve the Bundesbank's inflation goals and as a means for increasing the accountability of the central bank.

As Figure 3 suggests, Germany's monetary-targeting regime has been quite successful in producing low inflation. Indeed, an important success story occurred in the aftermath of German reunification in 1990. (This episode is discussed extensively in Mishkin and Posen (1997).) Despite a temporary surge in inflation stemming from the terms of reunification, the high wage demands and the fiscal expansion, the Bundesbank was able to keep these one-off effects from becoming embedded in the inflation process, and by 1995, inflation fell below the Bundesbank's inflation goal of 2 per cent.

3.2.2 Disadvantages

All of the above advantages of monetary-aggregate targeting depend on two big *ifs*. The biggest *if* is that there must be a strong and reliable relationship between the goal variable (inflation and nominal income) and the targeted aggregate. If there is velocity instability, so that the relationship between the monetary aggregate and the goal variable (such as inflation) is weak, then monetary-aggregate targeting will not work. The weak relationship implies that hitting the target will not produce the desired outcome on the goal variable and thus the monetary aggregate will no longer provide an adequate signal about the stance of monetary policy. Thus, monetary targeting will not help fix inflation expectations and be a good guide for assessing the accountability of the central bank. The breakdown of the relationship between monetary aggregates and goal variables such as inflation and nominal income certainly seems to have occurred in the United States (Stock and Watson 1989; Friedman and Kuttner 1993, 1996; Estrella and Mishkin 1997) and may also be a problem even for countries that have continued to pursue monetary targeting.

The second *if* is that the targeted monetary aggregate must be well-controlled by the central bank. If not, the monetary aggregate may not provide as clear signals about the intentions of the policy-makers and thereby make it harder to hold them accountable. Although narrow monetary aggregates are easily controlled by the central bank, it is far from clear that this is the case for broader monetary aggregates like M2 or M3 (Friedman 1996).

These two problems with monetary targeting suggest one reason why even the most avid monetary targeters do not rigidly hold to their target ranges, but rather allow undershoots and overshoots for extended periods of time. Moreover, an unreliable relationship between monetary aggregates and goal variables calls into question the ability of monetary targeting to serve as a communications device that both increases the transparency of monetary policy and makes the central bank accountable to the public.

3.3 Inflation targeting

Because of the breakdown in the relationship between monetary aggregates and goal variables such as inflation, many countries have abandoned monetary targeting – or as attributed to Gerald Bouey, the former governor of the Bank of Canada, 'We didn't abandon monetary aggregates, they abandoned us'. Another choice for a monetary-policy strategy that has become increasingly popular in recent years is inflation targeting, which involves the public announcement of medium-term numerical targets for inflation with an institutional commitment by the monetary authorities to achieve these targets.[8] Additional key features of inflation-targeting regimes include increased communication with the public and the markets about the plans and objectives of monetary policy-makers and increased accountability of the central bank for obtaining its inflation objectives.

3.3.1 Advantages

The primary advantage of inflation targeting is its transparency to the public. Like monetary-aggregate and exchange-rate targets, it is readily understood by the public, but, even more directly than the others, it makes clear the commitment to price stability. Inflation targeting keeps the goal of price stability in the public's eye, thus making the central bank more accountable for keeping inflation low which helps counter the time-inconsistency problem.

In contrast to the exchange-rate target, but like the monetary-aggregate target, inflation targets enable monetary policy to focus on domestic considerations and to respond to shocks to the economy. Finally, inflation targets have the advantage that velocity shocks are largely irrelevant because the monetary-policy strategy no longer requires a stable money-inflation relationship. Indeed, an inflation target allows the monetary authorities to use all available information, and not just one variable, to determine the best settings for monetary policy.

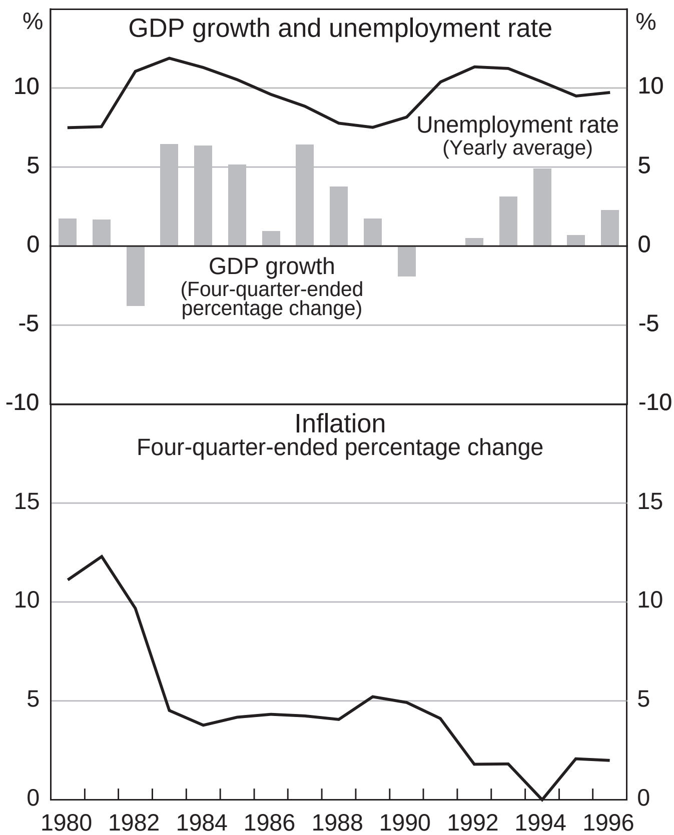
The increased accountability of the central bank under inflation targeting can also help reduce political pressures on the central bank to pursue inflationary monetary policy and thereby avoid the time-inconsistency problem. Moreover, inflation targeting helps focus the political debate on what a central bank can do – that is control inflation – rather than what it cannot do – raise economic growth permanently by pursuing expansionary policy. An interesting example of this occurred in Canada in 1996, discussed extensively in Mishkin and Posen (1997), when the president of the Canadian Economic Association criticised the Bank of Canada for pursuing monetary policy that was too contractionary.

8. Detailed analyses of experiences with inflation targeting can be found in Goodhart and Vinals (1994), Leiderman and Svensson (1995), Haldane (1995) and McCallum (1996), among others.

The existence of the inflation target helped channel a debate on whether the Bank of Canada was pursuing too contractionary a policy into a substantive discussion over what should be the appropriate target level for inflation, with both the Bank and its critics having to make explicit their assumptions and estimates of the costs and benefits of different levels of inflation. Indeed, as a result of the debate, the Bank of Canada won support through its response, its responsiveness, and its record, with the result that criticism of the Bank was not a major issue in the run-up to the 1997 elections as it had been before the 1993 elections.

The first three countries to adopt formal inflation targets were the United Kingdom, Canada and New Zealand . All three have found this monetary-policy strategy to be very effective in keeping inflation under control, as can be seen in Figures 5, 8 and 9. After implementing inflation targeting in 1990, New Zealand continued a disinflation that had started in the mid 1980s, and since 1992 core inflation has remained within the inflation target range of 0 to 2 per cent most of the time.[9]

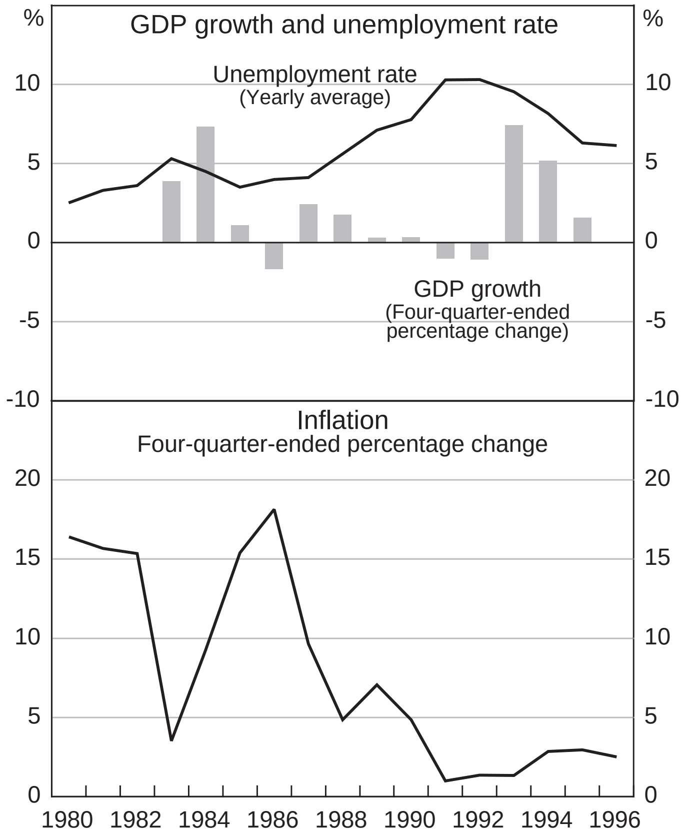
Figure 8: Canada



Source: Bank for International Settlements.

9. Since December 1996, the inflation target range has been widened to 0 to 3 per cent.

Figure 9: New Zealand



Source: Bank for International Settlements.

Shortly after adopting inflation targets in February 1991, the Bank of Canada was faced with a hike in the value-added tax, a negative supply shock that in the past might have led to a ratcheting up in inflation. Instead, this supply shock led to only a one-time increase in the price level and was not passed through to a persistent rise in the inflation rate. Indeed, after the initial effect of the tax rise, inflation resumed its downward trend, causing the inflation targets to even be undershot. By 1992, inflation had fallen to below 2 per cent and has remained close to this level ever since, which can arguably be viewed as achieving price stability.

After the September 1992 foreign-exchange crisis, when the British were forced out of the ERM and therefore lost their exchange-rate nominal anchor, the British government resorted to an inflation-targeting regime to keep inflation in check. Inflation continued its downward trend and, by November 1993, it had fallen to the midpoint of the target range of 2.5 per cent. The inflation-targeting regime in the United Kingdom was not without its problems, however, because it was conducted under severe political constraints: that is, under a system in which the government, not the central bank set the monetary-policy instruments. As a result, accountability for achieving the inflation targets was unclear: whether it was the agency that made the public forecasts (the Bank of England) or the agency that set the monetary-policy instruments (the Chancellor of the Exchequer). This lack of accountability led to much confusion as to the degree of commitment to the inflation targets, an issue that was finally resolved with the May 1997 announcement by the Labour government that it would grant operational independence to the Bank of England and make it fully accountable for achieving the inflation targets. Yet, even given this handicap, British inflation targeting, which had been accompanied by intensive efforts by the Bank of England to communicate clearly and actively with the public, has been associated with lower and more stable inflation rates, something that might not necessarily have been expected given past British experience.

Given the success of inflation targeting in controlling inflation in New Zealand, Canada and the United Kingdom, other countries such as Australia, Finland, Israel, Spain and Sweden have followed in their footsteps and adopted inflation targets.

3.3.2 Disadvantages

Although inflation targeting has been successful in controlling inflation in countries that have adopted it, it is not without criticisms. In contrast to exchange rates and monetary aggregates, inflation is not easily controlled by the monetary authorities. Furthermore, because of the long lags in the effects of monetary policy, inflation outcomes are revealed only after a substantial lag. Thus, an inflation target is unable to send immediate signals to both the public and markets about the stance of monetary policy. However, we have seen that the signals provided by monetary aggregates may not be very strong, while an exchange-rate peg may obscure the ability of the foreign-exchange market to signal that overly expansionary policies are in place. Thus, inflation targeting may nevertheless dominate these other strategies for the conduct of monetary policy.

Some economists, such as Friedman and Kuttner (1996), have criticised inflation targeting because they believe that it imposes a rigid rule on monetary policy-makers that does not allow them enough discretion to respond to unforeseen circumstances. This criticism is one that has featured prominently in the rules-versus-discretion debate. For example, policy-makers in countries that adopted monetary targeting did not foresee the breakdown of the relationship between these aggregates and goal variables such as nominal spending or inflation. With rigid adherence to a monetary rule, the breakdown in their relationship could have been disastrous. However, the interpretation of inflation targeting as a rule is incorrect and stems from a confusion that has been created by the rules-versus-discretion debate. In my view, the traditional dichotomy between rules and discretion can be highly misleading. Useful policy strategies exist that are ‘rule-like’ in that they involve forward-looking behaviour which constrains policy-makers from systematically engaging in policies with undesirable long-run consequences, thereby avoiding the time-inconsistency problem. These policies would best be described as ‘constrained discretion’.

Indeed, inflation targeting can be described exactly in this way. As emphasised in Bernanke and Mishkin (1997) and Mishkin and Posen (1997), inflation targeting as actually practised is very far from a rigid rule. First, inflation targeting does not provide simple and mechanical instructions as to how the central bank should conduct monetary policy. Rather, inflation targeting requires that the central bank use all available information to determine what are the appropriate policy actions to achieve the inflation target. Unlike simple policy rules, inflation targeting never requires the central bank to ignore information and focus solely on one key variable.

Second, inflation targeting as practised contains a substantial degree of policy discretion. Inflation targets have been modified depending on economic circumstances. Furthermore, central banks under inflation-targeting regimes have left themselves considerable scope to respond to output growth and fluctuations through several devices. First, the price index on which the official inflation targets are based is often defined to exclude or moderate the effects of 'supply shocks'; for example, the officially targeted price index may exclude some combination of food and energy prices, indirect-tax changes, terms-of-trade shocks, and the direct effects of interest-rate changes on the index (for example, through imputed rental costs). Second, as already noted, inflation targets are typically specified as a range. While the use of ranges generally reflects uncertainty about the link between policy levers and inflation outcomes, it is also intended to allow the central bank some flexibility in the short run. Third, short-term inflation targets can and have been adjusted to accommodate supply shocks or other considerations, such as the value of the exchange rate. This accommodation is done either by modifications to the inflation target or by having an explicit escape clause in which the inflation target can be suspended or modified in the face of certain adverse economic developments.

However, despite its flexibility, inflation targeting is not an exercise in policy discretion subject to the time-inconsistency problem. Because an inflation target by its nature must be forward-looking and because inflation targeting makes a central bank highly accountable by transparently making clear how it is to be evaluated, inflation targeting constrains discretion so that the time-inconsistency problem is ameliorated.

An important criticism of inflation targeting is that a sole focus on inflation may lead to larger output fluctuations. However, a counter to this argument is that inflation targeting provides not only a ceiling for the inflation rate, but also a floor. Inflation targeting thus can act to attenuate the effects of negative, as well as positive, shocks to aggregate demand. An interesting historical example is that of Sweden in the 1930s, which adopted a 'norm of price stabilisation' after leaving the gold standard in 1931. As a result, Sweden did not undergo the devastating deflation experienced by other countries during the Great Depression (Jonung 1979). It is almost always true that the process of disinflation itself has costs in lost output and unemployment, and these costs may well increase the closer one comes to price stability.[10]

Nevertheless, disappointingly, there is little evidence that inflation targeting lowers sacrifice ratios even when central banks have adopted inflation targets and have credibly maintained price stability for a length of time (Debelle and Fischer 1994; Posen 1995). Indeed, as we have seen in inflation-targeting countries such as Canada and New Zealand (Figure 8 and 9), the decline in inflation that occurred even with inflation targets was

10. This is an implication of the Akerlof, Dickens and Perry (1996) argument that lower inflation may lead to higher unemployment because of downward rigidities in nominal wages.

accompanied by slow growth and a rise in unemployment. Only after the disinflation had taken place did these economies begin to experience high growth rates.

The experience with costly disinflations suggests that a single-minded focus on inflation may be undesirable. For this reason, several economists have proposed that central banks should target the growth rate of nominal GDP rather than inflation (Taylor 1985; Hall and Mankiw 1994). Nominal GDP growth has the advantage that it does put some weight on output as well as prices. Under a nominal-GDP target, a decline in projected real output growth would automatically imply an increase in the central bank's inflation target, which would tend to be stabilising.[11] Cecchetti (1995) has presented simulations suggesting that policies directed to stabilising nominal GDP growth may be more likely than inflation targeting to produce good economic outcomes, given the difficulty of predicting and controlling inflation.

Nominal-GDP targeting is a strategy that is quite similar to inflation targeting and has many of the same advantages and so is a reasonable alternative. However, there are two reasons why inflation targets are preferable to nominal-GDP targets. First, a nominal-GDP target forces the central bank or the government to announce a number for potential GDP growth. Such an announcement is highly problematic because estimates of potential GDP growth are far from precise and change over time. Announcing a specific number for potential GDP growth may thus indicate a certainty that policy-makers may not have, and may also cause the public to mistakenly believe that this estimate is actually a fixed target for potential GDP growth. Announcing a potential GDP growth number is likely to be political dynamite because it opens policy-makers to the criticism that they are willing to settle for growth rates that the public many consider to be too low. Indeed, a nominal-GDP target may lead to an accusation that the central bank or the targeting regime is anti-growth, when the opposite is true because a low inflation rate is a means to promote a healthy economy that can experience high growth. In addition, if the estimate for potential GDP growth is too high and becomes embedded in the public mind as a target, it leads to the classic time-inconsistency problem demonstrated in the model of Barro and Gordon (1983) in which there is a positive inflation bias.

A second reason why inflation targets are preferable to nominal-GDP targets relates to the likelihood that the concept of inflation is much better understood by the public than the concept of nominal GDP, which is often easily confused with real GDP. If this is so, the objectives of communication and transparency would be better served by the use of an inflation target. Furthermore, because nominal and real GDP can easily be confused, a nominal-GDP target may lead the public to believe that a central bank is targeting real GDP growth, something that is highly problematic as explained above.

It is important to recognise that, given the various escape clauses and provisions for short-run flexibility built into the inflation-targeting approach, there is little practical difference in the degree to which inflation targeting and nominal-GDP targeting would allow for accommodation of short-run stabilisation objectives. Thus, inflation targeting has almost all the benefits of nominal-GDP targeting, but does not suffer from the disadvantages discussed.

11. Hall and Mankiw (1994) point out that the equal weighting of real output growth and inflation implied by a nominal-GDP targeting is not necessarily the optimal one; in general, the relative weight put on the two goal variables should reflect social preferences.

3.4 'Just do it': pre-emptive monetary policy without an explicit nominal anchor

Several countries in recent years, most notably the United States, have been able to successfully reduce and control inflation without an explicit nominal anchor such as an exchange rate, a monetary-aggregate target, or an inflation target. Although in these cases, there is no explicit strategy that is clearly articulated, there is a coherent strategy for the conduct of monetary policy nonetheless. This strategy involves forward-looking behaviour in which pre-emptive monetary-policy strikes against inflation are conducted periodically.

As emphasised earlier, monetary-policy effects have long lags. In industrialised countries with a history of low inflation, the inflation process seems to have tremendous inertia: estimates from large macroeconometric models of the US economy, for example, suggest that monetary policy takes as long as two years to affect output and three years to have a significant impact on inflation. For other countries whose economies respond more quickly to exchange-rate changes or that have experienced highly variable inflation, and therefore have more flexible prices, the lags may be shorter.

The presence of long lags means that monetary policy must not wait until inflation has already reared its ugly head before responding. By waiting until inflation has already appeared, the monetary authorities will be too late; inflation expectations will already be embedded in the wage- and price-setting process, creating an inflation momentum that will be hard to halt. Once the inflation process has started rolling, the process of stopping it will be slower and costlier.

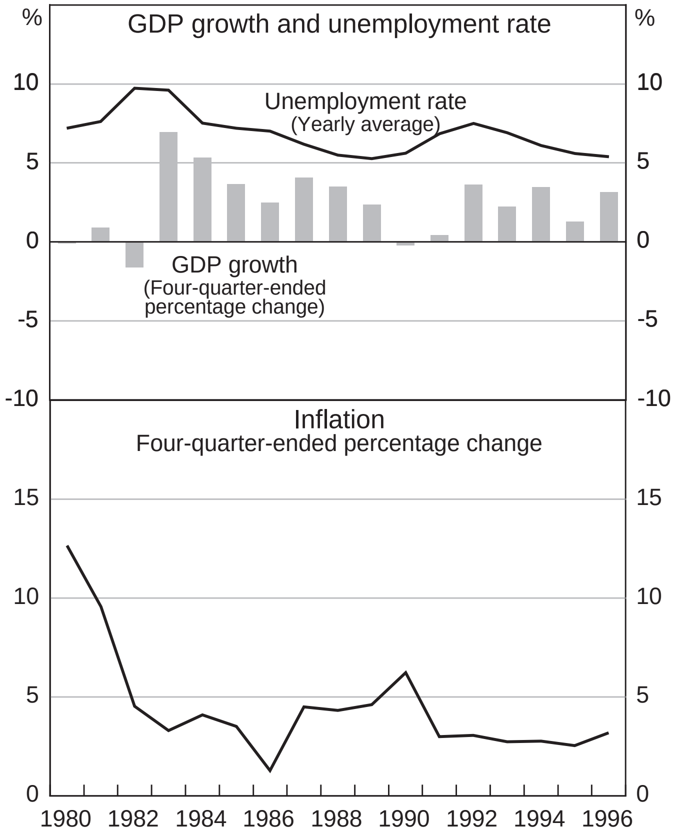
In order to prevent inflation from getting started, monetary authorities must therefore behave in a forward-looking fashion and act pre-emptively: that is, depending on the lags from monetary policy to inflation, policy-makers must act well before inflationary pressures appear in the economy. For example, if it takes roughly three years for monetary policy to have its full impact on inflation, then, even if inflation is quiescent currently but, with an unchanged stance of monetary policy, policy-makers see inflation rising over the next three years, they must act today to tighten monetary policy to prevent the inflationary surge.

This pre-emptive monetary-policy strategy is clearly also a feature of inflation-targeting regimes because monetary-policy instruments must be adjusted to take account of the long lags in their effects in order to hit future inflation targets. However, the 'just do it' strategy differs from inflation targeting in that it does not officially have a nominal anchor and is much less transparent in its monetary-policy strategy.

3.4.1 Advantages

The main advantage of the 'just do it' policy is that it has worked well in the past. As we can see in Figure 10, the Federal Reserve has been able to bring down inflation in the United States from double-digit levels in 1980 to around the 3 per cent level by the end of 1991 and has kept it in a narrow range around this level since then. Indeed, the performance of the US economy has been the envy of the industrialised world in the 1990s: inflation has remained low, real GDP growth has been high, while unemployment

Figure 10: United States



Source: Bank for International Settlements.

has been well below that of the majority of the other OECD countries. The 'just do it' strategy has the advantage of central banks solving the time-inconsistency problem by engaging in forward-looking behaviour, along the lines McCallum (1995) has suggested, but still has left the central bank with discretion to deal with unforeseen events in the economy.

3.4.2 Disadvantages

Given the success of the 'just do it' strategy, a natural question to ask is why countries such as the United States should consider other monetary-policy strategies which would change something that has already worked well, especially given the inability to know what types of challenges will confront monetary policy in the future: In other words, 'If it ain't broke, why fix it?' The answer is that the 'just do it' strategy has some disadvantages that may cause it to work less well in the future.

An important disadvantage of the 'just do it' strategy is that it may not be very transparent. This may create financial and economic uncertainty that makes the economy function less efficiently. Furthermore, because of the lack of transparency, a 'just do it' strategy may leave the central bank relatively unaccountable. As a result, the central bank is more susceptible to the time-inconsistency problem, whereby it may pursue short-term objectives at the expense of long-term ones. Furthermore, because of the lack of transparency and accountability, it may be harder for the central bank to lock in low inflation: the absence of a nominal anchor makes inflation expectations more susceptible to rise when there are negative supply or other shocks to the economy, thus making higher inflation likely.

The most important disadvantage of the 'just do it' strategy is that it depends on individuals: that is, the chairman or governor of the central bank and the composition of the monetary board that participates in monetary-policy decisions. Having forward-looking individuals who sufficiently value price stability can produce excellent policies. For example, Chairman Greenspan and other Federal Reserve officials continually have expressed a strong preference for low, steady inflation, and their comments about stabilisation policies have prominently featured consideration of the long-term inflation implications of their policies.

The problem with a strategy that is based on individuals is that the individuals can change. If the chairman or other members of the FOMC were replaced by people who were less committed to price stability as an important goal for the Fed, the Fed could conceivably return to policies that created the high inflation of the 1970s. Moreover, our earlier discussion suggested that the time-inconsistency problem and a bias towards high inflation may not arise in the central bank, but may instead come from pressures exerted by politicians. Thus, for example, even if similar individuals to those currently on the FOMC were in charge of monetary policy, a different political environment might push them to pursue more expansionary policies. Indeed, in recent years the executive branch of the US government has rarely criticised the Federal Reserve for its policies, and this may have contributed to the success the Federal Reserve has had in controlling inflation.

One way to encourage monetary policy to focus on long-run objectives such as price stability is to grant central banks greater independence. In the view of many observers, politicians in a democratic society are shortsighted because they are driven by the need to win their next election. With their focus on the upcoming election, they are unlikely to focus on long-run objectives, such as promoting a stable price level. Instead, they will tend to seek short-run objectives, like low unemployment and low interest rates, even if the short-run objectives may have undesirable long-run consequences. With a grant of independence, central banks are able to communicate to the public that they will more likely be concerned with long-run objectives and thus be a defender of price stability, particularly if there is a legislated mandate for the pursuit of price stability.

Recent evidence seems to support the conjecture that macroeconomic performance is improved when central banks are more independent. When central banks in industrialised countries are ranked from least legally independent to most legally independent, the inflation performance is found to be the best for countries with the most independent central banks.[12] However, there is some question as to whether causality runs from

12. See Alesina and Summers (1993), Cukierman (1992), and Fischer (1994) among others.

central bank independence to low inflation, or rather, whether a third factor is involved such as the general public's preferences for low inflation that create both central bank independence and low inflation (Posen 1995).

Central bank independence may have much to recommend it and, while there is a current trend to greater independence of central banks, this independence may still not be enough to produce sufficient commitment to the goal of price stability. This is why, despite the success of a 'just do it' strategy for monetary policy, it may be very worthwhile to institutionalise the commitment to price stability and formalise the strategy by making explicit a commitment to a nominal anchor as with inflation targeting.

4. Conclusions

What we have seen over the past thirty years is a growing consensus that price stability should be the overriding, long-term goal of monetary policy. With this mandate, the key question for central bankers is what strategies for the conduct of monetary policy will best help to achieve this goal. This paper discusses four basic strategies: exchange-rate pegging, monetary targeting, inflation targeting, and the 'just do it' strategy of pre-emptive monetary policy with no explicit nominal anchor. Although none of these strategies dominates the others for every country in the world, we do see that some strategies may make more sense under certain circumstances than others. For example, the breakdown of the relationship between monetary aggregates and goal variables, such as nominal spending or inflation, implies that monetary targeting is unlikely to be a viable option in the United States for the foreseeable future. On the other hand, exchange-rate pegging is not even an alternative for the United States because it is too large a country to anchor to its currency to any other. Thus, a lively debate is worth pursuing over whether the United States would be better served by the Federal Reserve continuing to operate as it has, or whether it would be better for it to switch to an inflation-targeting regime with its increased transparency and accountability.

For some other countries that are both small and where government institutions have relatively low credibility, a stronger commitment mechanism may be required to keep inflation under control. In these circumstances, a strategy of exchange-rate pegging, particularly with a strict commitment mechanism such as a currency board, might be more attractive. However, as this paper makes clear, such a strategy is not without its dangers and may require measures to protect the financial sector from adverse shocks.

The study of strategies to control inflation is one of the most important that monetary economists encounter. Indeed, this paper is just part of a larger project on this topic that has been under way under my direction at the Federal Reserve Bank of New York.

References

Akerlof, G., W. Dickens and G. Perry (1996), 'The Macroeconomics of Low Inflation', *Brookings Papers on Economic Activity*, 1, pp. 1–59.

Alesina, A. and L.H. Summers (1993), 'Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence', *Journal of Money, Credit and Banking*, 25(2), pp. 151–162.

Anderson, P. and D. Gruen (1995), 'Macroeconomic Policies and Growth', in P. Anderson, J. Dwyer and D. Gruen (eds), *Productivity and Growth*, Reserve Bank of Australia, Sydney, pp. 279–319.

Bailey, M.J. (1956), 'The Welfare Cost of Inflationary Finance', *Journal of Political Economy*, 64(2), pp. 98–110.

Barro, R.J. and D.B. Gordon (1983), 'A Positive Theory of Monetary Policy in a Natural Rate Model', *Journal of Political Economy*, 91(4), pp. 589–610.

Bernanke, B.S. and F.S. Mishkin (1992), 'Central Bank, Behavior and the Strategy of Monetary Policy: Observations from Six Industrialized Countries', in O. Blanchard and S. Fischer (eds), *NBER Macroeconomics Annual*, MIT Press, Cambridge, Massachusetts, pp. 183–228.

Bernanke, B.S. and F.S. Mishkin (1997), 'Inflation Targeting: A New Framework for Monetary Policy?', *Journal of Economic Perspectives*, 11(2), pp. 97–116.

Briault, C. (1995), 'The Costs of Inflation', *Bank of England Quarterly Bulletin*, 35(1), pp. 33–45.

Bruno, M. (1991), 'High Inflation and the Nominal Anchors of an Open Economy', Princeton University International Finance Section, Essays in International Finance No. 183.

Calvo, G. (1978), 'On the Time Consistency of Optimal Policy in the Monetary Economy', *Econometrica*, 46(6), pp. 1411–1428.

Cecchetti, S. (1995), 'Inflation Indicators and Inflation Policy', in B. Bernanke and J. Rotemberg (eds), *NBER Macroeconomics Annual*, MIT Press, Cambridge, Massachusetts, pp. 189–219.

Clarida, R. and M. Gertler (1997), 'How the Bundesbank Conducts Monetary Policy', in C.D. Romer and D.H. Romer (eds), *Reducing Inflation: Motivation and Strategy*, University of Chicago Press, Chicago, pp. 363–406.

Cukierman, A. (1992), *Central Bank Strategy, Credibility, and Independence: Theory and Evidence*, MIT Press, Cambridge, Massachusetts.

Debelle, G. and S. Fischer (1994), 'How Independent Should a Central Bank Be?', in J. Fuhrer (ed.), *Goals, Guidelines, and Constraints Facing Monetary Policymakers*, Federal Reserve Bank of Boston, Boston, pp. 195–221.

English, W.B. (1996), 'Inflation and Financial Sector Size', Board of Governors of the Federal Reserve System, Finance and Economics Discussion Paper No. 96-16.

Estrella, A. and F.S. Mishkin (1997), 'Is There a Role for Monetary Aggregates in the Conduct of Monetary Policy', *Journal of Monetary Economics*, (forthcoming).

Feldstein, M. (1997), 'The Costs and Benefits of Going from Low Inflation to Price Stability', in C.D. Romer and D.H. Romer (eds), *Reducing Inflation: Motivation and Strategy*, University of Chicago Press, Chicago, pp. 123–156.

Fischer, S. (1993), 'The Role of Macroeconomic Factors in Growth', *Journal of Monetary Economics*, 32(3), pp. 485–512.

Fischer, S. (1994), 'Modern Central Banking', in F. Capie, C. Goodhart, S. Fischer and N. Schnadt (eds), *The Future of Central Banking: The Tercentenary Symposium of the Bank of England*, Cambridge University Press, Cambridge, pp. 262–308.

Friedman, B.M. (1996), 'The Rise and Fall of Money Growth Targets as Guidelines for U.S. Monetary Policy', NBER Working Paper No. 5465.

Friedman, B.M. and K.N. Kuttner (1993), 'Another Look at the Evidence on Money-Income Causality', *Journal of Econometrics*, 57(1-3), pp. 189–203.

Friedman, B.M. and K.N. Kuttner (1996), 'A Price Target for U.S. Monetary Policy? Lessons from the Experience with Money Growth Targets', *Brookings Papers on Economic Activity*, 1, pp. 77–146.

Friedman, M. (1968), 'The Role of Monetary Policy', *American Economic Review*, 58(1), pp. 1–17.

Friedman, M. (1977), 'Nobel Lecture: Inflation and Unemployment', *Journal of Political Economy*, 85(3), pp. 451–72.

Goodhart, C. and J. Vinals (1994), 'Strategy and Tactics of Monetary Policy: Examples from Europe and the Antipodes', in J. Fuhrer (ed.), *Goals, Guidelines, and Constraints Facing Monetary Policymakers*, Federal Reserve Bank of Boston, Boston, pp. 139–187.

Groshen, E.L. and M.E. Schweitzer (1996), 'The Effects of Inflation on Wage Adjustments in Firm-Level Data: Grease or Sand?', Federal Reserve Bank of New York Staff Reports No. 9.

Haldane, A.G. (1995), *Targeting Inflation*, Bank of England, London.

Hall, R.E. and N.G. Mankiw (1994), 'Nominal Income Targeting', in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 71–94.

Hess, G.D. and C.S. Morris (1996), 'The Long-Run Costs of Moderate Inflation', *Federal Reserve Bank of Kansas City Economic Review*, Second Quarter, pp. 71–88.

Jonung, L. (1979), 'Kurt Wicksell's Norm of Price Stabilization and Swedish Monetary Policy in the 1930s', *Journal of Monetary Economics*, 5(4), pp. 459–496.

Judson, R. and A. Orphanides (1996), 'Inflation, Volatility and Growth', Board of Governors of the Federal Reserve System Finance and Discussion Paper No. 96-19.

Kydland, F.E. and E.C. Prescott (1977), 'Rules Rather Than Discretion: The Inconsistency of Optimal Plans', *Journal of Political Economy*, 85(3), pp. 473–491.

Leiderman, L. and L.E.O. Svensson (eds) (1995), *Inflation Targets*, Centre for Economic Policy Research, London.

Lucas, R.E. (1976), 'Econometric Policy Evaluation: A Critique', *Journal of Monetary Economics*, 1(2), pp. 19–46.

McCallum, B.T. (1995), 'Two Fallacies Concerning Central-Bank Independence', *American Economic Review*, 85(2), pp. 207–211.

McCallum, B.T. (1996), 'Inflation Targeting in Canada, New Zealand, Sweden, the United Kingdom, and in General', NBER Working Paper No. 5597.

Mishkin, F.S. (1996), 'Understanding Financial Crises: A Developing Country Perspective', in M. Bruno and B. Pleskovic (eds), *Annual World Bank Conference on Development Economics 1996*, World Bank, Washington D.C., pp. 29–62.

Mishkin, F.S. and A. Posen (1997), 'Inflation Targeting: Lessons from Four Countries', *Federal Reserve Bank of New York Economic Policy Review*, 3, pp. 9–110.

Obstfeld, M. and K. Rogoff (1995), 'The Mirage of Fixed Exchange Rates', *Journal of Economic Perspectives*, 9(4), pp. 73–96.

Posen, A.S. (1995), 'Central Bank Independence and Disinflationary Credibility? A Missing Link?', Federal Reserve Bank of New York Staff Reports No. 1.

Samuelson, P.A. and R.M. Solow (1960), 'Analytical Aspects of Anti-inflation Policy', *American Economic Review*, 50(2), pp. 177–194.

Sarel, M. (1996), 'Nonlinear Effects of Inflation on Economic Growth', *International Monetary Fund Staff Papers*, 43(1), pp. 199–215.

Stock, J.H. and M.W. Watson (1989), 'Interpreting the Evidence on Money-Income Causality', *Journal of Econometrics*, 40(1), pp. 161–182.

Taylor, J. (1985), 'What Would Nominal GDP Targeting Do to the Business Cycle?', *Carnegie-Rochester Conference on Public Policy*, 22, pp. 61–84.

Discussion

1. Josh Felman

It is always a pleasure to read papers by Rick Mishkin, since they are invariably clearly written, well-focused, and compellingly argued. As I have discovered, however, these same pleasures make life difficult for those who are asked to comment on his papers. Even after several readings, I still find it difficult to find any argument with which I would really disagree. Nonetheless, allow me to raise three quibbles, which of course represent my own views and not those of the IMF. First, I would like to qualify Mishkin's conclusions on exchange-rate pegging. Second, I would like to query his definition of inflation targeting. And third, I would like to raise an important inflation-targeting issue, which he has not mentioned.

On exchange-rate pegging, the paper concludes that the September 1992 ERM crisis demonstrates that not all countries that fix their rate have a strong underlying commitment to this rule. *Prima facie*, this statement would necessarily seem to be true: after all, how else can one explain why France remained in the ERM, while Britain dropped out, except by the latter's weaker commitment to the peg? Like many other 'truths', however, this statement does not convey the whole story.

In this case, what is missing is a recognition that the costs of sustaining the ERM peg varied from country to country, and were particularly high in Britain. One reason is that in Britain, unlike in continental countries, interest-rate increases have a prompt and sizeable effect on housing payments, since most mortgages are variable-rate loans. In 1992, moreover, the economy had turned down and housing prices had slumped, leaving many people with negative equity in their homes. In these circumstances, the country would have had to pay a very high social price for sustaining the peg, since a prolonged period of high interest rates would have forced many home-owners into bankruptcy.

Even clearer is the more recent case of Thailand. There, the initial commitment was extremely strong, as the country had maintained a stable rate for 13 years. Yet, when export growth began to slow and asset prices began to fall, financial markets began to test this commitment, forcing the authorities to maintain high interest rates. As these rates began to undermine the financial system, commitment began to wane, and – after fighting for one year – the country eventually decided to abandon the peg.

From these examples, then, I would draw a somewhat different set of conclusions from Mishkin. To begin with, I would claim that commitment is an endogenous variable, which depends on a cost/benefit calculation. This calculation can be altered by speculative attacks, which can impose very high costs on countries which try to defend a fixed rate. Speculators, knowing this, will therefore attack currencies whenever they expect that these costs would be high, even if reserves are large and the authorities' initial commitment is strong.

Now, on to the issue of inflation targeting. Mishkin defines inflation targeting as the announcement of a numerical target for inflation, coupled with a commitment by the monetary authorities to achieve this target. Once again, while I do not disagree, I do not think this tells the whole story. In my view, inflation targeting is better defined as the attempt to institutionalise a commitment to low inflation. In a way, Mishkin himself recognises this, when he argues that the chief drawback of the 'just do it' approach is that it relies on individuals – and then recommends inflation targeting as a way of ensuring that the commitment will be sustained once the current individuals are gone.

Of course, no other inflation-targeting country has gone as far as New Zealand, which has entrenched its commitment to price stability in law. But every country has gone some way down this road. One practice, which has been adopted here in Australia, is to have the government and the monetary authority issue a joint statement endorsing the inflation target and specifying that monetary policy will be directed toward that end. Another critical step has been to strengthen the fiscal position, in order to minimise the Sargent-and-Wallace-type risk that high levels of government indebtedness will eventually force monetary policy to abandon its inflation objective, and monetise the debt.

In addition, I would stress the importance of two other measures to enhance the commitment to price stability. One is establishing a sound regulatory framework for the financial system, to limit the risk that monetary policy will need to be redirected toward resolving banking problems. The other is promoting labour-market flexibility, to ensure that policy tightenings needed to preserve price stability do not have unduly large effects on employment and output.

Now, I would like to turn to my third quibble. The paper makes no mention of an issue which I believe to be central to inflation targeting, namely the question of the policy horizon. As Svensson has stressed, the main task of central banks under inflation targeting is to set their policy instruments so that their inflation forecast equals their inflation target over some defined policy horizon. But how is this horizon to be chosen? Haldane, in his paper for the conference notes that the horizon will depend on technology, in the form of the monetary transmission lag, and on preferences, with respect to the output-inflation trade-off.

Let us examine how these two factors might play out in practice. To fix ideas, consider the case of a central bank which has made a forecasting error, so that inflation is likely to exceed the target by a significant margin, starting in the next period – say, one year hence. In these circumstances, the bank must decide how quickly it should try to bring inflation back to target.

Under inflation targeting, the institutional framework provides a strong incentive (a preference, in Haldane's terminology) for the central bank to try to limit the deviation from target. Moreover, such a policy may actually be technologically feasible in a small open economy, where the exchange rate has a powerful and prompt direct effect on prices. In this case, the central bank could keep inflation on track by tightening policy sufficiently to generate a large exchange-rate appreciation. Subsequently, of course, the tight stance will also begin to affect prices via the interest-rate channel, causing inflation to threaten to undershoot the target. At this point, policy can be relaxed.

Such a policy approach, however, could have considerable cost. During the periods of sharp tightening, there could be a large loss of output, especially in the traded sector. More generally, over the policy cycle, there could be large swings in the exchange rate and interest rates, which would increase uncertainty and reduce output, again especially in the traded sector.

At the same time, a strategy of bringing inflation back to target gradually has its own problems. It runs the risk of undermining the central bank's objective of improving its inflation-fighting credibility, as well as the target's role as an anchor for expectations. Indeed, under this approach financial markets may be left without any short-term anchor, unless the central bank explicitly publishes its inflation projections, showing the path that it is aiming to achieve.

Allow me to conclude without a conclusion. I do not pretend to have a definitive answer to the policy-horizon issue, nor does, I presume, anyone else. One possibility may be to shift the incentive structure for central banks, by defining the inflation target in terms of domestic underlying inflation, rather than inflation including import prices. But I'm sure this approach, too, has drawbacks, and that other possibilities exist. For precisely this reason, it would have been nice if this thorny – and central – inflation-targeting issue had been discussed. Perhaps we can start now.

2. General Discussion

See the general discussion following the paper by Malcolm Edey (p. 72).

The Debate on Alternatives for Monetary Policy in Australia

Malcolm Edey

1. Introduction

Debate on the monetary-policy framework can be viewed as taking place at two distinct levels. At one level, there is debate about the appropriate choice of policy system from a range of conceptually distinct alternatives such as inflation targets, nominal-income targets, money targets, fixed exchange rates, and various more radical schemes. The other level of debate is that occurring within some broadly accepted system, concerning the system's detailed parameters and design features – in the case of inflation targeting, this covers issues like the time-frame, the design of pre-commitment mechanisms and the scope to be allowed for business-cycle stabilisation within the policy framework.

In the Australian context, debate has occurred at both these levels, broadly reflecting the character of the international literature. Some critics of monetary policy in Australia have advocated moving to radically different systems of one sort or another, including a currency board (Hanke, Porter and Schuler 1992), monetary-base control (McTaggart and Rogers 1990; Makin 1993), a commodity standard (Evans and Dowd 1992) or a target for M1 (Weber 1994). McKibbin (1996) looked at a variety of alternatives for Australia, including nominal-income targeting. Various other proposals could be viewed as being more accepting of the current framework, but arguing for some significant changes of emphasis within it. For example, Stemp (1996) argued for an exclusive inflation focus with tighter pre-commitment to the target, while Pitchford (1996) and McDonald (1997) have effectively argued for a shift in the opposite direction to allow an increased focus on output stabilisation.

The title of a recent contribution by Stanley Fischer (1995) – *The Unending Search for Monetary Salvation* – nicely captures the tone of much of this area of debate. One gets the sense from many of the participants in the debate that an ideal system is thought to exist, if only it could be found or if only policy-makers would adopt it. But, as Fischer indicates, the search for an ideal system is unending, and what is actually required is a choice between realistic alternatives. The purpose of the present paper is to review the debate on alternative monetary-policy systems as it applies to Australia. The argument is primarily directed at the broader of the two levels of analysis – the choice of system – and leaves issues of detailed design features of an inflation target to other contributions to this conference. In covering these issues, the paper aims to give a general rationale for the type of policy system that we currently have, and to show where our system is placed in the menu of theoretical and practical alternatives.

2. Monetary-policy Systems

I use the term 'monetary-policy system' to mean some coherent framework for making monetary-policy decisions and for explaining them to the public. A useful way to classify possible systems is according to the instrument or operational objective emphasised by the policy-maker. There would seem to be four broad theoretical possibilities in this regard:

- quantity-setting systems, based on the control or targeting of a monetary aggregate;
- final-targeting systems, where an interest-rate instrument is used in the direct targeting of final objectives;
- exchange-rate or commodity standards; and
- *laissez-faire* approaches to the monetary standard.

Before discussing in detail the criteria for choosing among the different policy approaches, it will be useful to examine more precisely what they entail and in what sense the differences are important in practice. Clearly, there is potential for overlaps and hybrids among some of these approaches, particularly between the first two.

2.1 Rate setting or quantity setting?

In principle, domestically focused monetary policy is conducted at the operational level using either an interest-rate or a quantity instrument. The usual textbook assumption is that policy is conducted by quantity setting: that is, by setting some variable *m* either on an exogenous growth path or adjusting it systematically in response to shocks to other variables. This immediately raises the question of whether this *m* can be controlled. To the extent that this question is addressed in the literature, two types of approach seem possible. One is to focus consideration on the monetary base which, if not controllable already, can by assumption be made so by appropriate institutional changes. The other route is to introduce the concept of money as an intermediate target, under which some other policy instrument (in practice, the short-term nominal interest rate, *i*) is adjusted with the aim of keeping the chosen monetary aggregate close to the targeted path. The distinction is between rules of the following forms:

$$m_t = m_t^T \qquad \text{(quantity rule)}$$

$$i_t = \gamma(m_t - m_t^T) \qquad \text{(monetary target)}$$

where m^T is the target path and γ represents the responsiveness of policy to a deviation from target.

There are few, if any, cases of policy being conducted on the basis of strict monetary-base control as defined above. The cases most frequently cited are those of Swiss monetary-base targeting in the period since 1980, the Bundesbank's Central Bank Money target (1974 to 1988) and the Federal Reserve's period of targeting non-borrowed reserves of the banking system (1979 to 1981). In none of these cases, however, was the monetary-base variable kept strictly to a pre-determined path. In a review of these policy approaches, Goodhart (1995) concluded that the role of the monetary base in practice was more like that of an intermediate target, being used by policy-makers as a signal rather than as a policy instrument.[1] Intermediate targeting systems more generally, using the broader monetary aggregates, were, of course, common to many other countries (including Australia) in the 1970s and 1980s, and such a system still plays an important part in the public explanation of policy in Germany.

Quantity setting can be contrasted, in principle, with rate setting, where short-term interest rates are adjusted to achieve a systematic influence on final objective variables – usually some combination of prices and output. This definition encompasses a range of theoretical possibilities, including inflation targets and nominal-income targets, and would also seem capable of describing more pragmatic policies in countries where numerical objectives are not formally specified.[2] Three stylised rules in this class might be written as follows:

$$i_t = \bar{r} + \pi_t + \gamma(\pi_t - \pi_t^T) \qquad \text{(inflation)}$$

$$i_t = \bar{r} + \pi_t + \gamma(\Delta py_t - \Delta py_t^T) \qquad \text{(nominal income)}$$

$$i_t = \bar{r} + \pi_t + \gamma_1(\pi_t - \pi_t^T) + \gamma_2(y_t - \tilde{y}_t) \qquad \text{(Taylor rule}^3\text{)}$$

where i represents the nominal interest rate, π the inflation rate, py nominal income, $(y–\tilde{y})$ the output gap, and the superscript T a target value.

The common feature of these rules is that interest rates respond systematically to deviations of prices and output from 'normal' paths, where these are expressed in terms of inflation targets combined with some notion of potential output. Such rules can alternatively be expressed in terms of expectations of these variables based on currently available information, which would seem a reasonable representation of the way many central banks currently describe the conduct of their policies.

There is some empirical evidence to support the realism of this general class of simple rate-setting rules; for example Taylor (1993), in an empirical study of US monetary policy, found that his rule gave quite an accurate explanation of the federal funds rate over the period since 1987. Obviously a range of more complex rules in the rate-setting category is also possible, many of which are studied in detail in applied work such as that of McKibbin (1996) and Bryant, Hooper and Mann (1993), as well as by de Brouwer and O'Regan (1997). An important feature sometimes added to empirical rules of this form is an interest-rate smoothing term designed to limit instrument variability (Lowe and Ellis 1997).

Goodhart (1989) notes that there is a basic duality in theory between any rate-setting rule of the type described above and a corresponding quantity-setting rule. The point can be illustrated by combining a standard money-demand function with some assumed policy response under a quantity-setting framework:

$$m - p = \alpha y - \delta i + \beta x + u \qquad \text{(money demand)}$$

1. For a detailed discussion of policy in Switzerland and Germany, see Laubach and Posen (1997).
2. Some of these targeting policies have also been proposed in frameworks that assume a quantity instrument; for example, McCallum (1988) and Feldstein and Stock (1994).
3. As proposed by Taylor (1993).

$$m = ay + bp \qquad \text{(money supply)}$$

where x is some vector of pre-determined variables. This quantity-setting policy implies an equivalent interest-rate reaction function of the form

$$i = (\frac{\alpha - a}{\delta})y + (\frac{1-b}{\delta})p + \frac{\beta}{\delta}x + \frac{1}{\delta}u$$

which allows money to be eliminated from the system.[4]

Notwithstanding this theoretical equivalence, the two approaches can be viewed as quite different in practical terms where policy-makers are looking for relatively simple robust principles for conducting and explaining policy. In general, simple interest-rate rules imply complicated quantity rules, and *vice versa*, so there are potentially large differences in the way the two approaches would be operationalised and explained to the public. I return to this point in a later section.

2.2 Price-level determinacy

A point of controversy in the literature has been the question of price-level determinacy under a rate-setting policy system. Sargent and Wallace (1975) made the claim, repeated by Sargent (1979, p. 362), that ‘there is no interest rate rule that is associated with a determinate price level’. This proposition has an important commonsense element but, as subsequent literature has shown, is also subject to an important limitation. The commonsense element in the simplest case is clear: under a fixed interest-rate rule, inflation shocks reduce the real interest rate and are therefore self-reinforcing, so the rule is unstable; and under rational expectations, this instability collapses to indeterminacy in the short run. The same conclusion extends to any exogenous rate-setting policy or to any policy that links the interest rate only to real variables.

The important limitation to this principle is provided by McCallum (1981, 1986), who showed that price-level determinacy is ensured in any rate-setting policy rule specified to have a stabilising effect on the price level or on some other nominal variable.[5] This condition is generally satisfied by reaction functions that move interest rates in response to deviations of the price level or the inflation rate from some targeted path. Blinder (1996) provides a useful summary of this conclusion, stating that the nominal anchor under such a rule is the central bank’s commitment to raise interest rates when the inflation rate is too high.

The general claim that rate-setting systems are always indeterminate must therefore be seen as fallacious. But, with some exceptions (Ball 1997), there has been some reluctance in the academic literature to study policy in terms of an interest-rate instrument, notwithstanding the fact that many central banks now present their policy decisions to the public in rate-setting terms. Large parts of the literature, including much of the literature on time consistency and inflation targeting, bypass the question of the

4. In a full system, money cannot be eliminated if the stock of money is an argument in another equation, for example through real-balance effects. But the point remains that policy can be fully defined by an interest-rate reaction function.

5. See also Edey (1990), Taylor (1993), Fuhrer and Moore (1995) for discussion of this result.

policy instrument altogether by assuming that the instrument is the inflation rate, set directly by the central bank (Svensson 1995; Walsh 1995). Others retain a framework that explicitly assumes direct control of a quantity instrument: for example, McCallum (1988), who assumes monetary-base control, and Feldstein and Stock (1994), who assume an M2 instrument, both in the context of an intermediate target for nominal income. Still others regard instrument-setting as an essentially technical detail, and focus only on the choice of targets. These sorts of approaches do seem to neglect an important aspect of practical policy design.

2.3 Targets with and without base drift

A further aspect of target setting is the decision on whether to allow 'base drift': that is, whether or not the policy should aim to correct accumulated deviations from the target. This issue applies to any targeting regime, but is most frequently raised with respect to inflation targets, where the distinction is between an inflation-rate and a price-level target. Base drift, as occurs under a standard inflation-rate target, clearly increases the long-run variability of the targeted variable, but is usually argued to reduce short-run variability.[6] The point can be illustrated by considering the two forms of targeting below, where both are subject to a given degree of control uncertainty:

$$p_t = p_t^T + u_t \qquad \text{(control error)}$$

$$\pi_t = p_t - p_{t-1}. \qquad \text{(definition of inflation)}$$

Under a price-level target,

$$p_t^T = p_o + \lambda t$$

where λ is the permitted rate of inflation. This implies

$$\text{var}(p_t) = \sigma_u^2$$

$$\text{var}(\pi_t) = 2\sigma_u^2.$$

The corresponding inflation target is

$$p_t^T = p_{t-1} + \lambda, \text{ which implies}$$

$$\text{var}(p_{t+k}) = k\sigma_u^2$$

$$\text{var}(\pi_t) = \sigma_u^2.$$

The pure inflation target in this example thus produces a smaller variance of the inflation rate itself, but results in an infinite unconditional variance of the price level: uncertainty about the future price level increases as the forecast horizon lengthens. The relative desirability of these stylised systems thus depends partly on the extent to which longer-run price-level certainty is desired in its own right, as well as on other considerations

6. Svensson (1995) provides a counterexample.

such as the output cost of achieving price-level corrections that might periodically be required under a levels target.

Usual practice in targeting regimes has been to allow a high degree of base drift, with targets generally specified in rates of change rather than levels. Although the issue has been widely discussed in the academic literature, designers of inflation-targeting systems have paid little attention in practice to the issue of limiting base drift, perhaps implicitly accepting arguments that there is no net benefit to doing so. The only clear case of a drift-free target seems to have been the Swedish price-level target of the 1930s, when policy over a number of years was aimed at keeping the level of the CPI constant. This period was something of a special case and, according to Jonung (1992), the policy was designed to prevent deflation associated with the onset of the depression.

2.4 Fixed exchange rates and commodity standards

The main alternative to an internal policy anchor of the sorts set out above is an external anchor such as a fixed exchange rate or commodity standard. Exchange-rate-oriented policy systems vary considerably in the degree of practical exchange-rate flexibility permitted, from European-style systems with fluctuation bands and adjustable parities at one end of the spectrum to currency boards at the other. The general observation can be made that, the more flexible the exchange-rate pegging mechanism, the more closely the system is likely to resemble one of the domestic targeting arrangements described above. The current Israeli system offers an interesting example of an intermediate system where an adjustable exchange-rate band is operated in conjunction with an inflation objective and is effectively viewed as a means of achieving that objective (Ben-Bassat 1995).

In recent years, there has been some revival of interest in currency boards as a distinct monetary-policy alternative. Currency boards were common in early colonial monetary systems and currently operate in several countries, including Hong Kong, Argentina and some eastern European countries. There was a brief flurry of advocacy of a currency-board arrangement for Australia a number of years ago.[7] In essence, a currency board involves a fixed exchange rate where the board is required to hold reserves of the anchor currency at least equal to the domestic monetary base, the intention being that convertibility between the domestic and foreign currencies could thus be guaranteed. Market operations in such a system are strictly limited to exchanging currency on demand at the official exchange rate, so the system eliminates any scope for independent policy action. The proposal thus has a natural appeal to economists opposed to central bank discretion, and those supporting it in Australia did so on principle rather than with a case for linking to any particular currency in mind.[8]

7. Currency boards were put forward in the Australian debate by Hartley and Porter (1988), Hanke, Porter and Schuler (1992) and Walters (1992). For detailed exposition and analysis of currency boards, see Schwartz (1993).

8. None of the papers cited above in respect of Australia address the question of which currency would be the anchor.

Leaving aside for the moment the question of whether a fixed exchange rate is in itself desirable, the structural features of currency boards have not been without criticism. The currency-board structure is designed to be, in principle, run-proof, but critics argue that a 100 per cent reserve requirement is not sufficient to guarantee this. A strict currency board is prevented from acting as a lender of last resort and cannot provide discretionary liquidity support to the banking system or to government securities markets. In effect, the monetary system is anchored to that of the base currency, but without access to discretionary liquidity support from that source. This being the case, it is conceivable that, even with 100 per cent reserve backing of the monetary base, such a system could still be vulnerable in the event that expectations of devaluation triggered attempts to liquidate bank deposits and government securities in order to obtain foreign currency.[9] This point is acknowledged by some proponents of currency boards, and the implication drawn is that reserves well in excess of the monetary base might be needed to secure viability.

Another class of rule-based remedies sometimes put forward by critics of existing monetary arrangements is the commodity standard. The simplest cases of gold or other single-commodity standards have numerous historical precedents, although most proponents in recent years have argued for more sophisticated multi-commodity systems, designed to be less sensitive to changes in the relative prices of the anchor commodities. In the Australian debate, commodity standards have been advocated in recent years by White (1989) and Evans and Dowd (1992). The general form of these proposals is to require currency issuers to guarantee convertibility between the currency and the designated commodity basket at a fixed parity. In principle, such a system could be operated either by a central bank or, as discussed below, by competing private banks subject to the convertibility requirement.

Proponents of these schemes recognise the practical difficulty of requiring conversion of a whole commodity basket, and they therefore envisage a provision that the public could demand conversion using any individual commodity in the basket, based on prevailing relative prices. In this way, it is argued that stability of the commodity-price index as a whole would be ensured without the public having to transact all commodities in the basket. A variant of this proposal, put forward by Dowd (1990), would adjust the parity price of the commodity basket by an amount sufficient to offset movements in the consumer price index. The argument is that this would provide an automatic mechanism guaranteeing general price stability – in effect, whenever the CPI was above its target level, the public would have the right to buy commodities at a discount from the monetary authority.

2.5 Monetary *laissez-faire*

Closely related to the literature on commodity standards are various proposals for monetary *laissez-faire*. Like currency-board proposals, these would involve abolition of central banks, and they therefore appeal to a certain brand of economists with radical libertarian views. There are two main types of proposal in this field, which are often put under the general label of 'free banking'. The less radical of the two, implicit in the work

9. This appears to have been an important phenomenon in Argentina in the aftermath of the Mexican crisis; see OECD (1995).

of Dowd (1996) and other commodity-standard proposals, would involve a free-banking regime linked to a legally established commodity standard. The essence of this system is the absence of any government-guaranteed money: the government's role would be limited to defining the unit of account, and private currency issuers would compete to offer sound money denominated in that unit.

The more radical (and truly *laissez-faire*) proposal is that envisaged by Hayek (1990) and others, under which there would be no government-determined nominal anchor at all. Instead, competing private issuers would be free to link their currencies to any value standard, or to issue pure fiat monies, subject only to a combination of self-imposed constraints and market discipline to prevent over-issue. Interestingly, it is recognised that currency issuers in such a system would face a kind of time-consistency problem analogous to that studied in the inflation-targeting literature, since issuers would always have an incentive to inflate away the value of their liabilities. However, provided this could be overcome by appropriate pre-commitment mechanisms, it is argued that competition among money issuers in such a model would lead to a convergence on Friedman's (1969) socially optimal inflation rate (Selgin and White 1994).

Needless to say, these radical systems have not been implemented, so it is not possible to point to practical working models. According to Selgin and White (1994), the nearest approximation to a free-banking system occurred in 19th century Scotland under a gold exchange standard, although even in that case there appears to be some room for debate as to how pure an example of free banking this represents.[10]

3. Criteria for Choosing between Systems

Leaving aside some of the more radical elements from the above menu, the range of feasible policy options can be viewed as including a spectrum of intermediate- and final-targeting systems, along with policies based on fixed or managed exchange rates. In examining the merits of the various alternatives, three main characteristics of a desirable monetary-policy system would seem to be relevant.[11] First, the system must satisfy the nominal-determinacy requirement. This means that it must anchor the inflation rate, at least in the long run, which rules out fixed nominal or real interest rates along with any rule directed only at real variables. The second characteristic is efficiency, or desirable short-run stabilisation properties in terms of the variables that enter into the social objective function. Thirdly, the system should have desirable properties in terms of discipline, commitment and its effect on inflation expectations.

Arguably there is some trade-off involved between the second and third of these characteristics. In general, complex rules out-perform simple rules in terms of stabilisation properties, since they can encompass simple rules as special cases. But policy credibility – the third characteristic – is usually argued to require a reasonable degree of simplicity in the policy framework. Indeed, the whole debate on choosing among alternative

10. Goodhart (1988) argues that the Scottish banks benefited indirectly from liquidity support from the Bank of England.

11. This classification is adapted from Hall and Mankiw (1994).

targeting frameworks presupposes that the relevant choices are among relatively simple rules. I return to this point below after looking in more detail at the question of short-run stabilisation.

3.1 Stabilisation and the sources of shocks

Focusing on relatively simple rules of the types outlined in the previous section, the question can be asked: which class of rules is most likely to provide satisfactory properties of macroeconomic stabilisation? To answer this question comprehensively would require a full-scale simulation exercise along the lines of de Brouwer and O'Regan (1997) and McKibbin (1996) to assess the properties of the competing rules. But without going into that kind of exercise, some general principles can be outlined on the basis of theory combined with evidence about the sources of potential shocks.

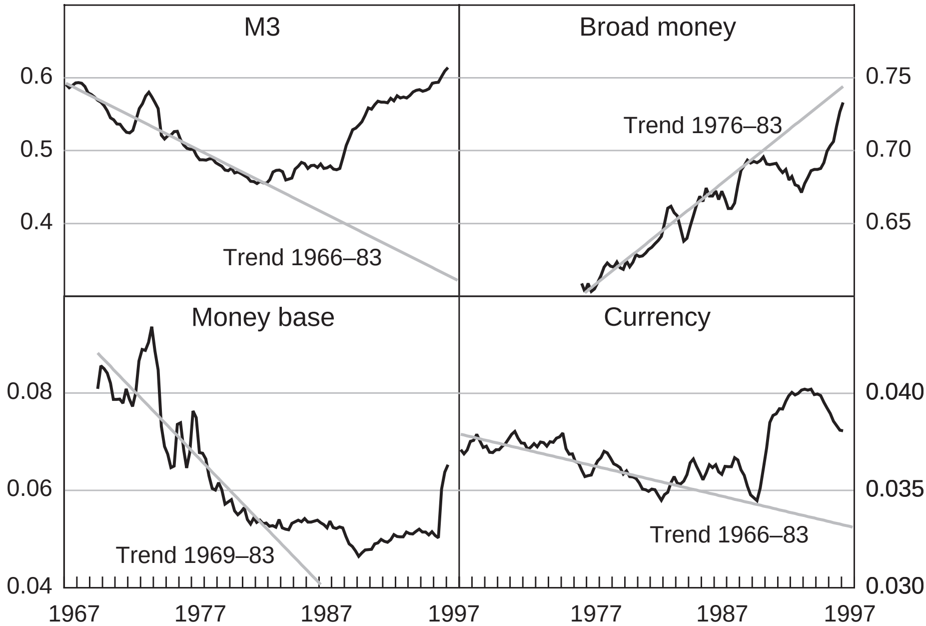
It can be presumed that the policy objective function includes a goal of minimising some combination of price and output variability. Fixed rules in terms of a monetary quantity or an exchange rate will tend to perform badly by these criteria when there are economically significant shocks that move the equilibrium relationship between the fixed variable and the variables in the objective function. The classic cases of this principle are shocks to domestic money demand and external shocks affecting the real exchange rate. There is considerable evidence in Australia that both types of shock are economically important.

3.2 Money-demand stability

In the case of money-demand shocks, the well-known result from Poole (1970) is that, with a fixed money supply, the shock is transmitted directly to interest rates and to the real economy, whereas a rate-setting policy automatically offsets the shock. This intuitive result translates readily into more general theoretical frameworks where the rate-setting policy is linked to final policy targets of the kind discussed above (Edey 1990).

Considerable efforts have been devoted in Australia, as elsewhere, to empirically examining aspects of money-demand stability. In Australia, the most comprehensive recent study appears to be that of de Brouwer, Ng and Subbaraman (1993). This study systematically examined a series of money-demand functions using a range of alternative definitions of the key variables and alternative testing procedures. A key aspect of the study was to test for the existence of a cointegrating relationship between money, income and the short-term interest rate, which would seem a minimal requirement for reliance on a monetary target for policy purposes. The results provided supporting evidence of cointegration in only a small minority of the permutations that were generated (11 of a possible 192). The strongest evidence of cointegration was found in the case of the currency aggregate (8 out of 24 cases), but this relationship has since deteriorated, with the ratio of currency to income shifting markedly in the out-of-sample period. These results confirm the visual impression of instability apparent from the data on money-to-income ratios in Figure 1.

Figure 1: Monetary Aggregates
As a proportion of GDP



Other studies such as those by de Haan and Zelhorst (1991) and Stevens, Thorp and Anderson (1987) approached the issue by focusing on parameter stability, finding evidence that parameters were unstable. This contrasts with earlier results such as that of Pagan and Volker (1981) which found no evidence of instability. A point often overlooked in this literature is that parameter stability is a necessary, but not a sufficient, requirement for viability of a policy that relies on the monetary aggregates. In Poole's and similar analyses, the unattractiveness of monetary targeting stems not from parameter change, but from the variability of the error term in the money-demand equation. It is this term that transmits shocks to the interest rate under a fixed money rule and thereby shocks the real economy, particularly when the interest elasticity of money demand is low. In this context, it is relevant to note that, even in empirical studies where the parameters appear stable, quarterly standard errors in the money-demand equations are quite high – typically of the order of 2 per cent. Given the very low interest elasticities of money demand that are typically estimated, this would imply highly volatile interest rates if the stock of the given aggregate were to be stabilised. (Of course, convinced proponents of monetary targeting would argue that expectations under such a regime would change in a way that would engender greater stability.)

A less-demanding requirement that might be made of the monetary aggregates is that they convey useful short-run information on prices and output even where they do not have a stable long-run relationship with those variables. Even here, however, the evidence is not particularly encouraging. Weber (1993) did find a significant role for M1 as an explanator in a VAR system including output. However, a more exhaustive study by Tallman and Chandra (1996), covering a range of financial aggregates and specifications over the period 1976 to 1995, found little evidence of a consistently useful information role for the aggregates over most of the period.

Related to the issue of money-demand stability is that of controllability of the targeted aggregate. The experience of most monetary-targeting regimes has been that monetary aggregates were not controlled with the degree of accuracy implied by their target bands, either because they could not be controlled to that degree or because, as a result of money-demand instability, it was not sensible to do so. Outcomes of monetary targets in a range of these countries are summarised in Table 1. Difficulties in control and interpretation are evident in the fact that many countries experimented with more than one aggregate in the search for a reliable relationship, and most, with the possible exceptions of Germany and Switzerland, eventually downgraded or abandoned their targets. In most of the countries included in the table, the specified targets or projections were achieved only about half the time and, on average, monetary growth deviated from target midpoints by about 2 percentage points. In these respects, the two countries usually regarded as the most serious monetary targeters, Germany and Switzerland, fared no better than the rest.

Table 1: Monetary Targets and Projections

Country		Period	Average absolute deviation from target midpoint	Proportion of years within target range (%)[(a)]
Australia		1977–1985	2.6	33.3
Canada		1976–1982	1.3	71.4
France		1977–1996	2.5	50.0
Germany		1975–1996	1.8	54.5
Italy		1975–1996	2.7	31.8
Switzerland		1975–1996	2.6	47.6
United Kingdom		1976–1996	2.7	52.4
United States	M2	1975–1996	1.5	63.6
United States	M3	1975–1996	1.8	40.9

Australia – M3

Canada – M1

France – M2 (1977–1983), M2R (1984–1985), M3 (1986–1987), M2 (1988–1991), M3 (1992–1996)

Germany – Central Bank Money (1975–1987), M3 (1988–1996)

Italy – TDC (1975–1985), M2 (1986–1996)

Switzerland – M1 (1975–1979), Monetary base (1980–1996)

United Kingdom – M3 (1975–1983), M0 (1984–1996)

Note: (a) Where a point target was specified, a range of 1.5 percentage points either side of the midpoint has been assumed.

Source: Argy, Brennan and Stevens (1989) updated from national sources.

3.3 Terms-of-trade shocks and the real exchange rate

It is well documented that Australia's real exchange rate is subject to significant cyclical swings and that terms-of-trade movements, driven by commodity export prices, are the principal medium-term contributor to that process (Gruen and Wilkinson 1994). Given Australia's position as a small economy and a price taker in world markets, these terms-of-trade movements can, to a first approximation, be regarded as exogenous. From the point of view of the monetary framework, this raises the question of how the nominal exchange-rate response to these shocks should be managed: whether the nominal rate should be allowed to adjust, or whether the required real exchange-rate changes should be effected through price-level adjustment. Most standard models would imply a preference for nominal exchange-rate flexibility in these circumstances, which would seem to be a major reason why advocacy of a return to fixed exchange rates has remained a minority view in the Australian debate.

The magnitude of terms-of-trade effects on the economy under different exchange-rate regimes is illustrated in Figure 2, adapted from Gruen and Dwyer (1995). This illustrates the impact of major terms-of-trade shifts in three historical episodes – the first two under a fixed exchange-rate regime in the 1950s and 1970s, and the third floating. The differences in outcomes under the two regimes seem clear. With a fixed exchange rate, terms-of-trade shocks were transmitted more or less directly to domestic inflation and, to a lesser extent, to the business cycle whereas, in the floating-rate episode, the shock was largely absorbed by exchange-rate fluctuation.[12]

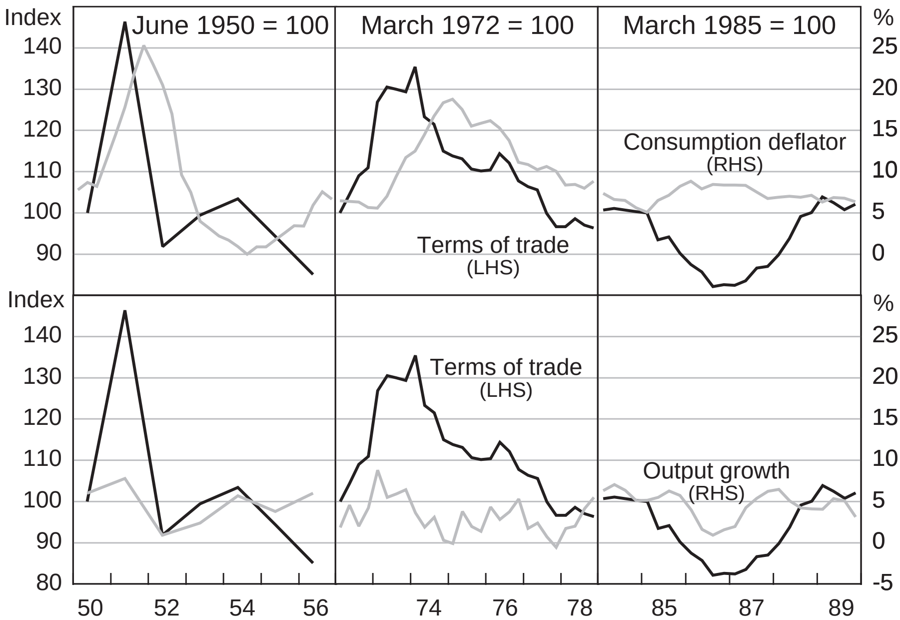
The international comparisons presented in Table 2 suggest that this issue is likely to have greater relevance for Australia than for most other countries. In international terms, Australia's terms of trade are highly variable, with only Japan and New Zealand among OECD countries experiencing greater variability in the period since 1970. Terms-of-trade variability reflects, among other things, differences in the commodity intensities of a country's exports and imports. New Zealand and Australia are relatively intensive commodity exporters, and manufactured-goods importers, while in Japan the reverse is the case. Both configurations result in relatively high terms-of-trade variability. In contrast, many of the European countries have relatively stable terms of trade and are therefore likely to be less subject to shocks to their real exchange rates from that particular source. These rankings point to one possible reason why fixed exchange rates have remained more popular, or have been more sustainable, in Europe than elsewhere.[13]

Another dimension of this issue is the correlation between a country's terms-of-trade movements and those of potential partners in a fixed exchange-rate arrangement. The case might be made that terms-of-trade movements would be less likely to disrupt a fixed exchange-rate arrangement where they are closely correlated among the countries concerned. To examine this, some terms-of-trade correlations with the major economies are presented in the right-hand columns of Table 2. The pattern emerges that the closest

12. In the 1970s episode, however, discretionary exchange-rate adjustments probably dampened the effects.

13. This line of argument ignores possible endogeneity of the terms of trade but, in the case of small countries, which must be regarded as price takers on world markets, this seems likely to be a reasonable approximation.

Figure 2: Terms of Trade, Inflation and Output Growth



terms-of-trade correlations involving any of the three major economies are generally those between the continental European economies and Germany. No doubt this is partly a consequence of imposed exchange-rate stability among these countries, but it is also likely to reflect similarities in their composition of trade which imply that they are less exposed to divergent relative-price shocks. Australia's terms of trade are not only highly volatile, but are only weakly or negatively correlated with those of the major economies. This again points to the relative unsuitability for Australia of a fixed exchange rate to one of those countries.

These arguments point, at least impressionistically, to the likelihood that terms-of-trade variability would make a significantly greater contribution to macroeconomic variability in Australia under a fixed exchange rate than under an alternative policy focused on final objectives. Recent theoretical contributions such as those of Eichengreen and Wyplosz (1993) and Obstfeld (1994) have focused on another disadvantage of fixed exchange-rate regimes, namely their potential vulnerability to self-fulfilling attacks. This literature, stimulated by the European exchange-rate crises of 1992–93, points to an important interaction between the macroeconomic stabilisation properties of exchange-rate regimes and their vulnerability to attack.

A self-fulfilling attack in this context is defined as arising where the expectation of a devaluation raises the domestic interest rate to a point that reinforces devaluation risk and makes further currency defence unsustainable. This was arguably an important feature of the ERM experience in 1992–93. Eichengreen and Wyplosz argue that the growth of international capital mobility has significantly increased the risk that this form of instability of a fixed exchange rate can arise. The theory suggests that speculative

Table 2: Terms-of-trade Variability, 1970–95[(a)]

	Standard deviation (per cent)	Correlation with: United States	Japan	Germany
Asia-Pacific				
Australia	8.7	0.20	-0.05	-0.22
Hong Kong	1.7	0.00	-0.50	-0.60
Japan	11.4	0.57	1.00	0.75
Korea	7.9	0.70	0.70	0.60
New Zealand	10.1	0.22	0.28	0.09
Singapore	2.0	0.20	-0.40	-0.30
North America				
Canada	3.3	-0.42	-0.51	-0.41
United States	4.4	1.00	0.57	0.43
Europe				
Austria	3.0	0.30	0.41	0.73
Belgium	7.1	0.00	0.05	-0.14
Denmark	3.7	0.55	0.75	0.87
Finland	4.1	0.31	0.27	0.45
France	5.0	0.66	0.82	0.88
Germany	4.9	0.41	0.73	1.00
Greece	4.3	0.09	-0.07	-0.41
Iceland	2.8	0.15	0.58	0.44
Ireland	5.1	0.56	0.54	0.54
Italy	5.4	0.42	0.63	0.84
Netherlands	1.8	0.59	0.39	0.48
Norway	7.2	-0.27	-0.76	-0.76
Portugal	4.6	-0.03	0.63	0.55
Spain	6.8	0.32	0.65	0.63
Sweden	3.7	0.53	0.38	0.55
Switzerland	4.5	0.55	0.68	0.79
United Kingdom	4.3	0.32	0.11	0.23

Note: (a) Calculated from percentage changes in terms of trade. Hong Kong data begin 1983, Singapore 1980, Iceland 1975 and Switzerland 1972.

Sources: National government publications.

attacks are most likely to occur under conditions where the exchange-rate link is not in some sense a natural fit: for example, where the relevant countries are subject to divergent shocks, or where the exchange-rate commitment is not underpinned by some exogenous political logic. Recent empirical work on currency crises by Funke (1996) provides some support for these models.

For the purposes of the present discussion, the important point is not just that fixed exchange rates are potentially vulnerable to attack, but that the degree of vulnerability, both in theory and practice, seems to be related to the performance of an exchange-rate regime in terms of domestic macroeconomic stabilisation. Speculative attacks are most likely to occur where there is perceived to be a strong domestic policy logic favouring realignment, and this situation in turn is most likely to arise in countries where there are significant shocks that move the real exchange rate. In light of the preceding discussion this point has obvious relevance to the choice of monetary regime for Australia.

3.4 The role of intermediate targets

The evidence described above is supportive of the general claim that Australia is subject to important shocks to domestic money demand and to the real exchange rate. These shocks tend to worsen the performance of fixed money-supply or fixed exchange-rate rules relative to policies based on targeting of final objectives. A useful way of formalising this argument in the case of money-supply rules is to consider the following three types of rule (where the notation is interpreted as deviations of variables from steady-state or target values):

(i) *Fixed money supply*

Assuming the money-demand function is of the form

$$m_t = p_t + y_t - \delta i_t + u_t$$

a fixed money supply rule implies that the interest rate is determined by

$$i_t = \frac{1}{\delta}(p_t + y_t) + \frac{1}{\delta}u_t .$$

(ii) *Money target*

Under this rule the interest rate is assumed to adjust according to

$$i_t = \gamma m_t .$$

Combining this with the money-demand function, the equation for the interest rate is

$$i_t = \left(\frac{\gamma}{1+\gamma\delta}\right)(p_t + y_t) + \left(\frac{\gamma}{1+\gamma\delta}\right)u_t .$$

(iii) *Final-targeting policy*

Policy responds to some weighted combination of expected deviations of prices and output from normal or targeted values,

$$i_t = \gamma_1 E(p_t) + \gamma_2 E(y_t) .$$

The structure of these rules is such that each can be considered a restricted case of the one below it. The problem faced by the policy-maker in the case of rules (ii) and (iii) is to choose optimal response parameters, given available knowledge about the structure of the economy and the sources of shocks. Expressed in this way, the money-supply target can be viewed as a restricted version of the final-targeting policy, where the money stock is considered as a signal conveying information about the variables in the reaction function. An intermediate target for the money stock, rigorously followed, thus amounts to an information restriction that requires the monetary authority to ignore all other sources of information about prices and output. At the next level in the hierarchy of rules, the fixed money rule can be viewed as a special case of the money-targeting rule; it corresponds to the case of perfect control, where the response elasticity with respect to deviations of the money stock from target tends to infinity. Given this hierarchical structure, it can thus be argued that final-targeting policies encompass intermediate monetary targets and fixed money rules as special cases, and therefore outperform them. An analogous argument could be made with respect to the potential role of the exchange rate as a target or policy indicator.

Related to this argument is Svensson's (1996) view that, under inflation targeting, the inflation forecast can be seen as the intermediate target of policy. The policy rule, in effect, is to adjust the instrument to ensure that the inflation forecast is continually consistent with the target. Again, this makes clear that a conventional intermediate monetary-targeting strategy is really a restricted form of a final-targeting policy that uses the money stock as the sole signal for the expected value of the final target variable.

3.5 Simplicity and credibility

The preceding discussion underlines the point that simple rules are outperformed, in terms of stabilisation properties, by complex rules. But simple rules are argued to carry advantages in terms of transparency and credibility. This leads naturally to the idea that some flexibility could be given up in order to obtain those benefits.

This issue is related to, but not identical to, the question of rules versus discretion in the conduct of monetary policy. The rules-versus-discretion debate defines discretion as policy that is unconstrained by pre-commitment. Discretionary policy in this sense is argued to give rise to a short-term focus by the policy-maker that results in inflationary bias. This principle underlies much of the theoretical literature on inflation targeting, which seeks to devise pre-commitment technologies and incentive schemes to 'solve' the time-consistency problem.

Opinions differ as to the practical relevance of this approach. Summers (1991) claims that the time-consistency problem is central to the design of appropriate policy institutions. A similar claim is implicit in the literature on optimal incentives for central bankers, which models the way governments can use contracts and other constraints to stop central banks from generating excessive inflation. Others such as McCallum (1995) and Blinder (1996) are sceptical that a presumed desire of the public and politicians to restrain inflationist central banks could really be the key issue. Arguably, the reverse is more likely. McCallum (1995) makes the further point that, even on this literature's own terms, government-imposed constraints do not solve the time-consistency problem but merely re-locate it; governments who set the policy parameters would be subject to the same time-consistency problem as is assumed to exist for central banks.

Another criticism of the time-consistency literature is that it fails to identify the attractions of simplicity. In the time-consistency approach the key requirement of a credible policy is pre-commitment. This has no necessary link with simplicity: in general, complex or conditional rules will still outperform simple fixed rules provided full pre-commitment to such a rule is possible. While it might be argued that pre-commitment would be more effective with a simple rule, this does not seem to capture the main practical arguments for simplicity. In practice, simple rules are sought partly because they are less likely to be model-dependent and, perhaps more importantly, because they are likely to foster public understanding and learning about the policy framework. King (1996) notes that these latter considerations are hard to model but likely to be important in practice.

It can be argued that final-targeting rules such as inflation targets have become popular because they reflect a balance of simplicity and flexibility. These considerations are also relevant to the more detailed questions of target design within a final-targeting regime. As King's paper notes, any final-targeting framework can be thought of as a combination of an inflation target and a response to real shocks. The need to balance flexibility and simplicity is clearly relevant to decisions as to how tightly to specify the inflation target and how much emphasis to give to factors other than inflation in the policy rule.

In this context, it is relevant to ask the question: in what sense are the final-targeting or rate-setting rules discussed in this paper really rules? As Blinder (1996) notes, this question is partly one of semantics. Any systematic way of conducting policy can in principle be written down in algebraic form and called a rule. But usually when we talk about rules there is some connotation of simplicity and verifiability, in the sense that an observer would be able to monitor ongoing compliance with the rule by the policy-maker. The final-targeting policies described here do not have that characteristic because they generally require policy to respond to forecasts which can never be determined purely objectively. This suggests a better characterisation of final-targeting policies such as inflation targets is Bernanke and Mishkin's (1997) concept of 'constrained discretion'. The targeting framework defines the objectives sufficiently tightly to constrain central bank behaviour, but not to the extent of precisely prescribing movements in the instrument. The central bank's job is to filter information for its implications for inflation and other relevant variables, and to assess the required response in terms of the policy instrument. The framework could thus be described as allowing discretion at the level of interpreting information, but subject to constraints at the level of goals and ultimate outcomes.

4. The Policy Spectrum in Practice

The point has already been made that differences among alternative policy approaches are not as great in practice as they can be made to appear in theory. Tables 3 and 4, adapted from the BIS and Padoa-Schioppa (1996), classify a range of industrial countries into four groups according to their broad policy approaches. The clearest practical distinction is between the exchange-rate-oriented approaches that prevail in continental Europe and the rest. Reasons for the policy preference for exchange-rate stability in the European countries are well known and have already been alluded to. They include the desire to ‘import’ monetary discipline and credibility through the currency anchor, the relatively high degree of integration and macroeconomic convergence among at least the core group of European countries, and the role of exchange rates in the longer-run strategic program for monetary and political integration.

With regard to the strictest form of fixed exchange-rate arrangement – the currency board – there are several working examples at present (Table 5). Generally, the countries that now have currency boards are either extremely small former-colonial economies (not included in the table), or are countries that have had special historical reasons for adopting such an arrangement. For example, Hong Kong’s currency board was adopted in the midst of serious financial turmoil associated with uncertainty about the colony’s political future. In Argentina, a currency board was adopted in 1991 in an effort to bring to a definitive end several decades of unsatisfactory monetary performance characterised by bouts of hyperinflation. Currency boards have been adopted in Estonia and Lithuania and have been proposed recently in other countries such as Bulgaria, as part of the program of transition to market-based economic systems in these countries. The common element in all these country experiences was a desire, as a result of the particular historical circumstances of each country, to make a decisive break with the previous monetary regime.

Table 3: Styles Of Monetary Management
G7 Countries, 1970–94

	Exchange-rate pegging	Money supply	Inflation	‘Classic Style’[(a)]
United States	—	1979–84	—	1970–78, 85–94
number of years		*6*		*19*
Japan	1970–71	—	—	1972–94
number of years	*2*			*23*
Germany	—	1975–94	—	1970–74
number of years		*20*		*5*
France	1970–71, 79–94	—	—	1972–78
number of years	*18*			*7*
United Kingdom	1970–71, 90–92	1980–83	1993–94	1972–79, 84–89
number of years	*5*	*4*	*2*	*14*
Italy	1970–71, 79–92	—	—	1972–78, 93–94
number of years	*16*			*9*
Canada	—	—	1991–94	1970–90
number of years			*4*	*21*
Total number of years	*41*	*30*	*6*	*98*

Note: (a) The terminology is Padoa-Schioppa’s and refers to floating exchange-rate countries that do not place a heavy reliance on numerical targets.

Source: Padoa-Schioppa (1996).

Table 4: Classification of Monetary-policy Approaches
Selected OECD Countries, 1997

Exchange-rate pegging	Monetary target	Inflation target	No numerical target
France	Germany	UK	US
Italy	Switzerland	Canada	Japan
Netherlands		Australia	
Belgium		New Zealand	
		Sweden	
		Spain	
		Finland	

Sources: Padoa-Schioppa (1996) and BIS Annual Reports (1996, 1997). Padoa-Schioppa's classifications are used for the G7 countries, except that Italy is now counted as having returned to a narrow exchange-rate band. Other countries are counted as exchange-rate peggers where they are classified as having a narrow exchange-rate band by the BIS. Otherwise, the BIS classification as to the 'domestic anchor' is used. Spain is an unusual case because it is classified by the BIS as having both a narrow exchange rate band and an inflation target.

Table 5: Currency Boards
Countries with Population Greater than 1 Million

Country	Base currency	Year established
Argentina	US dollar	1991
Estonia	Deutschemark	1992
Hong Kong	US dollar	1983
Lithuania	US dollar	1994
Namibia	South African rand	1993

Of more relevance to Australia are the remaining countries listed in Table 4, where the three remaining policy approaches cited are inflation targets, monetary targets, and policies without explicit numerical objectives. The sources cited for the table count Germany and Switzerland as currently the only two monetary-targeting countries in the group. According to Padoa-Schioppa (1996), a monetary target has been the main policy anchor in only two other cases among the G7 countries in the period since 1970: the US in 1979–84 and the UK in 1980–83. Switzerland has, since 1980, conducted a monetary-base target, first on an annual basis and subsequently, since 1990, on a five-year moving-average basis with a target average growth rate of 1 per cent per annum. In Germany, a target for M3 has been in operation since 1988, replacing an earlier target for Central Bank Money.

As was noted in the previous section, neither the Swiss nor German targets have been adhered to with the sort of mechanical precision assumed in the textbook analysis of monetary rules; on average, targets in the two countries have been achieved with about the same frequency as was typical in countries that subsequently abandoned or downgraded their targets. Monetary authorities in both countries pay attention to more general macroeconomic developments in determining policy settings, and both have publicly announced numerical objectives for inflation in the longer term (2 per cent in Germany, 1 per cent in Switzerland). The monetary target in Germany is explicitly derived each year from desired outcomes for inflation and growth in the year ahead. In this sense, the differences in approach from those of countries with inflation targets or non-explicit objectives would seem to be primarily at the level of public explanation: the monetary target, particularly in Germany, functions as a device for communicating and explaining the policy strategy.[14]

The most numerous group of countries in Table 4 comprises those classified as inflation targeters. The distinguishing feature of these regimes is an explicit numerical inflation objective which serves as a basis for the central bank's decision-making and for a process of accountability and public explanation; policy is generally conducted through the short-term interest rate, although some countries focus on a monetary conditions index as a short-term policy indicator. Within this general definition, there are a number of shades of difference relating to the target level, time horizon and the nature of the mechanisms for pre-commitment and accountability, some key features of which are summarised in Table 6.

In terms of target levels the various countries are fairly close together, with the most common target midpoint being 2 per cent; Australia and the UK have target midpoints of a half percentage point above that, while New Zealand is a half percentage point below. The more important differences in system design would seem to be those that govern the degree of flexibility permitted to the central bank to tolerate temporary variations in inflation around the target midpoint. In principle, systems with hard-edged bands and commitments to keep inflation continuously within a specified range, as in New Zealand, can be contrasted with systems such as those of Australia and Finland that focus on the average rather than the permitted range; however these differences can be easily exaggerated given the presence of caveats and exclusions in many systems. Also relevant are the reporting mechanisms for explaining policy and for requiring the central bank to account for its actions, including potentially accounting for any failure to achieve inflation outcomes consistent with the target. Issues of appropriate design of these characteristics are to be covered by other papers at this conference and are not analysed here. For the current discussion, the main point to note is that these design features can be thought of as placing the inflation-targeting countries on a spectrum, within which there is an underlying similarity of objectives for inflation but with varying degrees of pre-commitment to limiting its variability.

One could take this argument further and argue that non inflation-targeters such as the US and Germany can be placed on the same spectrum. There is an obvious affinity with the inflation targeters in their anti-inflation objectives, as well as a similarity in the style

14. This view is supported by Clarida and Gertler's (1996) estimates of a German policy reaction function.

Table 6: Characteristics of Inflation Targets in Selected Countries

Country	Target first announced	Current target range	Target details: a. Target variable; b. Other caveats; c. Set by; d. Target horizon
New Zealand	March 1990	0–3% band; no explicit midpoint	a. Consumer price index (CPI) excluding interest-cost components, government charges, indirect taxes and subsidies and significant changes in import or export prices. b. Natural disasters. c. Policy Target Agreement (PTA) between Finance Minister and central bank Governor. d. PTA for the five-year tenure of the Governor.
Canada	February 1991	midpoint 2%; ±1% band	a. CPI. b. Food and energy prices, indirect taxes, natural disasters. c. Finance Minister and central bank Governor. d. December 1993: 1995–98 target; new target by end 1997.
United Kingdom	October 1992	2.5%; ±1% reporting range	a. Retail price index excluding mortgage interest payments. b. Indirect taxes and subsidies. c. Chancellor of the Exchequer. d. Indefinite.
Sweden	January 1993	midpoint 2%; ±1% band	a. CPI. b. Indirect taxes and subsidies, interest costs and effects of depreciation after the move to a flexible exchange rate. c. Bank of Sweden. d. ‘in 1995 and beyond’.
Finland	February 1993	2%; no explicit band	a. CPI excluding indirect taxes, subsidies and housing-related capital cities. b. – c. Bank of Finland. d. ‘permanently’.
Australia	1993	average of 2–3% over the medium term	a. CPI excluding fruit and vegetables, petrol, interest costs, public-sector prices and other volatile prices. b. – c. Reserve Bank of Australia. d. Indefinite.
Spain	Summer 1994	3.5–4% by first quarter 1996; <3% by late 1997	a. CPI. b. – c. Bank of Spain. d. Medium-term objective for 1997.

Source: BIS 1996 Annual Report, updated to incorporate recent changes to targets in the United Kingdom and New Zealand.

of decision-making.[15] What distinguishes the inflation targeters is their use of the targets as a formal pre-commitment mechanism and as a vehicle for focusing the public's inflation expectations and explaining policy actions.

Developing a theme from the previous section, we might expect to find that tighter pre-commitment mechanisms would be adopted in countries that have felt the greatest need to signal a clear regime shift. This seems most likely to be the case where inflation performance in the past has been relatively unsatisfactory. The historical inflation experiences summarised in Table 7 seem broadly consistent with that pattern. The countries that now have inflation targets are those that had relatively high inflation rates in the late 1970s, were slow to bring inflation down in the 1980s, and did not have a

Table 7: Consumer Price Inflation

Average annual rate

	1976–80	1981–85	1986–90	1991–96	Latest
Pegged exchange rate					
France	10.5	9.7	3.1	2.2	0.9
Italy	17.0	14.0	5.7	4.9	1.6
Belgium	6.4	7.0	2.1	2.4	1.7
Netherlands	5.9	4.2	0.7	2.6	2.2
Average	**10.0**	**8.7**	**2.9**	**3.0**	**1.6**
Monetary target					
Germany	4.0	3.9	1.4	3.2	1.6
Switzerland	2.3	4.3	2.5	2.8	0.5
Average	**3.1**	**4.1**	**2.0**	**3.0**	**1.1**
Inflation target					
United Kingdom	14.4	7.2	5.9	3.2	2.6
Canada	8.8	7.5	4.5	2.1	1.5
Australia	10.6	8.3	7.9	2.5	1.3
New Zealand	14.8	12.1	9.4	2.1	1.8
Spain	18.6	12.2	6.5	4.9	1.5
Sweden	10.5	9.0	6.2	3.6	0.2
Average	**13.0**	**9.4**	**6.7**	**3.1**	**1.5**
No numerical objective					
United States	8.9	5.5	4.0	3.1	2.2
Japan	6.7	2.8	1.4	1.2	1.9
Average	**7.8**	**4.2**	**2.7**	**2.2**	**2.1**

Source: Datastream.

15. This view receives some support from Chinn and Dooley (1997), who find no significant differences in estimated policy reaction functions for the US, Japan and Germany.

satisfactory option of importing low-inflation credibility through the European exchange-rate mechanism. New Zealand, which probably has the hardest-edged target, had one of the worst inflation records to overcome. In contrast, countries like the US and Germany, with much better track records, arguably had less need for that kind of policy constraint. Notwithstanding these differences in starting points, the table illustrates that there has been a substantial convergence in inflation outcomes in the 1990s across all four policy approaches.

5. Conclusions

The debate on policy alternatives in Australia in the past decade has canvassed a wide range of approaches, some radical and some more conventional. The argument developed in this paper is that the combined logic of theory, empirical evidence and international experience point to what I have termed final-targeting systems, of which inflation targets are a special case, as the approach most likely to deliver satisfactory outcomes. The policies of most industrial countries at present, other than those where policy is directed at exchange-rate stability, can probably be placed under this general heading.

Final-targeting systems would seem to fit somewhere in between traditional concepts of rules and discretion in monetary policy. They embody an element of rule-like behaviour because they constrain monetary policy within certain broad bounds, but they are not true rules in the sense of describing a precise and indisputable path for the policy instrument at each point in time. The description of these systems as a form of ‘constrained discretion’ (in the terminology of Bernanke and Mishkin) probably best captures their essential characteristic.

Within this category of policy systems, there is a spectrum of possible choices with respect to such design features as the choice of target, width of tolerance bands, accountability and pre-commitment devices and the like. The existence of this spectrum points to a basic and inescapable trade-off between simplicity and flexibility in the design of a policy system. It is not surprising that there is no consensus model at the level of detailed system design, since these characteristics are likely to be valued differently by different countries. The advantages of simplicity are that it promotes accountability, discipline and public understanding of the policy. These things are likely to be considered most valuable where past policies are viewed as unsatisfactory, and so a country’s chosen position on the spectrum will tend to reflect its own monetary-policy history.

References

Argy, V., A. Brennan and G. Stevens (1989), 'Monetary Targeting: The International Experience', in I. Macfarlane and G. Stevens (eds), *Studies in Money and Credit*, Reserve Bank of Australia, Sydney, pp. 10–52.

Ball, L. (1997), 'Efficient Rules for Monetary Policy', NBER Working Paper No. 5952.

Bank for International Settlements, *Annual Report*, various, Basle.

Ben-Bassatt, A. (1995), 'The Inflation Target in Israel: Policy and Development', in A. Haldane (ed.), *Targeting Inflation,* Bank of England, London, pp. 15–48.

Bernanke, B.S. and F.S. Mishkin (1997), 'Inflation Targeting: A New Framework for Monetary Policy?', NBER Working Paper No. 5893.

Blinder, A.S. (1995), 'Central Banking in Theory and Practice', Marshall Lectures presented at the University of Cambridge.

Blinder, A.S. (1996), 'On the Conceptual Basis of Monetary Policy', remarks for the Senior Executives Conference, Mortgage Bankers Association, New York, 10 January.

Bryant, R., P. Hooper and C. Mann (1993), 'Stochastic Simulations with Simple Policy Regimes', in R. Bryant, P. Hooper and C. Mann (eds), *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*, The Brookings Institution, Washington D.C., pp. 373–415.

Chinn, M. and M. Dooley (1997), 'Monetary Policy in Japan, Germany and the United States: Does One Size Fit All?', Macquarie University, Centre for Japanese Economic Studies Working Paper Series No. 97-5.

Clarida, R. and M. Gertler (1996), 'How the Bundesbank Conducts Monetary Policy', NBER Working Paper No. 5581.

de Brouwer, G., I. Ng and R. Subbaraman (1993), 'The Demand for Money in Australia: New Tests on an Old Topic', Reserve Bank of Australia Research Discussion Paper No. 9314.

de Brouwer, G. and J. O'Regan (1997), 'Evaluating Simple Monetary-policy Rules for Australia', paper presented at this conference.

de Haan, J. and D. Zelhorst (1991), 'Financial Deregulation and the Stability of the Demand for Money in Australia', *Kredit Und Capital*, 24(3), pp. 319–331.

Dowd, K. (1990), 'Ending Australia's Inflation: The Need for Radical Monetary Reform', *Policy*, 6(3), pp. 15–17.

Dowd, K. (1996), 'The Case for Financial *Laissez-Faire*', *The Economic Journal*, 106(436), pp. 679–687.

Edey, M. (1990), 'Operating Objectives for Monetary Policy', Reserve Bank of Australia Research Discussion Paper No. 9007.

Eichengreen, B. and C. Wyplosz (1993), 'The Unstable EMS', Centre for Economic Policy Research Discussion Paper No. 817.

Evans, N.R. and K. Dowd (1992), 'Honest Money', Australian Institute for Public Policy, Policy Paper No. 21.

Feldstein, M. and J.H. Stock (1994), 'The Use of a Monetary Aggregate to Target Nominal GDP', in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 7–62.

Fischer, S. (1995), 'The Unending Search for Monetary Salvation', in B. Bernanke and J. Rotemberg (eds), *NBER Macroeconomics Annual*, MIT Press, Cambridge, Massachusetts, pp. 275–286.

Friedman, M. (1969), 'The Optimum Quantity of Money', in *The Optimum Quantity of Money and Other Essays*, Aldine Publishing, Chicago, pp. 1–50.

Fuhrer, J.C. and G.R. Moore (1995), 'Monetary Policy Trade-offs and the Correlation Between Nominal Interest Rates and Real Output', *American Economic Review*, 85(1), pp. 219–239.

Funke, N. (1996), 'Vulnerability of Fixed Exchange Rate Regimes: The Role of Economic Fundamentals', *OECD Economic Studies*, 26, pp. 157–176.

Goodhart, C.A.E. (1988), *The Evolution of Central Banks*, MIT Press, Cambridge, Massachusetts.

Goodhart, C.A.E. (1989), 'The Conduct of Monetary Policy', *Economic Journal*, 99(396), pp. 293–346.

Goodhart, C.A.E. (1995), 'Money Supply Control: Base or Interest Rates?', in *The Central Bank and the Financial System*, MIT Press, Cambridge, Massachusetts, pp. 249–262.

Gruen, D.W.R. and J.A. Dwyer (1995), 'Are Terms of Trade Rises Inflationary?', Reserve Bank of Australia Research Discussion Paper No. 9508.

Gruen, D.W.R. and J. Wilkinson (1994), 'Australia's Real Exchange Rate – Is it Explained by the Terms of Trade or by Real Interest Differentials?', *Economic Record*, 70(209), pp. 204–219.

Hall, R.E. and N.G. Mankiw (1994), 'Nominal Income Targeting', in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 71–93.

Hanke, S.H., M.G. Porter and K. Schuler (1992), 'A Bundesbank or a Reserve Currency Board', in D. Moore (ed.), *Can Monetary Policy be Made to Work,* Institute of Public Affairs, Melbourne, pp. 36–50.

Hartley, P.R. and M.G. Porter (1988), 'Monetary Management in Australia', Monash University, Centre of Policy Studies Discussion Paper Series No. D132.

Hayek, F.A. (1990), 'Denationalisation of Money: The Argument Refined: An Analysis of the Theory and Practice of Concurrent Currencies', Hobart Paper No. 70.

Jonung, L. (1992), 'Swedish Price-Stabilisation Policy, 1931–1939, The Riksbank and Knut Wicksell's Norm', in *Monetary Policy with a Flexible Exchange Rate*, Sveriges Riksbank, Stockholm, pp. 25–39.

King, M. (1996), 'How Should Central Banks Reduce Inflation? Conceptual Issues', *Bank of England Quarterly Bulletin*, 36(4), pp. 434–448.

Laubach, T. and A.S. Posen (1997), 'Disciplined Discretion: The German and Swiss Monetary Targeting Frameworks in Operation', Federal Reserve Bank of New York Research Paper No. 9707.

Lowe, P. and L. Ellis (1997), 'The Smoothing of Official Interest Rates', paper presented at this conference.

Makin, T. (1993), 'Reserve Bank Independence or a Money-Growth Rule?', *Policy*, 9(4), pp. 9–12.

McCallum, B.T. (1981), 'Price Level Determinacy with an Interest Rate Policy Rule and Rational Expectations', *Journal of Monetary Economics,* 8(3), pp 319–329.

McCallum, B.T. (1986), 'Some Issues Concerning Interest Rate Pegging, Price Level Determinancy and the Real Bills Doctrine', *Journal of Monetary Economics*, 17(1), pp. 135–160.

McCallum, B.T. (1988), 'Robustness Properties of a Rule for Monetary Policy', *Carnegie-Rochester Series on Public Policy,* 29, pp. 173–204.

McCallum, B.T. (1995), 'Two Fallacies Concerning Central Bank Independence', *American Economic Review,* 85(2), pp. 207–211.

McDonald, I.M. (1997),'The Australian Inflation Target and the Shape of the Short-Run Phillips Curve', paper presented at the Macroeconomics Workshop, University of New South Wales, 3–5 April.

McKibbin, W. (1996), 'Disinflation, Fiscal Consolidation and the Role of Monetary and Fiscal Regimes', Australian National University Centre for Economic Policy Research Discussion Paper No. 348.

McTaggart, D. and C. Rogers (1990), 'Monetary Policy and the Terms of Trade: A Case for Monetary Base Control in Australia?', *Australian Economic Review*, 90, pp. 38–49.

Obstfeld, M. (1994), 'The Logic of Currency Crises', NBER Working Paper No. 4640.

OECD (1995), *Economic Survey of Mexico*, Paris.

Padoa-Schioppa, T. (1996), 'Styles of Monetary Management', Bank of Italy IMES Discussion Paper No. 96-E-20.

Pagan, A.R. and P.A. Volker (1981), 'Short-Run Demand for Transactions Balances in Australia', *Economica*, 48(192), pp. 381–395.

Pitchford, J.D. (1996), 'Alternatives for Monetary Policy: An Appraisal', *Australian Economic Review*, 113, pp. 40–50.

Poole, W. (1970), 'Optimal Choice of Monetary Policy Instrument in a Simple Stochastic Macro Model', *Quarterly Journal of Economics*, 84(2), pp. 197–216.

Sargent, T.J. (1979), *Macroeconomic Theory*, Academic Press, New York.

Sargent, T.J., and N. Wallace (1975), 'Rational Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule', *Journal of Political Economy*, 83(2), pp. 169–183.

Schwartz, A.J. (1993), 'Currency Boards: Their Past, Present and Possible Future Role', *Carnegie-Rochester Series on Public Policy*, 39, pp. 147–187.

Selgin, G.A. and L.H. White (1994), 'How Would the Invisible Hand Handle Money?', *Journal of Economic Literature*, 32(4), pp. 1718–1749.

Stemp, P.J. (1996), 'The Role of Monetary Policy in Australia: A Minimalist Approach', *Australian Economic Review*, 113, pp. 10–28.

Stevens, G.R., S. Thorp and J. Anderson (1987), 'The Australian Demand Function for Money: Another Look at Stability', Reserve Bank of Australia Research Discussion Paper No. 8701.

Summers, L. (1991), 'How Should Long-Term Monetary Policy be Determined?', *Journal of Money, Credit and Banking*, 23(3), pp. 625–631.

Svensson, L.E.O. (1995), 'Optimal Inflation Targets, "Conservative" Central Banks, and Linear Inflation Targets', NBER Working Paper No. 5251.

Svensson, L.E.O. (1996), 'Price Level Targeting versus Inflation Targeting: A Free Lunch?', NBER Working Paper No. 5719.

Tallman, E.W. and N. Chandra (1996), 'The Information Content of Financial Aggregates in Australia', Reserve Bank of Australia Research Discussion Paper No. 9606.

Taylor, J.B. (1993), 'Discretion Versus Policy Rules in Practice', *Carnegie-Rochester Series on Public Policy*, 39, pp. 195–214.

Walsh, C. (1995), 'Optimal Contracts for Independent Central Bankers', *American Economic Review*, 85(1), pp. 150–167.

Walters, Sir A. (1992), 'Should Australia have a Currency Board?', in D. Moore (ed.), *Can Monetary Policy be Made To Work?*, Institute of Public Affairs, Melbourne, pp. 80–90.

Weber, E.J. (1993), 'The Role of Money During the Recession in Australia in 1990–92', University of Western Australia Department of Economics Discussion Paper No. 93.15.

Weber, E.J. (1994), 'Will Inflation Return?', University of Western Australia Department of Economics Discussion Paper No. 94.10.

White, L.H. (1989), Depoliticising the Supply of Money: Constitution of Competition?, paper presented at CIS Policy Forums, 'Do We Need a Reserve Bank?', Sydney, 27 September, Wellington, 29 September.

Discussion

1. Ian M. McDonald

The aim of Malcolm Edey's paper is to review the debate on alternative monetary-policy systems as they apply to Australia and to give a general rationale for the system we have, which is the inflation target. The paper focuses on the choice between policy systems and not on the detailed parameters of individual systems. Discussion of those details is in other papers of the conference. Four types of monetary-policy systems are compared. These are money-supply-setting systems (such as the Friedman monetary rule), final-targeting systems using the interest rate as the intermediate target, exchange-rate-setting systems, and *laissez-faire* or free-banking systems. Inflation being one of the possible final targets of monetary policy, the inflation-target system is one example of a final-targeting system.

In this comment I will focus on the rationale or case that Malcolm Edey puts forward for the inflation-target system. I will then discuss the implications for the level of activity of an inflation-target system. This latter topic is an important one which should influence our evaluation of the inflation-target system and yet gets little comment in Edey's paper.

The rationale for an inflation-targeting system

Edey argues that the advantage of final-targeting systems over money-supply-setting or exchange-rate-setting systems is that they 'encompass' these other systems and therefore can outperform them. Consider for example the money-supply-setting system known as the Friedman rule. This provides a particularly stark comparison with final-targeting systems. Under the Friedman rule the money supply is set for each period independently of any information about how the economy is performing. Edey's argument is that a final-targeting system, by allowing the setting of monetary policy to be adjusted in the light of information about developments in economic performance, can do at least as well as and generally better than the Friedman rule.

Edey observes that final-targeting systems can yield complex rules. Indeed it is the complexity of these rules which gives them the potential to outperform the simple rules of the other systems considered. Complex rules offer the flexibility to adjust monetary policy in the light of economic developments. But, argues Edey, simple rules have the advantages of 'transparency' and 'credibility'. Edey emphasises that these advantages are not the commitment of monetary policy since the monetary authority can commit to a complex rule. They are instead the advantages of fostering public understanding about the behaviour of the economy and about the operation of the policy framework. For example, the Reserve Bank of Australia's inflation target, by emphasising a narrow range of two to three per cent, will encourage the formation by the public of an expected rate of inflation of two to three per cent, provided of course a track record of inflation in the two to three per cent range is established. Thus the simplicity of the inflation target can help to anchor inflationary expectations. It can reduce the responsiveness of the public's expected rate of inflation to changes in the actual rate of inflation.

I am in agreement with Edey's argument. The role of the inflation target in fostering public understanding and in anchoring inflationary expectations, provided it is backed up by achievement, is a far more persuasive argument for using an inflation target to set monetary policy than the idea that central bankers need to be committed to low inflation outcomes. I do not see central bankers as irresponsible inflators who will attempt, in Barro and Gordon (1983) fashion, to trick the public into increasing their labour supply above privately optimal levels. The minor role of commitment in Edey's rationale for the inflation target is underlined by Edey pointing out that an observer would have difficulty in monitoring ongoing compliance by the Reserve Bank of Australia with the inflation target because the system requires the Reserve Bank to respond to forecasts. Forecasts are not 'objective' and so it would be hard to say at the time that the Reserve Bank is not doing its best to meet the inflation target.

What does an inflation target imply for the performance of economic activity?

If there is a unique natural rate of unemployment, or NAIRU, then following an inflation target will automatically cause monetary policy to expand when the rate of unemployment is high. This automatic expansion may be slow in coming and follow a significant period of time during which the rate of unemployment is high but eventually this automatic response would occur. This is because an unemployment rate in excess of the natural rate will create downward pressure on the rate of inflation. This downward pressure will cause the rate of inflation to fall. Eventually the rate of inflation and the forecast of future inflation under unchanged monetary policy will fall below the target range and this will require the Reserve Bank of Australia to expand monetary policy in order to meet the inflation target. However in practice it appears that the natural rate of unemployment is not well defined and may not be unique. Consider the following evidence.

From a study on inflation and unemployment for the United States for the period 1961 to 1995, Staiger, Stock and Watson (1997) conclude that their 'estimates (of the natural rate of unemployment) are imprecise' (p. 46). They find that forecasts of inflation are similar whether the natural rate of unemployment is assumed to be 4.5, 5.5 or 6.5 per cent. The 95 per cent confidence interval on their estimate of the current value of the natural rate of unemployment is 4.3 per cent to 7.3 per cent. One can argue that their estimates are even less precise than they suggest. In their estimating procedure they use a polynomial in time which allows their estimate of the natural rate to follow to some extent the path of the actual rate of unemployment. From their Figure 2, p. 38, it appears that the point estimate of the natural rate was about 5 per cent in 1966 and about 7 per cent in 1980. This variation is driven, not by the supply-side factors on which the concept of the natural rate is based, but by the path of the actual rate of unemployment. Thus, if this variation was dropped then the imprecision of the Staiger, Stock and Watson estimates of the natural rate of unemployment would be even greater.

For Australia the imprecision of estimates of the natural rate of unemployment is even greater than for the United States. In a recent study, Crosby and Olekalns (1996) find, using Australian data for the period 1959 to 1995, the natural rate of unemployment varying between 2.3 per cent and 9.5 per cent. The Murphy model of the Australian economy estimates, using Australian data for the period 1976 to 1991, the natural rate of unemployment as 7.1 per cent (Powell and Murphy 1995, p. 107). However the 80 per cent confidence interval of this estimate places the natural rate for the Murphy model in the range of 0 per cent to 22.2 per cent (McDonald 1997). A 95 per cent confidence interval would yield an even larger range and would not rule out the possibility of a negative natural of unemployment! The reason the Australian estimates of the natural rate of unemployment are less precise than the United States estimates is probably related to the larger range of variation of the actual rate of unemployment in Australia. This reason is suggested by the tendency of natural rate estimates to follow the actual rate of unemployment.

The imprecise estimation of the natural rate of unemployment reflects a weak or non-existent tendency for the rate of inflation to respond to different rates of unemployment. Note that it is different rates of unemployment which have little effect on the rate of inflation. *Changes* in the rate of unemployment do appear to cause changes in the rate of inflation, as first documented by Phillips (1958) and labelled the Phillips loops. Of particular importance for economic policy is the fact that persistently high rates of unemployment do not cause a decreasing rate of inflation. This is shown most dramatically for the interwar period, during which high rates of unemployment persisted for years – over 20 years in the UK – without generating a decreasing rate of inflation (see for evidence on this McDonald 1995, pp. 102–113).

The weak or non-existent downward effect on the rate of inflation is a plausible reason why inflation persisted so long after the increase in inflation the early 1970s. Central bankers were not, in Barro and Gordon fashion, seen by the public as irresponsibly pushing unemployment below the natural rate. Instead they were (responsibly) reluctant to keep on increasing unemployment as long as inflation was high

The imprecise estimates of the natural rate of unemployment imply that the automatic tendency under an inflation target for monetary policy to eventually offset high unemployment is weak or non-existent. This weakness suggests a case for the activity target to be included with the inflation target as the guide for monetary policy. Of course the imprecision of the estimates of the natural rate also suggests that it is impossible to specify with much certainty the level of activity at which policy makers should aim. In view of this, the activity target is perhaps best incorporated in the following fashion:

- set monetary policy to minimise the rate of unemployment; and
- subject to not violating the inflation target.

For an example of how this policy may have worked in practice consider the experience in Australia from the trough of the recession in December 1992 to the end of 1996. During 1993 and 1994 the rate of unemployment fell. This followed the progressive easing of monetary policy which had begun, albeit from a tight base, in 1990. However following the first quarter in 1994, the rate of wage inflation as measured by the percentage rate of change of average weekly earnings increased. In the second half of 1994, to stop the rise in inflation by slowing the speed of the upswing, the Reserve Bank tightened monetary policy. Following this monetary tightening, the fall in the rate of unemployment slowed down in early 1995 and then, in mid 1995, ceased. At the same time, from the beginning of 1995, the rate of wage inflation fell. The underlying rate of inflation went above the 2–3 per cent range in the later half of 1995 but fell back into the range by the end of 1996. This pattern of inflation and unemployment is an example of a Phillips loop.

It appears that over the 1992 to 1996 period a decline in the rate of unemployment was achieved with only a temporary increase in the rate of inflation. Given that the rate of inflation at the end of 1996 was no greater than it had been at the end of 1992, it would appear that the decrease in the rate of unemployment can be reasonably regarded as a permanent decrease. Can a further decrease in the rate of unemployment from its current rate of about 8.5 per cent be achieved with similar success with regard to the rate of inflation? This raises the following questions about expansionary policy.

Does the inflation target help by reducing the size of variations in inflation in the Phillips loops? By anchoring inflationary expectations the inflation target may reduce the size of the fluctuations in the rate of inflation associated with the Phillips loops. This would increase the probability of success of non-inflationary, expansionary monetary policy.

Would a more clearly stated aggressive policy work better? The more convinced are firms that an expansionary phase will be cut off if inflation rises, the more resistant will they be to conceding large wage increases. Firms have a strong incentive to avoid being saddled with high wages relative to their competitors when growth declines.

When the rate of unemployment hits the minimum equilibrium rate, can monetary policy be reversed before the expected rate of inflation increases? Given that the formation by the public of price expectations tends to be backward-looking, the answer to this question is probably yes. If it were not the case the implications for macroeconomic performance would be bleak indeed, for it would require the RBA to restrict monetary policy before the rate of unemployment is at its minimum equilibrium rate. Note that under such a restrictive policy it would be pretty difficult to know what is the minimum equilibrium rate.

To answer these questions we need to know more about the theoretical causes of the Phillips loops. For example, if the decrease in unemployment in an upswing is caused by workers underestimating the rate of inflation, as for example in the model of loss aversion where the reference-wage is last period's real wage, see McDonald and Sibly (1997), then under rational expectations an expected monetary expansion will flow entirely into wages and prices with no reduction in the rate of unemployment. By contrast an alternative reference-wage specification based on the wages of other workers is shown by McDonald and Sibly (1997) to allow an upswing even if expansionary monetary policy is expected.

As noted above, in his case for an inflation target Malcolm Edey emphasises the role of the inflation target in fostering public understanding about the conduct of monetary policy. Although not spelt out by Edey, this educative role may come to have its greatest value in highlighting the link between economic efficiency and the achievement of a healthy level of activity, a link which exists if people are concerned about the real value of their wages. With monetary policy being set to achieve an inflation target it is easier to see that acts which increase the price level at a given level of activity have an 'employment cost' in that they provoke a deflationary monetary response. Thus the award of a higher minimum wage for a group of workers in excess supply will, through the monetary response, tend to increase the rate of unemployment. A postponement of tariff cuts will do the same. On the other hand, acts which lower prices at a given level of activity can be seen to have an 'employment benefit' in that they provoke an expansionary response. (Not of course artificial reductions achieved by price ceilings). Tariff cuts, by lowering prices will encourage the choice of expansionary monetary policy and thus aid the reduction of unemployment. Seen this way, the inflation target highlights the link between microeconomic reform and the achievement of better employment outcomes. If the public (and the politicians) can understand this link then perhaps there would be a sea-change in attitudes to economic policy.

References

Barro, R.J. and D.B. Gordon (1983), 'A Positive Theory of Monetary Policy in a Natural Rate Model', *Journal of Political Economy*, 91(4), pp. 589–610.

Crosby, M. and N. Olekalns (1996), 'Inflation, Unemployment and the NAIRU in Australia', Melbourne Institute Working Paper Series No. 7/97.

McDonald, I.M. (1995), 'Models of the Range of Equilibria' in R. Cross (ed.), *The Natural Rate of Unemployment: Reflections on 25 Years of the Hypothesis*, Cambridge University Press, London, pp. 101–152.

McDonald, I.M. (1997), 'Australia's Inflation Target and the Shape of the Short-Run Phillips Curve', paper presented at the Macroeconomics Workshop, University of New South Wales, 3–5 April.

McDonald, I.M. and H. Sibly (1997), 'Loss Aversion and the Non-neutrality of Money', University of Melbourne, mimeo.

Phillips, A.W. (1958), 'The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1957', *Economica*, 25(100), pp. 283–299.

Powell, A.A. and C.W. Murphy (1995), *Inside a Modern Macroeconomic Model: A Guide to the Murphy Model*, Springer-Verlag, Berlin.

Staiger, D., J.H. Stock, and M.W. Watson (1997), 'The NAIRU, Unemployment and Monetary Policy', *Journal of Economic Perspectives*, 11(1), pp. 33–49.

2. General Discussion

Discussion of the papers by Rick Mishkin and Malcolm Edey focused on three issues:

- the advantages and disadvantages of different monetary-policy frameworks;
- the presence of output in the objective function of the central bank; and
- whether or not an inflation target is better specified as a band or a point.

Inflation targeting was seen as an encompassing framework for monetary policy which nested other frameworks as special cases. In some countries it has served a particularly useful role in locking in low inflation. However, some participants thought that inflation targets had yet to be fully tested. They argued that when a large adverse supply shock occurs, it was likely that narrow inflation targets would be seen to be inferior to a system in which medium-term price stability was achieved through the operation of a rule like that proposed by Bryant, Hooper and Mann (see the papers by McKibbin and de Brouwer and O'Regan in this volume).

Some participants considered that the value of an exchange-rate target was understated in Mishkin's paper. Arguably, such a target has better transparency and accountability properties than an inflation target, although it was generally agreed that a fixed exchange rate was not appropriate for Australia. Furthermore, the recent experience of countries with exchange-rate targets appears to have been fairly similar to that of countries with inflation targets. Some participants argued that the international evidence was not clear as to whether inflation targets achieved price stability with less variability in output than did other policy frameworks; others noted that the appropriate framework depended very much on the particular circumstances of each country.

There was little support for a nominal-income target over an inflation target. A nominal-income target was felt to be less effective in tying down inflation expectations. It also suffers a large disadvantage *vis-à-vis* an inflation target, in that the value of nominal income itself is prone to frequent (and occasionally large) revisions. Other difficulties discussed included the difficulty of explaining to some members of the public the differences between real and nominal magnitudes, and the fact that a nominal-income target requires the monetary authorities to estimate and explicitly indicate their estimate of the potential growth rate of the economy.

Some participants thought that an inflation-targeting framework did not place sufficient weight on output considerations. In particular, it was argued that a system in which price stability was the only goal of monetary policy was unlikely to take appropriate account of the possibility of hysteresis effects: if these effects exist, pursuing an inflation target too vigorously might lead to an increase in unemployment in the medium term.

Others noted that a forward-looking inflation-targeting framework will always pay attention to fluctuations in output and employment, as these fluctuations affect inflation. The horizon of the policy rule (that is, how quickly inflation is returned to the targeted level after a shock) will determine exactly how much policy reacts to these fluctuations, but in general, in an inflation-targeting framework, monetary policy will always be endeavouring to move output back towards its potential level. Clarifying this is important in building and retaining public support for an inflation target.

Finally, some participants thought that the current specification of the inflation target in Australia was too vague. They argued that the use of a 'thick point', rather than a target band, created uncertainty about the Reserve Bank of Australia's tolerance of fluctuations in inflation. Others responded that a band might need to be quite large if it was intended that inflation was to be within the band almost all of the time. It was also noted that announcing a band may result in the public's inflation expectations focusing on the upper edge of the band, rather than the midpoint.

Designing Inflation Targets

Andrew G. Haldane*

1. Introduction

This paper discusses some operational issues regarding the design of monetary frameworks in general and inflation targets in particular. Among inflation targeters,[1] these issues are well-known and manifold (see, *inter alia*, Yates (1995), McCallum (1995), Debelle (1997), Siklos (1997) and the country contributions in the volumes by Haldane (1995) and Leiderman and Svensson (1995)). They include:

(a) At what *level* to set an inflation target?

(b) Which *price index* to target?

(c) Over what *horizon*?

(d) Is a *price-level* or *inflation* target to be preferred?

(e) What is the optimal inflation-target *bandwidth*?

(f) Which *shocks* should be accommodated or exempted?

(g) Should inflation *forecasts*, and other internal information, be *published*?

(h) Should *real*, as well as *nominal*, magnitudes be targeted?

The maintained hypothesis running through this paper is that any discussion of these issues needs to be rooted in an understanding and quantification of two things: the underlying structure of the economy ('technology'); and the welfare costs of inflation ('tastes'). Of these, by far the least is known about the second. Yet it is difficult even to begin to address issues (a) – (h) without some notion of these welfare costs. The general point here is straightforward. Central banks target inflation because they think it costly. So it is only by knowing where the costs of inflation lie, and their size, that we can design monetary frameworks which ensure these inflationary costs are minimised.

In the inflation-targeting sphere, there are also any number of *specific* examples illustrating this general proposition. For example on issue (b) – the choice of price index – 'underlying' price indices may well do a better job of delineating trend inflation disturbances. But if the costs of inflation in fact derive precisely from deviations around trend inflation, then the usefulness of these underlying indices is much reduced. Likewise, the choice between an inflation and price-level target – issue (d) – has been shown empirically to hinge on a well-defined trade-off between high-frequency and low-frequency price-level variability (Duguay 1994). An inflation target delivers less of

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1. Of which there are now seven: Australia, Canada, Finland, New Zealand, Spain, Sweden and the United Kingdom.

the former at the expense of more of the latter. But which of these variabilities – high versus low frequency – is the more damaging to welfare is an issue which can be resolved only by quantifying the costs of inflation. The same issue arises in the context of shock accommodation – issue (f). Conventional wisdom has it that equilibrium price-level shocks – for example, arising from supply shocks – ought to be accommodated or explicitly exempted. But such a choice stands or falls on how costly, in a welfare sense, we believe price-level disturbances to be.

Observing that the optimal design of an inflation target depends on the costs of inflation is, in principle, straightforward. But, in practice, economists have found measuring the costs of inflation an elusive task. The recent survey by Shiller (1996) on 'Why Do People Dislike Inflation?' is a telling diagnostic. While the survey found that the public were indeed strongly inflation averse, the primary reason for this aversion was inflation's perceived effect on real wages over time. That is not a welfare cost which monetary economists – with their predisposition towards dealing in deadweight-loss triangles – have much discussed.

Much has, of course, already been written on the *theoretical* foundations of the costs of inflation. Fischer and Modigliani (1975) is a classic treatment; see also Driffill, Mizon and Ulph (1990), Fischer (1981) and Briault (1995) for surveys. But there is much less work of an *empirical* nature quantifying these benefits and leveling likely costs against them. This paper could not hope to provide an all-embracing empirical account of the costs of inflation and their interaction with the design of inflation targets. So instead it focuses on just three of the operational questions raised at the outset: issue (a) – the optimal level of an inflation target; issue (c) – the horizon at which to target inflation; and issue (g) – the effects of greater central bank transparency. Sections 2–4 discuss each of these in turn.

In fact, resolving these three issues takes us a long way – perhaps all the way – towards specifying fully an optimal inflation-targeting framework. To see this, think of the generic form of the feedback rule under an inflation target,

$$\Delta i_t = \gamma(E_t\pi_{t+j} - \pi^*) \qquad (1)$$

where i_t is the policy instrument, π_{t+j} is inflation at time $t+j$, E_t is the expectations operator conditional on information at time t and earlier, π^* is the inflation target, and γ is a positive feedback coefficient. Such a feedback rule encapsulates quite neatly the operational practice of most inflation targeters. A conditional inflation forecast serves as the intermediate or feedback variable. And the deviation between this feedback variable and the inflation target dictates the necessary degree of instrument adjustment. There is, in effect, *inflation-forecast targeting* (Haldane 1997; Svensson 1997).

But, as defined in Equation (1), the rule is not operational; it is underspecified in several important respects. First, there is a choice to be made about π^* – the optimal level of the inflation target, issue (a). Second, there is the choice of an appropriate targeting horizon – the value of j in the feedback variable π_{t+j}, issue (c).[2] And third, there is the

2. King (1996) defines an inflation-targeting reaction function in almost identical terms, comprising two components: a steady-state nominal anchor (the choice of π^*); and an optimal short-run path for output and inflation (which is equivalent to choosing j in the feedback variable $E_t\pi_{t+j}$). The choice of j may itself be state-contingent.

whole question of what lies behind E_t – which goes to the issue of the need for a degree of transparency to ensure the feedback rule, Equation (1), is verifiable and monitorable, issue (g).[3]

Each of these design issues is discussed here in turn. Each issue is shown to depend on both 'taste' and 'technology' parameters. And each raises some issues which, as yet, remain largely unresolved among macroeconomists. Below we try to summon together some of the evidence on these issues – both what we do know from existing research and, as important, what we might seek to understand from future research. Section 5 briefly concludes.

2. The Optimal Level of an Inflation Target

There are a number of issues which bear upon the question of the optimal level for an inflation target – the choice of π^*. These are reviewed by, among others, Fischer (1994) and Yates (1995). Some of these issues are purely technical ('technology' issues); while others raise deeper-seated welfare-theoretic questions ('taste' issues). We discuss each in turn.

2.1 Measurement biases

Perhaps the major technical issue relates to measurement biases in published price indices. That measurement problem is endemic in monetary policy-making and is not at all specific to inflation targeting. After all, even the Bundesbank defines some medium-term inflation norm when formulating its monetary targets. Measurement bias is also an issue which has recently risen to prominence in policy circles following the report of the Boskin Commission (1996) in the United States. This concluded, among other things, that the bias in the US CPI was centred around 1.1 per cent per year.

Given the uncertainties attaching to bias estimates, a more meaningful metric of the likely measurement problem is provided by looking at ranges for bias – as do Crawford (1994) for Canada and Cunningham (1996) for the United Kingdom. Better still, we might calibrate the full probability distribution of likely measurement biases – as do Shapiro and Wilcox (1996) for the United States. Shapiro and Wilcox conclude that: 'there is a 10 per cent chance that the bias [in the United States] is less than 0.6 per cent points and a 10 per cent chance that it is greater than 1.5 per cent points per year'. That conclusion accords, broadly speaking, with Canadian and United Kingdom evidence, where the ranges for bias lie at or slightly below 1 per cent point (Crawford 1994; Lebow, Roberts and Stockton 1992; Cunningham 1996).[4]

If we believe these estimates, then measurement problems with existing price indices are non-trivial but not enormous. But that still leaves unresolved a larger, and more

3. A fourth issue – the choice of a feedback parameter γ – is not discussed, as this has a direct equivalence with the optimal targeting-horizon issue (the choice of j): that is, higher j (for given γ) is equivalent to smaller γ (for given j).

4. These ranges are typically lower than in the US because, at present, price index weights in the US are only revised every ten years. This makes US consumer price indices more susceptible to outlet and substitution biases. For this reason, one of the recommendations of the Boskin Commission was to shorten the interval between revising price index weights in the US.

important, conceptual question: whether existing price indices are meant simply to capture the acquisition cost of goods and services; or whether instead they are aiming to measure the cost of a constant-utility flow of services from these goods (a Hicksian price concept). The Boskin Commission called the latter a 'cost of living' index.

Existing statistical practice points firmly towards the former approach, despite the adjustments that statistical agencies routinely make for quality and new goods biases. The reasons for this are certainly pragmatic, for it is clear that the Hicksian price concept raises formidable statistical hurdles. To take a limiting example, consumption baskets now and in the last century are simply incomparable in utility terms given their radically different composition. It is difficult to think that any 'new good' or 'quality' bias adjustments could ever reconcile these two baskets. 'Shall I compare thee to a bushel of wheat?'

Indeed, consumption-basket comparisons may be equally problematic over much shorter timeframes. For example, Shapiro and Wilcox (1996) give the example of cataract operations between 1969–93. On conventional measures, the price of these has risen tenfold over the period. But, hedonically adjusted, they find that the 'true' price has only risen by a factor of around three. Equally stark examples are provided by Nordhaus (1994) – in the context of the price of lighting – Cutler *et al.* (1996) – in the context of heart-attack treatment – and Hausman (1997) – using the example of cellular telephones.

But which of these price concepts is the one relevant to the policy-maker? Policy-makers are interested in price indices precisely because of the welfare losses induced by disturbances to this index. But to isolate these welfare effects, we need a measuring rod for prices which partials out utility changes induced from other sources – for example, those resulting from a changing composition or quality of the underlying consumption basket. That calls for a price index constructed along Hicksian lines, despite the practical difficulties this may raise. Indeed, this was precisely the conclusion of the Boskin Commission, which argued for the construction of a 'cost of living' index in the United States.

The above discussion highlights three points. First, some progress has recently been made towards quantifying CPI measurement biases. These are typically found to centre around 1 per cent per year – though there are considerable uncertainties either side of this mode, especially on the upside. Second, even these adjustments may well still leave us some way short of a price index suitable for policy analysis. Measurement biases cannot meaningfully be separated from behavioural considerations – the statistics from the economics. So, third, that calls for a closer interface between statisticians and economists if monetary policy is in future to be meaningfully calibrated.

It is telling that some of the early classic texts in monetary economics – for example, Fisher's (1911) *The Purchasing Power of Money* and Keynes' (1923) *Tract on Monetary Reform* – devoted at least one chapter to index-number theory and its application to price measurement. Such theory is rarely mentioned in modern monetary economics textbooks. The one area where index-number theory and micro-optimising behaviour has been extensively used is in the construction of Divisia monetary aggregates (Barnett 1980). Some of that same theory might usefully be applied in an inflation context.

2.2 Some cost-benefit calculus

The other factors affecting the optimal level for an inflation target relate more to (inflation) tastes than to (inflation) technology. As a practical matter, the trade-off here is between, on the one hand, the welfare costs of operating at an inflation rate different than the first-best, and, on the other, the disinflationary costs of moving to this first-best. The optimal level of an inflation target is given by the equation of these marginal costs and benefits. There are many such welfare costs and benefits. Here we review some of the more important of them.

But we first need a baseline rate of inflation around which to conduct this counterfactual experiment. Average inflation among the G7 is currently around 2–3 per cent. That is also in line with Australia's 'thick point' inflation target of 2–3 per cent (Debelle and Stevens 1995) and with the inflation targets set by most other countries, including the UK's 2.5 per cent point target. With measurement bias of around 1 per cent point, that leaves disinflation equal to around 2 per cent points to achieve price-stability – zero inflation – as commonly defined. This is the counterfactual question we pose: is it worthwhile lowering inflation targets by 2 per cent points?[5] We are ruling out the Friedman first-best – of deflation equal to the real rate of interest – on practical grounds. For no country is this a practical option at present.[6]

One general point is worth making on the costs and benefits of a 2 per cent point disinflationary transition. While disinflationary costs are commonly judged to be *static* (or transient), the benefits of lower inflation are likely to be *dynamic* (or permanent). The dynamic benefit is the permanent rise in the level or growth rate of GDP resulting from the move to a lower steady-state inflation rate (denoted B below, and expressed as a per cent of initial GDP). The static cost is the short-run output loss from disinflationary transition (denoted C below, again as a per cent of initial GDP), under the assumption of long-run monetary-policy neutrality. The optimal inflation rate is given by the equation of these marginal costs and benefits,

$$C = B/(r - g) \tag{2}$$

where r is the discount rate and g is the steady-state growth rate of the economy. The RHS of Equation (2) simply measures the discounted present value of the period-by-period welfare benefit from lower inflation. The welfare benefits of future generations are discounted at a rate r.[7] The growth term captures the fact that the GDP base on which the welfare benefits are calculated will grow over time (Feldstein 1979). As a back-of-the-envelope calculation, note that with r=5 per cent and g=2.5 per cent – plausible-enough estimates – even B=0.5 per cent of GDP will generate a steady-state welfare gain of 20 per cent of initial GDP. This is a huge sum.

5. This experiment is in line with that recently conducted by Feldstein (1996) for the United States.
6. Though below we discuss some evidence on the welfare benefits of operating at the Friedman optimum and the costs of deflation.
7. A practice which Ramsey (1928) described as 'ethically indefensible'. Without such discounting, the welfare gains would, trivially, be infinite.

Of course, there are considerable uncertainties surrounding such estimates. They are, for example, acutely sensitive to the choice of discount rate, about which it is difficult to make objective inferences. But 5 per cent is probably on the high side if we hold store by the existing microeconomic evidence. For example, we can back-out a discount rate from the representative consumer's utility function, by equating it with the marginal rate of substitution of consumption over time. Assuming CES preferences and an elasticity of marginal utility of 2, Feldstein (1995) arrives at a discount rate of 1.5 per cent in the US. By this metric, the present value of any positive *B* implies a potentially infinite welfare gain. But uncertainties also attach to *B* and *C* which might alter radically such simple calculus – and we now turn to those.

2.3 Measuring the costs of inflation

What existing empirical evidence is there on the costs of operating at 2 per cent inflation rather than price stability? Aggregate reduced-form evidence is instructive. A number of authors have looked at the potential effects of inflation on *growth*. But the evidence is decisively negative at the levels of inflation currently prevailing in developed countries. For example, in a cross-section study of over 100 countries, Barro (1995) finds little relationship between inflation and growth at rates of inflation below 10 per cent.[8] Likewise, Sarel (1996) finds no evidence of inflation inhibiting growth at rates of inflation below 8 per cent.[9] Taken together, there is little from this aggregate evidence to strongly support a move from single-digit inflation figures to price stability. Perhaps that is not altogether surprising, since theoretical models can yield conflicting conclusions regarding the effects of low and steady inflation on growth (Orphanides and Solow 1990).

But this evidence does not negate an effect of inflation on the *level* of GDP. In this respect, a number of recent studies have found encouraging results. Almost without exception, these studies have focused on the effects of fully *anticipated* inflation. Following Bailey (1956), this has the merit of allowing welfare experiments to be conducted: that is, Harberger deadweight-loss triangles are identified and quantified. For example, in a recent well-publicised paper, Feldstein (1996) calculates the benefits of a 2 per cent point disinflation in the US, operating through various tax-induced distortions to private-sector decision-making: to consumption behaviour; to residential investment; to money demand; and to debt servicing. He estimates this welfare benefit to be as much as 0.7 per cent of GDP in perpetuity in the US.[10]

Some equivalent studies have been conducted for Germany, Spain and the United Kingdom. These yield ggregate welfare benefits, when compared on a like-for-like basis, of around 0.85 per cent, 1.47 per cent and 0.21 per cent of GDP respectively. Table 1 provides a summary and decomposition of these results.

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8. Judson and Orphanides (1996) reach an identical conclusion – although both find decisive evidence of an adverse effect of inflation on growth at rates of inflation above 10 per cent.
9. See also Fischer (1993) and Smyth (1994) for cross-section evidence on inflation-growth correlations.
10. Assuming an interest elasticity of saving of zero. Feldstein (1996) assumes a higher saving elasticity as his main case and hence arrives at higher welfare benefits of around 1 per cent of GDP.

Table 1: Tax/Inflation-induced Welfare Distortions

	US[(a)]	UK[(b)]	Germany[(c)]	Spain[(d)]
Consumption[(e)]	0.57	0.21	0.92	0.55
Housing	0.25	0.11	0.09	1.09
Money demand	-0.03	-0.02	-0.04	-0.07
Debt servicing	-0.10	-0.09	-0.12	-0.10
Total	**0.68**	**0.21**	**0.85**	**1.47**

Notes: (a) Taken from Feldstein (1996).
(b) Taken from Bakhshi, Haldane and Hatch (1997).
(c) Taken from Todter and Ziebarth (1997).
(d) Taken from Dolado, Gonzalez-Paramo and Vinals (1997).
(e) Assuming a zero-interest elasticity of saving. For Germany, where no zero-interest elasticity case is given, we have scaled down the estimates in line with Feldstein (1996). All of these benefits are calculated with a deadweight-loss parameter of around 0.4.

These estimates clearly vary quite widely, reflecting idiosyncracies in national tax systems. Further, the implication of these studies is that the implied welfare gains could just as well (at least in principle) be brought about by adjusting tax policy, rather than monetary policy. But that said, all point to non-trivial GDP-equivalent welfare gains. With B lying between 0.2 and 1.5, then the present value of any welfare gain is between 10 per cent and 60 per cent of initial GDP, assuming r=5 per cent and g=2.5 per cent.

Feldstein's estimates look reasonably robust if we calibrate welfare benefits using a general, rather than partial, equilibrium model (Abel 1996). And recently there has been a number of other general equilibrium analyses of the welfare costs of inflation. These have tended to focus on the distorting effects of the inflation tax on money holdings. But they go beyond Bailey's (1956) original analysis to consider interactions with other private-sector decisions. Lucas (1995), for example, presents theoretical evidence to support a logarithmically specified money-demand function. This has the effect of raising greatly estimated 'shoe leather' welfare benefits – by Lucas' reckoning to as much as 1 per cent of GDP for a 10 per cent point disinflation.

Three factors call into question the plausibility of such an estimate. First, a very significant part of this welfare gain accrues not during the transition to price stability, but in the transition from price stability to the Friedman first-best of zero nominal interest rates. For example, based on a UK calibration over the period 1870–95, Chadha, Haldane and Janssen (1998) estimate that around three-quarters of the 1 per cent of GDP welfare gain comes when moving from zero to negative inflation rates. The same is true in the general-equilibrium analysis of Dotsey and Ireland (1996).[11]

11. For example, a fall in inflation from 4 per cent to 2 per cent in Dotsey and Ireland (1996) yields a welfare benefit of only 0.045 per cent of GDP (using currency as a metric and switching off the endogenous growth channel: Table 3). The corresponding gains when moving to the Friedman optimum are 0.24 per cent of GDP.

Second, following from this, we have no empirically observed money-demand interest elasticities at rates of inflation at or below zero, so it is difficult to infer the form of the money-demand function around price stability. Mulligan and Sala-i-Martin (1996) attempt to obviate this problem by examining cross-sectional evidence on household money-demand functions. They infer, conversely, that money demand is actually rather interest-inelastic at low levels of nominal interest rates. The reason is that, at low interest rates, the small amount of interest income foregone reduces the incentive to substitute into interest-bearing alternative assets.

Finally, Lucas' (1995) estimates make no allowance for offsetting revenue effects (Phelps 1972). An interesting counterpoint is provided by two papers by Cooley and Hansen (1989, 1991). Both develop general-equilibrium models in an attempt to measure the welfare-distorting impact of the inflation tax. The earlier paper (Cooley and Hansen 1989) finds a significant distortionary impact. But once taxes are admitted (as in Cooley and Hansen 1991) this welfare gain is sacrificed entirely. Taken together, none of these general-equilibrium models would lead us to expect a significant additional welfare benefit arising from the inflation tax on money balances when moving from low positive inflation rates to price stability.

Some more recent studies have begun to quantify a wider set of welfare losses arising from the inflation tax than shoe-leather costs. For example, the Cooley and Hansen (1989, 1991) papers allow for explicit labour/leisure trade-offs, with lower inflation reducing the tax on consumption goods, and hence inducing increased labour supply and higher incomes. Further, because investment is deferred consumption, and because inflation acts as a tax on consumption, lower inflation also increases investment and the capital stock in this set-up. Dotsey and Ireland (1996) present a model in which lower inflation induces an employment redistribution away from (constant returns-to-scale) financial intermediation and towards (increasing returns-to-scale) production industries. So lower inflation, via an endogenous growth channel, can boost an economy's trend growth rate. This, in turn, has profound welfare implications. For example, in Dotsey and Ireland moving from price stability to the Friedman rule increases trend growth by as much as 0.2 per cent points, with a corresponding welfare gain of over 2 per cent points of GDP per year.[12]

In a similar spirit, English (1996) looks at the effects of inflation on financial-sector size in a cross-section of countries. He finds, on average, that each 10 per cent point rise in inflation raises the share of the financial sector in GDP by $1\frac{1}{2}$ per cent. This is a direct measure of the resources lost as a result of inflation. But again such a finding, like those of Cooley and Hansen (1989) and Dotsey and Ireland (1996), would seem to be more relevant during the transition to low and stable inflation rates, than to when such rates have already been achieved. For example, English notes that the inflation/financial-sector-size relationship disappears once the six-highest inflation countries are removed from his panel. So while these studies highlight behaviourally important welfare costs, it is difficult to believe they would add more than a few basis points to our estimate of B.

All of the above studies, of course, aim to quantify the costs of a fully *anticipated* inflation. What of the likely costs of unanticipated inflation? There seems to be a relative

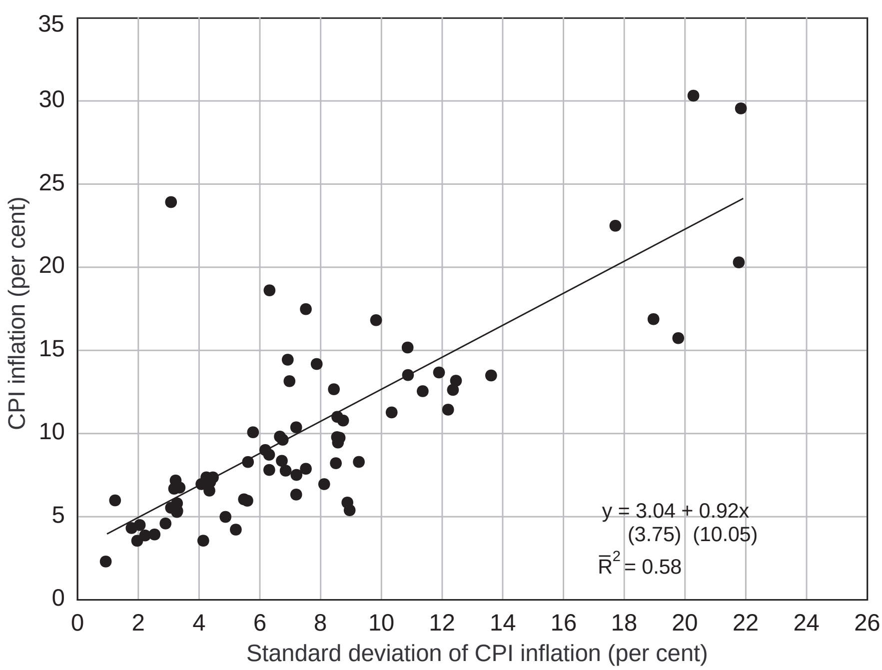
12. Using an M1 specification for money.

dearth of empirical evidence on these costs – or at least evidence which is well grounded in welfare economics. But it is the logical next step when assessing the welfare costs of inflation, given policy-makers' concern with stable prices rather than low average inflation *per se*. It would also be consistent with the evidence we have from the general public. Shiller's (1996) survey suggests that the largest perceived costs of inflation derive from inflation's adverse effect on real wages – historically the result of inflation 'surprises' and uncertainties.

Some stylised facts on inflation uncertainties are, however, illuminating. Figure 1 plots the mean and standard deviation of inflation in around 60 low-to-moderate inflation countries, averaged over the period 1965–95. It fits a line of best fit through this mean/variability relationship. As numerous time-series studies have shown, the mean/variance inflation relationship is clearly positive, statistically significant and proximately one-for-one. To map reduced inflation variability into welfare, we might think of using the results of Judson and Orphanides (1996). They find a strong cross-country relationship between inflation variability and growth, distinct from any effect from the level of inflation on growth. What is particularly striking is that they find – unlike with the inflation-growth relationship – that this link exists even among low-inflation countries (those with inflation below 10 per cent per year.) For these low-inflation countries, Judson and Orphanides find that a halving of the volatility of inflation might raise growth by as much as one quarter of one percentage point.

Given Figure 1, it is difficult to imagine that a halving of the volatility of inflation is feasible when moving from, say, 2–3 per cent inflation to price stability. There must, for

Figure 1: Mean and Variability of Inflation



example, be some minimum amount of inflation variability which is undiversifiable – and, indeed, desirable. But if the Judson/Orphanides ready-reckoners are even proximately correct, then reduced price variability could boost dramatically the welfare gains from a move to price stability. Even if lower inflation volatility has only a minuscule effect on growth, we would conclude that a move to price stability was unambiguously Pareto-improving – provided disinflation itself does not affect the economy's trend growth rate.

2.4 Measuring the costs of disinflation

These gross welfare benefits are only one side of the ledger. What of the costs? Almost all central bankers and most macroeconomists would believe such costs are transient; that the long-run Phillips curve is vertical. Taking money neutrality as read for the moment, we can infer disinflationary costs – the sacrifice ratio – either directly from a time-series estimated Phillips curve, or indirectly from an event study of disinflations (Ball 1994; Andersen 1992). Both, in their different ways, attempt to partial out supply shocks. And neither typically gives answers which are radically different. As a benchmark, we take Ball's (1994) average sacrifice-ratio estimates for Germany and the United States – the two countries whose past inflation performance has been closest to 2–3 per cent on average. This gives a sacrifice ratio of around 2–3 per cent: each percentage point of disinflation has, on average, been associated with a cumulative output loss (relative to trend) of around 2–3 per cent.

For plausible discount and growth rates, such transient losses (C) would almost certainly fail to counterbalance the permanent gains (B) outlined in the previous section. For example, the break-even welfare benefit necessary to counterbalance disinflationary costs of around 5 per cent points (2.5 per cent of output loss for each percentage point of inflation reduction) is around 0.125 per cent of GDP.[13] That is well below even the tax-induced welfare distortions outlined in Table 1 – before we even begin to consider the other welfare benefits of reducing anticipated and unanticipated inflation. So on the basis of this simple cost-benefit calculus, we would conclude that a shift to price stability – an inflation target of zero – was of clear net welfare benefit.

But uncertainties necessarily attach to estimates of disinflationary costs, C. Perhaps the biggest problem with existing sacrifice-ratio estimates is that they are drawn from prior – and therefore very different – monetary regimes. If expectational behaviour changes with regime, then so too will sacrifice-ratio estimates based around expectational Phillips curves. In particular, there are three reasons – in increasing order of potential importance – why historically estimated sacrifice ratios may *understate* the transitional output costs of disinflation.

2.4.1 Summers effects

This refers to the non-negativity constraint on nominal interest rates which, when zero inflation is targeted, in turn places a non-negativity constraint on real interest rates (Summers 1989). This constraint may then damp the ability of monetary policy to

13. Assuming the same values of r and g as earlier.

conduct effective stabilisation policy around price stability in the face of shocks, thereby raising output variability.

This Summers constraint will clearly bind more tightly, the closer is an inflation target to zero. But it is difficult to believe the cost would be punitive. Below-equilibrium (rather than negative) real interest rates ought to be sufficient to deliver output stabilisation in the face of the vast majority of shocks – the US experience in the early 1990s being perhaps a good example. And what little empirical work there is on this issue also finds this to be the case (Fuhrer and Madigan 1994).[14] Even in the face of large deflationary shocks, fiscal policy can always step into the breach – as has been the case recently in Japan.

2.4.2 Convex Phillips curves

A voluminous literature has recently emerged testing for Phillips-curve convexities – implying higher disinflationary output costs, the lower is inflation. These have been tested in many ways: using time series (*inter alia*, Clark, Laxton and Rose 1995; Laxton, Meredith and Rose 1995; Debelle and Laxton 1996); using cross-country data (Ball, Mankiw and Romer 1988); and using event studies (Ball 1994). Taken together, the evidence is broadly – though by no means overwhelmingly – supportive of some degree of Phillips-curve convexity in some countries.

One possible explanation of such convexities is downward nominal wage and price rigidities.[15] There are several strands of evidence here, summarised in Yates (1997). One has looked at the effects of inflation on the distribution of wages and prices. Under the null of downward rigidities, the skewness of the wage/price distribution ought to be decreasing in inflation. Aggregate wage and price data have generally rejected this null: for example, Lebow *et al.* (1992) in the US; Crawford and Dupasquier (1994) in Canada; Rae (1993) in New Zealand; and Hall and Yates (1997) in the UK. But disaggregated data for the US – Card and Hyslop (1996) and Groschen and Schweitzer (1997) – have been more supportive. Another strand of the literature has looked explicitly at the incidence of nominal wages cuts. Here the evidence is more conclusive. For example, Akerlof, Dickens and Perry (1996) argue that nominal wage cuts in the US are very rare, based on panel data and survey evidence. And the same seems to be true in the United Kingdom (Yates 1997).

But there are reasons why even these findings may not close the case on downward nominal rigidities. For example, because of trend productivity growth, *real* wage adjustment – and hence factor reallocation – can still be effectively brought about even without *nominal* wage cuts. And, perhaps most important, all of the above tests are subject to a significant Lucas critique: the absence of any data drawn from a regime approximating zero inflation.

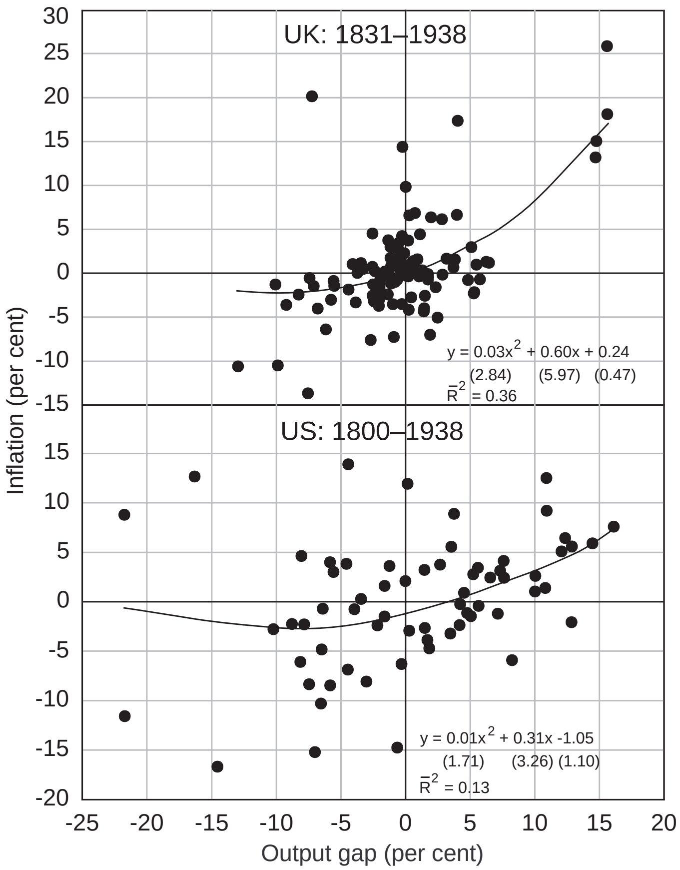
Using pre–Second World War data, during which time the monetary regime better approximated price stability, takes us some way towards countering this critique.

14. Indeed, it is arguable whether *ex ante* real interest rates can really ever be negative, without some extreme restrictions being placed on agents' utility functions.

15. Others include time-dependent pricing rules, as in Ball, Mankiw and Romer (1988).

Figure 2 plots some Phillips curves for the United States (over the period 1800–1938) and the United Kingdom (over the period 1831–1938). GDP deflator inflation is plotted on the *y* axis; and a measure of the output gap on the *x* axis, with trend output estimated using a Hodrick-Prescott filter.[16] The data have been crudely purged of supply shocks by excluding observations where the change in the output gap and price level in any given year was of the opposite sign. A second-order polynomial line of best fit is fitted through the data.

Figure 2: Phillips Curves



Two features are evident from Figure 2. First, the estimated Phillips curves are fairly flat when averaged around a regime approximating price stability. And second, more importantly, while there is evidence of some degree of convexity in these curves, it is still not that substantial. Although the output costs of disinflating increase as inflation falls, the increase is reasonably small. For example, the average implied sacrifice ratios for the UK and US from Figure 2 are between 1.5 and 3. This is not very different to the

16. With the smoothing parameter set equal to 1 600. This section draws on on-going work with Tony Yates.

benchmark estimates used above. Such a conclusion is very much in keeping with the comments by Gordon (1996) on Akerlof *et al.* (1996), who refers back to the pre-Civil War period in the United States as an example of falling prices not being associated with subdued growth. So in sum, while Phillips-curve convexities might marginally increase disinflationary costs, this by itself still seems unlikely to offset the permanent welfare benefits outlined above. Our calculus so far would suggest that the optimal inflation target remains around zero.

2.4.3 Money non-neutralities

The third and far-and-away potentially the most important issue concerning possible understatement of existing sacrifice-ratio estimates is when there are significant hysteresis effects: if disinflation is capable of lowering on a *permanent* (or at least very persistent) basis the equilibrium level of GDP in the economy. That alters the cost-benefit calculus thus,

$$C = (B - D)/(r - g) \tag{3}$$

where D is the effect of a 1 per cent point disinflation on the natural level of output.

In general, empirical evidence on hysteresis effects is equivocal. But several recent papers have brought the issue into sharper focus. Ball (1996a) conducts a cross-section study of the effects of disinflation on the NAIRU in 20 OECD countries. Taking these estimates at face value, each percentage point of disinflation is associated with a 0.42 per cent point rise in the NAIRU; or, using an Okun coefficient of 2, with a 0.8 per cent fall in the level of output (D=0.8). That would almost certainly be enough to counterbalance the benefits of lower inflation outlined above.

The model presented in Akerlof *et al*. delivers an even higher hysteresis ready-reckoner for disinflations which are engineered close to price stability. Their simulations suggest that a move from 3 per cent inflation to price stability would raise the unemployment rate by around 2.1 per cent points – that is, 0.7 per cent points are added to the NAIRU for each percentage point of disinflation (an output loss of, say, 1.4 per cent). In the Akerlof *et al.* model, such hysteresis effects are particularly acute around price-stability because of nominal-wage rigidities. If such results were even moderately robust, then disinflationary costs would dwarf potential welfare gains.

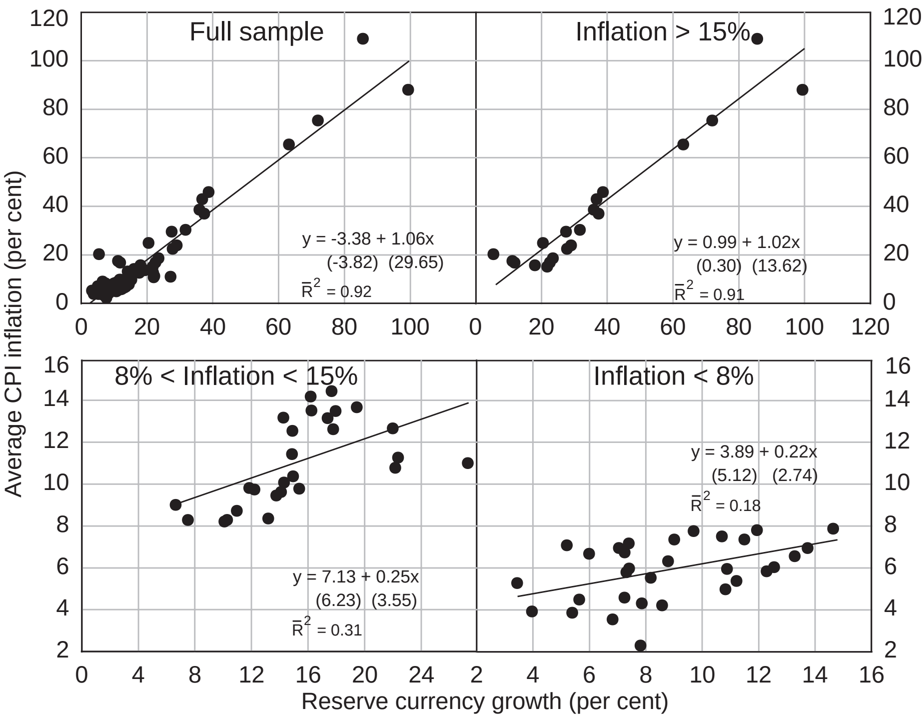
So is there an empirical counterweight to these studies suggesting potentially significant monetary non-neutralities? Lucas' (1996) Nobel Lecture contained some stark cross-country evidence supporting long-run money neutrality. This drew on prior work by McCandless and Weber (1995), looking at average inflation and money growth rates – on an M2 definition – in 110 countries over a thirty-year period. On the basis of this, McCandless and Weber construct a figure which is virtually identical to the first panel in Figure 3. This uses similar data only for a smaller sample of around 80 countries.[17] A linear regression line is fitted through the scatter. The relationship is

17. Also, for some of these countries the data sample is not as long as 30 years. We reach identical conclusions to those below if we use a broad (M2) measure of money instead of reserve currency. This section draws on joint work with Norbert Janssen and Glenn Hoggarth.

clearly positive and significant; in fact, it is insignificantly different from a 45° line.[18] *Prima facie*, this is strong evidence to support long-run money neutrality. Lucas observes: 'The kind of monetary neutrality shown in this figure needs to be a central feature of any monetary or macroeconomic theory that claims empirical seriousness'. That might be construed as an effective refutation of the potential importance of hysteresis effects.

Or is it? The first panel of Figure 3 contains countries whose average inflation rates are much above the levels relevant to present-day inflation targeters. It is instructive, then, to stratify the sample by inflation regime. We employ a three-way split into 'high', 'medium' and 'low' average inflation countries. The 'high' countries are those with average inflation in excess of 15 per cent – for example, Venezuela and Paraguay in our sample. The 'medium' bloc is those countries where average inflation lies between 8 per cent and 15 per cent – such as India and Greece. And the 'low' countries are those with average inflation below 8 per cent – such as Australia and the United States. The split is somewhat arbitrary and means that even the low-inflation bloc has average inflation above the rates currently prevailing in the G7. But the decomposition gives us a broadly equal number of countries in each bloc and allows us to draw some illustrative conclusions.

Figure 3: Money and Inflation Correlations



18. The constant in the regression is insignificantly different from zero and the slope is insignificantly different from unity.

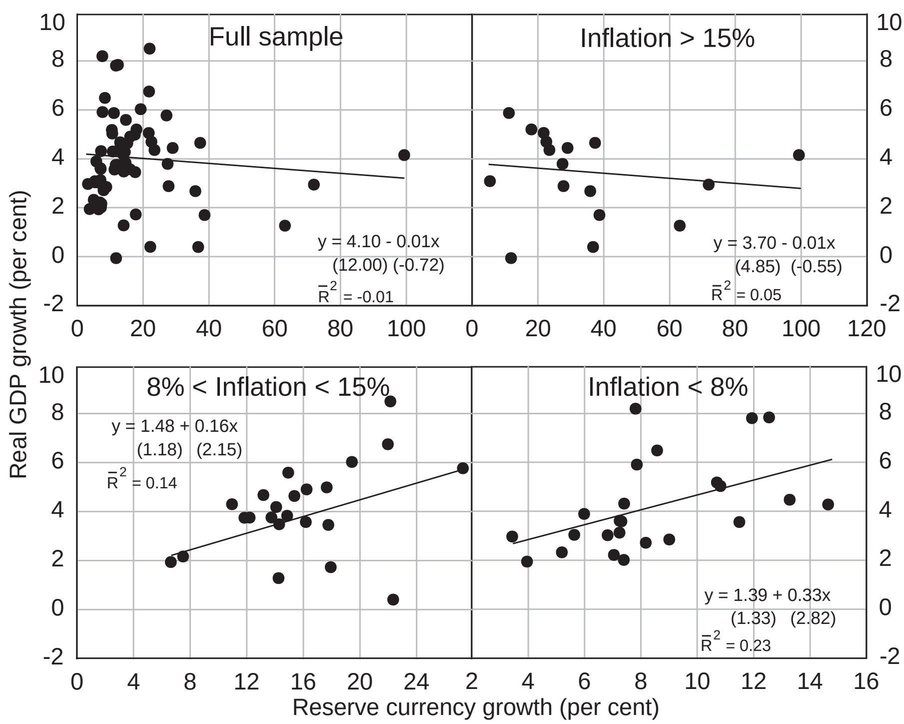
The second, third and fourth panels of Figure 3 repeat the correlation analysis from the first panel for each of these three country blocs. For the high-inflation countries, the picture is virtually identical to that when using the full sample of countries. The regression coefficient is insignificantly different from one, offering strong support for money neutrality. But the pattern changes – to an ever-greater degree – when we look at the medium- and low-inflation countries. For example, from Figure 3, a 1 per cent point rise in average money growth in the low-inflation countries is associated with a rise in inflation of only around 0.2 per cent points.

How do we account for this apparent non-neutrality? From the quantity equation,

$$\partial\pi/\partial m = 1 + \partial v/\partial m - \partial y/\partial m \tag{4}$$

where π is inflation, m is money growth, v is velocity growth and y is real output growth. So $\partial\pi/\partial m<1$, as was found empirically, could plausibly be the result of the effect of average money growth on velocity ($\partial v/\partial m<0$) rather than on real output ($\partial y/\partial m>0$). Observed correlations refute that explanation. Figure 4 plots average money growth against average real GDP growth for our full sample of countries and for the three inflation blocs. Again, for the full sample – as in Lucas (1996) – and for the high-inflation bloc, there is no statistically significant correlation between average money growth and real growth. But that conclusion breaks down for the medium- and low-inflation countries. For example, a 1 per cent point rise in money growth among low-inflation countries is on average associated with a 0.3 per cent rise in average real GDP growth.

Figure 4: Money and Growth Correlations



Of course, these are just time-averaged cross-country correlations. So we can infer little of a causal nature from them. One plausible explanation of these findings is, for example, that a third variable – financial development – is driving all the variables in the system. That would account for the simultaneous occurrence of low inflation (because of improved monetary and fiscal policy-setting), rising velocity (because of substitution into alternative near-money assets) and low growth (because of growth convergence). But another is that there are some monetary non-neutralities evident in economic systems as they approach low inflation rates. If the latter conclusion has any weight whatsoever – were lower inflation to reduce trend output growth – it would sweep away all of the welfare benefits of lower inflation highlighted earlier. It would justify sticking with inflation targets at around current levels. For that reason, it probably deserves further research.

3. The Choice of Targeting Horizon

3.1 Inflation-forecast targeting

At what horizon should inflation be targeted? From Equation (1), that is an issue which inflation-targeting countries cannot duck if they are to have a well-defined feedback variable, $E_t\pi_{t+j}$. The horizon problem raises two further, logically distinct, questions.

The *first* is the periodicity of inflation which the authorities should monitor and feedback from – for example, monthly, quarterly, annually, or perhaps longer horizons.[19] To date, few central banks have made much of this periodicity point, most preferring either to leave the inflation horizon opaque or simply to express the inflation rate as an annual change. But the issues it raises are rudimentary to the design of inflation targets. And, again, resolving the periodicity question cannot be easily detached from the welfare costs of inflation; it turns ultimately on whether it is high- or low-frequency inflationary disturbances which are the more welfare-depleting.

In fact, the self-same issues arise here as when dealing, *inter alia*, with CPI exemptions. For example, the typical kinds of exemption from CPI consumption baskets are volatile items – such as food and energy prices in Canada – and one-off price-level shifts associated with discernible supply shocks, such as 'significant' terms-of-trade changes in New Zealand. The macroeconomic reasons for these exclusions are well-known.

But what of the potential costs? For example, it could be that the very reason agents dislike inflation is because of volatility in the prices of everyday goods in the shops – food, utility prices *etc*. Were that the case, it would argue persuasively against their exclusion from targeted price indices. Further, there is support from Shiller's (1996) survey for the idea that agents would prefer a fixed price *level*, rather than inflation rate. When asked whether a price-level shift ought to be reversed, only 10 per cent of respondents in the US believed that it should not. Fascinatingly, virtually all economists, when asked this question, thought that price-level drift ought to be accommodated.

19. The inflation term in Equation (1) is best thought of as an instantaneous rate. Were it a longer-horizon inflation rate, that would justify lengthening *j*.

Nowhere in Shiller's survey were the differences between the views of the general public and those of economists more acute. If we take the public's views seriously, then the choice of inflation periodicity or of CPI exemptions or of price-level versus inflation targets goes well beyond the narrowly technical – beyond even the macroeconomics textbook. It takes us right back, in fact, to the welfare costs of inflation.

The *second* – more operational – issue is just how forward-looking monetary policy needs in practice to be: what is the optimal targeting horizon *j* for the feedback variable in Equation (1)? The need for an explicitly forward-looking dimension to monetary policy is now widely accepted. Kohn (1995) of the Federal Reserve Board recently commented that 'policy-makers cannot avoid looking into the future'. And even though such a forward-looking approach may only recently have found expression in the explicit design of monetary-policy frameworks, it has long been recognised by economists. In Keynes' (1923) *Tract on Monetary Reform* he observes: '...if we wait until a price movement is actually afoot before applying remedial measures, we may be too late'.

But what determines the *optimal* degree of policy forward-lookingness? This hinges, broadly speaking, on two factors: one 'technology' related – namely, the technical issue of the innate lags between the enactment of monetary-policy changes and their final effect on output and prices; and the other 'taste' related – namely, the relative weight the policy-maker places on output versus inflation variability. We consider these in turn.

3.2 The monetary-transmission lag

The lag between monetary-policy actions and their final effect on output and inflation has always been an area of considerable uncertainty. Following Friedman, these lags are not just 'long' but 'variable' too. But inflation-targeting central banks, operating according to (1), need necessarily to form a view of such lags. If it takes, say, one year before interest rates have any effect on inflation, then the central bank's inflation forecast needs to be formed *at least* one year ahead. In other words, the transmission lag places a strict *lower bound* on the optimal targeting horizon, *j*. This lower bound is dictated by simple technical feasibility. And it is clearly in central banks' interests to understand the limits of such a technical constraint.

There is a raft of empirical evidence addressing the transmission-lag question, much of it drawn from counterfactual VAR and macro-model simulations: for example, Sims (1994) for a selection of G7 countries. But the confidence intervals attaching to such simulations are known to be considerable. This raises two questions. First, does it much matter if we miscalculate the transmission lag when we set monetary policy? And second, what is the risk of such empirical mistakes occurring?

To gauge the potential effects of miscalculating the lag when setting monetary policy, consider a simple two-equation model of the economy,

$$\pi_t = E_t\pi_{t+1} + \psi\, y_{t-1} + u_t \tag{5}$$

and

$$y_t = -\beta(i_t - E_t\pi_{t+1}) \tag{6}$$

where y_t denotes real output, i_t the nominal interest rate, u_t a white-noise inflation shock and ψ and β are positive coefficients. Equation (5) is an expectational Phillips curve. Equation (6) is an aggregate-demand relation. For simplicity and without loss of generality we: (a) define (5) and (6) as deviations from equilibrium – that is, we partial out the natural rate of output from the RHS of (5) and the LHS of (6), and specify no 'core' rate of inflation in (5); (b) consider only one shock – coming from the supply side, u_t – but equally could have added aggregate-demand shocks to (6); and (c) normalise ψ to unity and omit any inflationary inertia in (5). So this is a standard aggregate-demand/aggregate-supply model. Note, crucially, that there is an explicit *one-period* lag in monetary transmission. Yesterday's output growth affects inflation today.[20]

First suppose that the monetary authorities estimate the lag correctly. Accordingly they follow the forward-looking inflation-target rule,[21]

$$i_t = \gamma(E_t\pi_{t+1} - \pi^*) \tag{7}$$

where the inflation projection is formed one period ahead – the horizon at which monetary policy affects inflation. The solution for inflation is then,

$$\pi_t = E_t\pi_{t+1} - \beta(\gamma - 1)E_{t-1}\pi_t + \beta\gamma\pi^* + u_t. \tag{8}$$

We solve this expectational difference equation using undetermined coefficients, by guessing a solution in the (minimum number of) predetermined state variables,

$$\pi_t = \phi_0 + \phi_1\pi_{t-1} + \phi_2 u_t. \tag{9}$$

We can run the expectations operator through Equation (9) to give us expressions for $E_t\pi_{t+1}$ and $E_{t-1}\pi_t$, giving us a set of undetermined coefficient constraints for ϕ_0, ϕ_1 and ϕ_2. For stability the key constraint is that associated with ϕ_1,

$$\phi_1 = \phi_1^2 - \beta(\gamma - 1)\phi_1. \tag{10}$$

This has two roots. Following McCallum (1983), we choose the root which rules out 'bubble' solutions – the value of Equation (10) for which $\phi_1 = 0$ whenever $\beta = 0$ – giving,

$$\phi_1 = [1 + \beta(\gamma - 1)]. \tag{11}$$

So provided appropriate restrictions are placed on the feedback coefficient ($\gamma > 1$), inflation will be stable and stationary ($\phi_1 < 1$).

Now suppose the authorities overestimate the lag, believing it to be two periods. The inflation-target rule is then

$$i_t = \gamma(E_t\pi_{t+2} - \pi^*) \tag{12}$$

which can be solved in an exactly analogous way to give a stability condition,

20. Svensson (1996) and Ball (1996b) add an extra lag to the IS curve and use an accelerationist Phillips curve with purely backward-looking expectations. But in all other respects their models are similar to the one used here.

21. This is different from Equation (1) in that, for simplicity, it is defined in levels rather than first-differences.

$$\phi_1 = (1-\beta)/(1-\beta\gamma). \tag{13}$$

This gives an identical stability restriction for inflation as in the case where the transmission lag is correctly inferred.

Finally, what if the transmission lag is underestimated by one period, giving a policy rule,

$$i_t = \gamma(\pi_t - \pi^*). \tag{14}$$

Solving as before, ruling out the 'bubble' root,

$$\phi_1 = \frac{1-\sqrt{(1+4\beta\gamma(1+\beta)^{-2})}}{2(1+\beta)^{-1}}. \tag{15}$$

Equation (15) tells us that ϕ_1 will be unambiguously negative and hence that inflation will be oscillatory. Underestimating the transmission lag will generate inflationary cycles – and the larger the feedback coefficient, γ, the larger the cycles. Indeed, at high values of γ, these oscillations could become explosive. So the message from these simple models is that underestimating the transmission lag is likely to have the more damaging impact on inflation control. It may lead to monetary policy generating cycles of its own. This really serves to underscore Kohn's comment – that monetary policy needs by necessity to have a forward-looking dimension if it is not itself to be a source of instability.

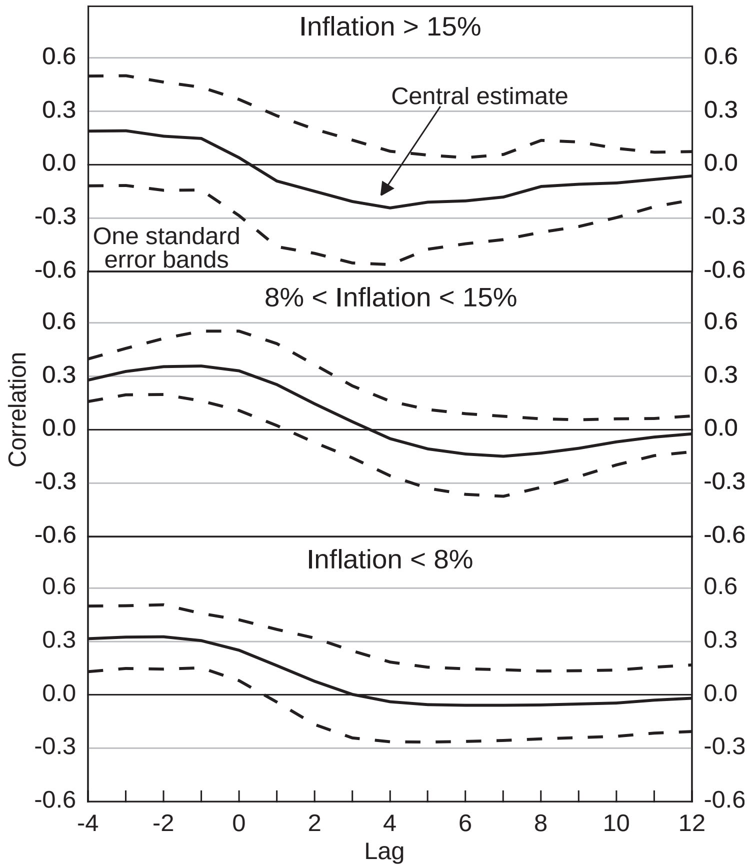
3.3 Some evidence on the lag

What evidence is there that such an underestimation of the transmission lag is likely? There are many reasons why we might be uncertain about the monetary-transmission lag. But perhaps the deepest-seated uncertainty is that existing evidence on transmission lags is drawn from the 1970s and 1980s – a very different, higher-inflation regime than the one operating today. Furthermore, there are theoretical grounds, and some anecdotal evidence, to suggest that the transmission lag is not invariant to such changes in inflation regime; it may well alter the lag.

Existing theory is ambiguous on the direction of this effect. On the one hand, low inflation might increase nominal rigidity in the economy and so lengthen (and deepen) the process by which monetary policy impacts on prices and output (Ball, Mankiw and Romer 1988). On the other, if lower inflation generates higher credibility, then expectational adjustment may well be quicker – and transmission lags will correspondingly be shorter. Anecdotal evidence, such as it is, seems to suggest the former effect may dominate. For example, a well-known stylised fact among high- or hyper-inflation countries is that transmission lags from money to prices are very short – often as little as months. And Friedman has commented that transmission lags were shorter in the 1970s than in preceding decades. If a low-inflation regime is likely to increase transmission lags, it increases the chances of underestimating the lag and hence disturbing inflation control.

Is there any formal evidence to support this anecdote? The *time-series* variation in inflation is, for most countries, insufficient to allow a meaningful comparison across different inflation regimes.[22] But *cross-country* variations in inflation are substantial enough to allow a comparison. Using the same set of countries as earlier – split into 'high', 'medium' and 'low' inflation blocs – Figure 5 plots the average correlation between short-term nominal interest rates and inflation in each of these country blocs at various leads and (in particular) lags measured in quarters.[23] The lead/lag is measured along the *x* axis, where a positive number indicates a relationship between *lagged* interest rates and inflation. The correlation coefficient is shown on the *y* axis. These correlations are averaged across each of the countries in each inflation bloc. Figure 5 also plots one standard-error bands around the mean, which are calculated as the cross-country standard deviation in the interest rate/inflation rate correlation at each lead/lag.

Figure 5: Interest Rate/Inflation Rate Correlations



22. And for those countries where we have long runs of data, we do not have the periodicity of data – quarterly or more frequently – necessary to allow us to differentiate meaningfully between transmission lags across different inflation regimes.

23. The analysis is no more than a first pass at the data: it looks at *unconditional* correlations, whereas ideally we would want to look at *conditional* correlations – the relationship between interest rate 'shocks' and inflation.

Several general features are evident from Figure 5:

- For each of the country blocs, the correlations generally indicate a *negative* relationship between inflation and lagged interest rates after a maximum of four quarters (and possibly sooner). This is as we would want if our correlations are to be interpreted as capturing the monetary-transmission lag, with higher interest rates depressing inflation over the short to medium run.
- The size and the timing of this negative relationship, however, varies quite markedly across inflation regimes. On *size*, interest rate/inflation rate correlations are much more negative for the high- than for the low- and medium-inflation bloc countries. For example, the average correlation between inflation and interest rates lagged one to two years is -0.2 for high-inflation countries; around -0.1 for moderate-inflation countries; and around -0.05 for low-inflation countries.
- That pattern is the mirror-image of the *output* response to an interest-rate rise in each of these countries (not shown in Figure 5). This is smallest for the high-inflation countries and becomes progressively larger as we move to the lower-inflation countries.
- On *timing*, the general pattern is that the inflation response takes longer, and is more protracted, the lower is the rate of inflation. For example, it takes only one quarter for the interest rate/inflation rate correlation to turn negative among the high-inflation bloc; and the largest negative correlation is found after around four quarters. For the moderate-inflation countries these lags are four quarters and seven quarters respectively; while for the low-inflation countries the lags are three quarters and eight quarters respectively.

We draw two conclusions from this. First, the observed responses in Figure 5 are consistent with a ‘nominal rigidity’ rather than a ‘credibility’ story. Monetary-policy changes appear to result, on average, in larger and more rapid responses from inflation, and more muted output effects, the higher is average inflation. Second, there is some evidence to support a lengthening transmission lag, the lower is average inflation. It could be that these effects are not sufficiently large to endanger monetary-policy setting. But without further data from a regime of price stability, caution is clearly appropriate.

3.4 Trading off output-inflation variability

Technical feasibility is one factor affecting the optimal targeting horizon, j. Another is the preferences of the authorities over output volatility on the one hand, and inflation variability on the other. This potential trade-off between output and inflation variability really goes to the heart of how best to conduct efficient stabilisation policy in the face of shocks. To see this, suppose there is an adverse supply shock, which pushes inflation above target and output below trend. How quickly the authorities then aim to return inflation to target – the choice of horizon for the feedback variable in Equation (1) – hinges on a trade-off. Faster disinflation – a shorter targeting horizon – reduces welfare losses deriving from inflation deviations from target. But it comes at the expense of a greater destabilisation of output in the short run. The obverse is true for slower disinflations. So the choice of targeting horizon (or speed of disinflation) can be thought of as an implicit trade-off between output and inflation variability.

These types of trade-off in the second moment of output and inflation have been popularised by the work of Taylor (1993). And the trade-offs themselves have been verified empirically using model simulations (Haldane and Salmon (1995) for the UK and Debelle and Stevens (1995) for Australia). What these studies typically find is evidence of a fairly malign trade-off, with very short or very long targeting horizons delivering extremely adverse output and inflation variability respectively. Such a trade-off is illustrated by the curve AA in Diagram 1.[24] Moving up the curve AA is equivalent to lengthening the implicit targeting horizon (reducing the speed of disinflation following a shock), thereby lowering output variability.

The trade-off curve can be thought to provide a menu of output/inflation variability choices for the authorities. But to locate the *optimal* targeting horizon we need also to define the preferences of the authorities over output/inflation variability. These are shown as the indifference curve BB in Diagram 1. The bliss point is clearly C, where output/inflation variability is minimised. This point is technically infeasible because it lies off AA. The optimal targeting horizon is given by the point D, where preferences are at a tangent to the technical constraint.[25]

From this it is clear that the optimal targeting horizon depends crucially on the marginal rate of substitution between output and inflation variability in the authorities' loss function. We would again expect such preferences to be rooted in an understanding of the relative costs of these two 'bads'. The difficulty here is the relative dearth of welfare-theoretic analysis which allows us to weight output and inflation variabilities. Here is another area where there is scope for further research.

No inflation-targeting country has yet sought to make entirely clear, much less write into legislation, an explicit targeting horizon for their monetary framework. In many ways this is understandable. When inflation targets were first introduced, the low accrued stock of credibility among those central banks concerned meant that the first priority was to provide an anchor for inflation over the medium term. But now that inflation expectations have been more securely anchored, the next step in designing inflation targets is to think further about specifiying the transition path back to equilibrium following shocks. This is equivalent to specifying a targeting horizon – which brings with it all the issues and imponderables raised above.

Could such a choice of targeting horizon be left to the discretion of the central bank? Doing so endows the central bank with a degree of goal independence over the desired mix of output and inflation variabilities. In other areas – for example, in the specification of the inflation target itself – such goal independence is generally deemed undesirable. Those 'taste' choices are believed best left to government, who in turn are meant to reflect the preferences of the public themselves. If this argument is accepted, then it applies as much to the choice of inflation-targeting horizon as it does to the choice of inflation target itself.

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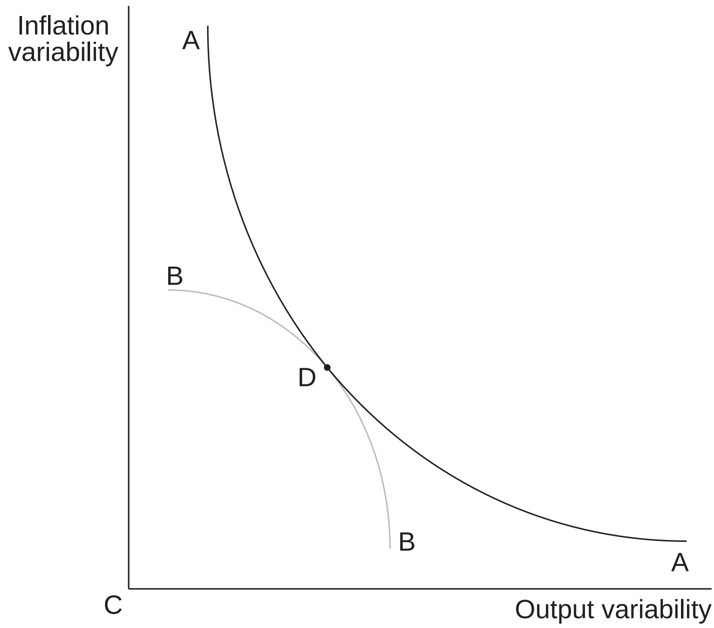
24. In most empirical simulations, including those in Taylor (1993), it is the relative weight on output versus inflation in the policy rule which is altering as we move down the curve, not the targeting horizon.

25. We would not necessarily expect this horizon to be state-invariant. The optimal targeting horizon is likely to depend also on the nature and persistence of shocks.

Diagram 1: Trade-off Between Inflation and Output Variability



4. Inflation Targeting and Transparency

4.1 Transparency in practice

A striking feature among central banks over recent years, in particular among inflation-targeting central banks, has been the extent to which they have sought to reveal more of their monetary-policy hand. There has been a quantum leap in the degree of transparency in central banks' actions and intentions. Among inflation targeters, this is arguably *the* feature differentiating their prior and present monetary frameworks.

There have been a number of vehicles for this greater transparency. Perhaps the most important has been the publication of inflation and monetary-policy reports. These are now published in Canada, Spain, Sweden, New Zealand, the United Kingdom and Norway, even though the last of these countries does not have a formal inflation target as such. Among those inflation targeters without formal inflation reports, such as Australia and Finland, greatly increased efforts have been made to communicate and explain monetary-policy actions: for example, through press releases at the time of monetary-policy changes; or through forward-looking synopses of inflation prospects in regular central bank bulletins and speeches. Other such moves towards greater transparency and accountability include: regular appearances before parliamentary committees (Australia, Sweden, Spain and New Zealand, among others); published minutes of monetary policy council meetings (the UK); and published forecasts for inflation (the UK) and sometimes other variables too (New Zealand).[26]

26. Norway also publishes inflation forecasts.

The reasons for this greater transparency among inflation targeters are clear when we think about the feedback rule, Equation (1). The intermediate variable, from which the authorities feed back when setting policy, is the conditional expectation on the part of the authorities of the future path of inflation, $E_t\pi_{t+j}$.[27] But without a vehicle for communicating the central bank's intentions, such conditional expectations are clearly unobservable. Indeed, they can be accurately inferred only with knowledge of the entire conditional probability distribution of likely inflation outturns on the part of the authorities.

Given this, if the reaction function of the authorities, Equation (1), is to be monitored by the public, inflation-targeting central banks need to make transparent just what $E_t\pi_{t+j}$ is and how it is being calculated. This could in principle be done qualitatively. But 'words' are likely to prove too opaque to be easily monitorable when describing a complete probability density function. So a preferred option is simply to publish the inflation forecasts which constitute the feedback variable. That is the approach taken by New Zealand and the UK. It allows the public to monitor the authorities' feedback rule in operation (Svensson 1996). And it ought in turn to be credibility enhancing, as well as serving as a public-accountability device.

Indeed, given that an inflation forecast is really a summary statistic for myriad information variables, there may well be a case for publishing not only the inflation forecast itself, but details of the way it is compiled too: for example, the underlying model (or models) on which it is based; the exogenous-variable assumptions; residual or judgmental adjustments *etc*. That would allow outsiders to audit the forecast and verify its objectivity. In fact, only New Zealand comes even close to such a set-up.

The Bank of England does publish details of its conditional probability distribution for future inflation. This permits an explicitly probabilistic approach to the setting of monetary policy. For example, monetary policy in the UK has recently been set with a view to securing a 'better-than-evens' chance of hitting the inflation target. Interest rates have been adjusted such that more than 50 per cent of the conditional probability mass for future inflation lies below 2.5 per cent. The basis for that probabilistic, 'better-than-evens' approach has been the Bank's probability distribution for inflation. This probabilistic approach can be verified and monitored by the general public using the Bank's published probability density function.

What might be the obstacles to greater transparency, in particular about $E_t\pi_{t+j}$? One argument which has been put forward is that central bank independence makes an inflation forecast redundant, because it becomes very difficult then to publish an inflation forecast different than the target. But that is a *non-sequitur*. An independent central bank can always solve the dual of the inflation-control problem and trace out instead a profile for interest rates consistent with meeting their inflation target.[28] That is pretty much what the Bank of Canada does internally, backing out an implied path for monetary conditions which is consistent with their target.

27. Because these are conditional inflation expectations formed by the authorities – rather than expectations formed by, say, the financial markets – a rule such as Equation (1) does not run into the nominal-indeterminacy problems discussed by Woodford (1994).

28. Though such a path need not, in general, be unique.

Further, there may well be legitimate policy reasons for bringing inflation forecasts in line with the inflation target at different speeds over different horizons at different times. Some of the reasons for this were discussed earlier. The optimal targeting horizon depends on the size and incidence of shocks and on the authorities' preferences over output and inflation variability. Publishing an inflation forecast can serve as a signalling device about the nature of shocks and the authorities' response to them. In this case, publication is not only feasible but positively desirable as a way of clarifying the authorities' reaction function.

A second potential objection to publication might arise when the policy-making structure is explicitly federal – as with the Federal Open Market Committee (FOMC) in the United States. For example, in the US, inflation forecasts are put before the FOMC through the Fed Board's 'Greenbook'. But these forecasts are explicitly staff projections; they do not necessarily constitute the views of any of the committee, not even the Chairman. Because of this, the 'Greenbook' projections are not published, except with the usual five-year lag. There is no published 'FOMC' forecast either, presumably because of the difficulty in finding consensus across the committee on how this ought to look.

But neither of these obstacles seems insurmountable. At the end of the day, the FOMC sets only one interest rate and so must implicitly have only one view – albeit a weighted-average view. That weighted-average view must in turn equate with some conditional forecast for inflation and possibly for other variables too. It is unclear what merit there is in leaving these forecasts implicit. Alternatively – and less dramatically – the Fed Board staff forecasts in the 'Greenbook' could be published with a less than five-year lag. As Romer and Romer (1996) have recently shown, these 'Greenbook' forecasts – for inflation, output *etc.* – have easily outperformed consensus outside forecasts in the recent past. So releasing this internal information would presumably reduce uncertainties regarding inflation and other variables of macroeconomic interest among the general public. It would also potentially help outsiders better understand the actions and intentions of the Fed itself, to the extent that 'Greenbook' information is used by the FOMC in its policy deliberations.

4.2 Transparency in theory

All of the above arguments are based on the assertion that greater central bank transparency is, on the whole, net beneficial. Does the existing academic literature provide support for this assertion? At least two literatures address this question: the time-consistency literature and the central bank secrecy literature.[29]

4.2.1 Time consistency and transparency

The time-consistency literature is well-known. Discretion imparts the incentive to generate inflation surprises for short-term output gain – an incentive which, under

29. These literatures are not strictly separable, but we have treated them as such below. See Brunner (1981) and Goodfriend (1986) for excellent discussions of central banking and secrecy.

rational expectations, imbues the economy with an inflation bias (Barro and Gordon 1983). There is a variety of institutional means of circumscribing discretion and hence curtailing inflation bias. Two that are well known are the appointment of independent or 'conservative' central bankers (Rogoff 1985) and the adoption of (linear) inflation contracts (Walsh 1995a; Persson and Tabellini 1993). Both of these game-theoretic institutional fixes are believed by some to have analogues in the real world. The Bundesbank is, for many, the archetypal 'conservative' central bank; while New Zealand's Policy Targets Agreement is often thought to have parallels with a Walsh contract (Walsh 1995b).[30]

A third such institutional fix is greater transparency. Under a transparent monetary regime, inflationary opportunism would be quickly spotted and may not then even deliver a short-run boost to output.[31] This then decreases the incentive to generate an inflation surprise in the first place. The logic here is really the flipside of Cukierman and Meltzer (1986). In that paper, the central bank seeks ambiguity so that it can disguise inflation surprises. These days, inflation-targeting central banks are deliberately forgoing one means of camouflaging these surprises. This then serves as a public demonstration of their unwillingness to countenance such surprises – hence lowering inflation bias.

This notion can be formalised by returning to the inflation-targeting reaction function, Equation (1). Without information on $E_t\pi_{t+j}$, agents cannot infer whether the change in the policy instrument derives from news about the feedback variable ($E_t\pi_{t+j}$) or from a shift in the inflation target itself (π^*). That uncertainty will lead risk-averse wage-bargainers to take out inflation insurance by raising their inflation expectations. Revealing $E_t\pi_{t+j}$ simplifies the signal extraction problem, inducing wage-bargainers to take out less inflation insurance when forming their expectations – hence imposing less of an inflation bias.

4.2.2 The term structure and transparency

A second literature has emerged looking explicitly at the effects of central bank secrecy on financial-market behaviour. Its genesis was a legal enquiry in the US into the Fed's need for secrecy (Goodfriend 1986). The Fed defended its private information on the grounds that this helped stabilise short-term interest rates. And subsequently a series of papers have emerged analysing the theoretical basis of the Fed's defence (Dotsey 1987; Rudin 1988; Tabellini 1987).

The effects of transparency on *conditional* interest-rate variability seem reasonably clear. Transparency serves to *reduce* uncertainty – interest-rate forecasting errors – because forecasts are based on a superior information set. That is easily seen from Equation (1). The less the public know about the authorities' conditional expectations of future inflation, the less they know about the authorities' feedback variable. Hence, the larger are the interest-rate forecasting errors the public will make when guessing the authorities' policy actions.

30. Though, ultimately, Walsh (1995b) concludes the two are not isomorphic.

31. See Briault, Haldane and King (1996) and Nolan and Schaling (1996) for a formalisation of this point.

The effects of transparency on *unconditional* interest-rate variability are less certain. But Dotsey (1987) and Rudin (1988) argue that transparency should *increase* unconditional interest-rate variability, for conventional LeRoy and Porter (1981) type reasons: the cleaner and more frequent the signal, the greater the responsiveness of asset prices to 'news'.[32] These predictions ought to be empirically testable. And while the discussion in the literature to date has been couched in terms of short-term – in the US, federal funds rate – variability, the same arguments in fact apply along the whole of the yield curve. Transparency reveals information on the *future*, as well as current, behaviour of the monetary authorities; it hence affects expectations of future as well as current short-term interest rates.[33]

4.3 Some evidence on transparency

So what empirical evidence is there on the effects of transparency? To date, the empirical literature is sparse to non-existent on this issue. Below we offer some illustrative evidence, separated – again somewhat artificially – along the lines of the two literatures discussed above.

4.3.1 Inflation bias and transparency

Taking the time-consistency literature first, the testable implication here is that expected, and hence actual, average inflation should be lower the greater is transparency. But inflation targets have been in place for too short a time to allow any meaningful inference from *actual* inflation: the average duration of inflation targets is around 3–4 years, while the average transmission lag is itself around 2–3 years. It is for these reasons that Almeida and Goodhart (1996) conclude that the case for inflation targets is as yet 'unproven'.

Alternatively, we might look directly at *expected* inflation. A number of recent papers have done so, typically using either bond yields (Freeman and Willis 1995) or surveyed inflation expectations (Almeida and Goodhart 1996; Siklos 1997) as a metric. Neither measure strongly supports the hypothesis that inflation expectations have fallen. But then neither measure is ideally suited to the task.

Surveyed inflation expectations typically refer to horizons (at most) one to two years ahead. But because inflation at those horizons is critically affected by the cycle, these expectations tell us more about the relative cyclical positions of economies than about the longer-term credibility of their monetary policies. And it is the latter hypothesis which is at issue in the time-consistency literature.

Bond yields *do* embody longer-horizon expectations. But even they need to be interpreted carefully. For example, Table 2 compares bond yield differentials between the inflation-targeting countries and an (equally weighted) average of the US and Germany on two dates: at the time these countries first announced an inflation target and currently. Table 2 clearly suggests some narrowing of yield differentials between the

32. Tabellini (1987) develops a model with multiplicative uncertainty about the authorities' reaction function and learning. In this set-up, transparency *reduces* unconditional interest-rate variability.

33. Haldane and Read (1997) develop an analytical model illustrating this point.

inflation targeters and the US and Germany. That is consistent with some credibility bonus. But the pattern is fairly disparate, with the Finnish differential falling by almost 400 basis points and the UK by only 100 basis points.

There are two reasons why bond yield data might give a misleading impression of relative credibility gains. First, the data make no attempt to control for real interest-rate shifts. Second, and more important, bond yields are *averages* of future short-term rates and as a result are also cyclically sensitive. A less contaminated view of inflation expectations, abstracting from the cycle, is given by *forward* rates – point rather than average expectations. In particular, long-maturity forward rates can be used to abstract from the cycle and provide information on shifts in the perceived credibility of monetary policy.

Figure 6 attempts to control for the above two effects using UK data. The first panel looks at the forward-rate differential between the UK and Germany on three dates: just prior to the introduction of the UK's inflation target; just prior to the announcement of Bank of England operational independence; and currently.[34] From this, it is clear that the small fall in bond yield differentials in Table 2 obscures an interesting forward-rate pattern, with short-term forward rates diverging – because of divergent UK-German cycles – but longer-term forward rates converging markedly. As a result, in April this year the forward-rate differential between the UK and Germany was less than one percentage point from around 2002 onwards. And since the announcement of operational independence for the Bank, the differential has shifted down further to around zero from 2002 onwards. Since it is these cycle-invariant *long-maturity* forward rates that are the true arbiter of the perceived credibility of the new regime, the clear implication is that the UK's *relative* credibility has improved since the introduction of its inflation target; inflation bias has been reduced. This message is obscured looking just at bond yield data.

What of *absolute* credibility? The second panel of Figure 6 uses data from the UK's indexed-bond market to infer forward inflation expectations from the difference between the nominal and real forward-rate curves (Deacon and Derry 1994). It too suggests reduced inflation bias. For example, UK forward inflation rates expected in 2010 fell by

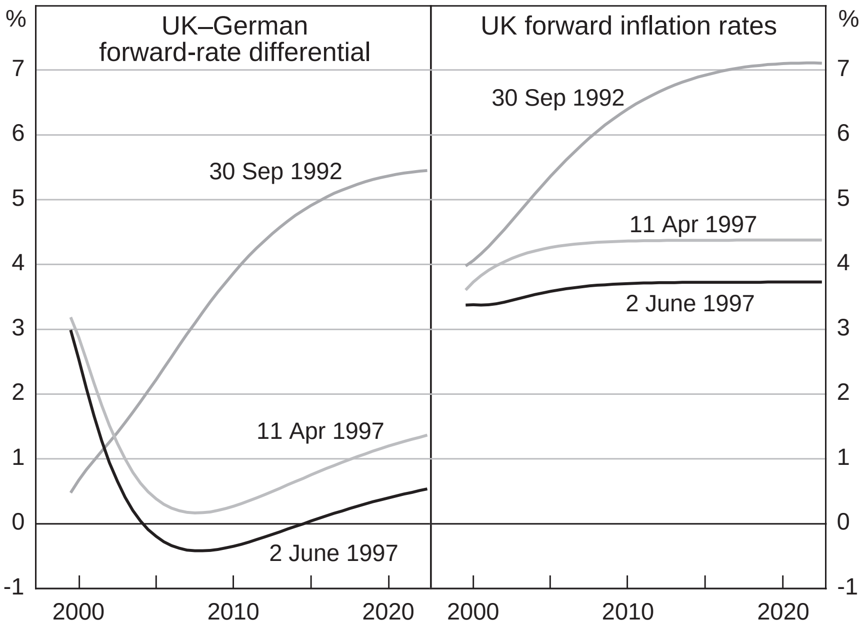
Table 2: Bond Yield Differentials Among Inflation Targeters

	Canada	Australia	Finland	Sweden	NZ	UK	Spain
Regime begins	1.69	1.35	3.74	3.66	3.43	2.22	3.19
Currently	0.30	-0.50	-0.10	0.92	1.60	1.22	0.84
Change	**1.39**	**1.85**	**3.84**	**2.74**	**1.83**	**1.00**	**2.35**

Note: Differentials are with an equally weighted average of the US and Germany. Data are long-term – mostly 10-year – government bond yields. The dates on which the regimes start are: New Zealand, March 1990; Canada, February 1991; the UK, October 1992; Sweden, February 1993; Finland, March 1993; Australia, (around) April 1993; Spain, November 1994.

34. These forward rates are extracted from estimated yield curves using the extended Nelson and Siegel methodology of Svensson (1994); see Deacon and Derry (1994).

Figure 6: Measures of Monetary-policy Credibility



almost three percentage points – from above 7 per cent to below $4^1/_2$ per cent – between September 1992 and April 1997. And the announcement of Bank of England independence led to a further 50 basis-point drop in expected inflation, to a level of around 3.75 per cent. That compares with implied inflation expectations of over 7 per cent as recently as five years ago. If we make some allowance for inflation risk premia, then implied forward inflation expectations are now probably not very much above the UK's 2.5 per cent inflation target. So the message is clearly that absolute and relative inflation biases have fallen in the UK since the introduction of its inflation target. There is a variety of reasons why this might be the case. But greater transparency must be prominent among them, especially during the pre-independence period. It would be interesting to apply such forward-rate analysis to other inflation-target countries which have undergone transparency transformations.

4.3.2 The term structure and transparency

A more direct test of the effects of transparency is found by looking at interest-rate variability. We look at both short- and long-term interest-rate variability, recognising the effects of transparency on both. And in line with the literature, we draw a distinction between *conditional* and *unconditional* effects along the yield curve. Although the analysis again confines itself to the UK, the same technology could be applied elsewhere.

The effects of transparency on *unconditional* interest-rate variability are well illustrated by event studies around the time of 'news' releases. The two transparency events we focus on in the UK are the publication of the monthly minutes of the meetings between the Chancellor and the Governor,[35] and the publication of the Bank of England's *Inflation Report* – neither of which existed prior to the introduction of the UK's inflation target. The former release takes place on a monthly cycle; the latter on a quarterly cycle.

The top two panels of Figure 7 show the *intra-day* response of *short-term* interest-rate expectations derived from the futures market on the day of the transparency event; while the bottom two panels do the same looking at *long-term* interest-rate expectations in the futures market. All of these responses are averaged across the events in question: the thirty-six Chancellor/Governor minutes releases between April 1994 and March 1997; and the seventeen *Inflation Report* releases between March 1993 and March 1997. The time of publication is also shown on the figures.

It is clear from both panels that these transparency events have clear effects on both short- and longer-term interest-rate expectations. As might be expected, these effects are more marked at the short end. For example, publication of the Governor/Chancellor minutes has led on average to an adjustment in short-term futures interest rates of over 3 basis points – not a large amount, but a significant spike nonetheless. More generally, the intra-day responses point towards transparency having clearly raised unconditional asset-price – in particular, interest-rate – volatility, in a way not likely absent these news releases. That is entirely in keeping with the results of theoretical analyses; it is in many ways a natural concomitant of greater transparency.

The really striking effects of transparency are found by looking at *conditional* term-structure variability. We again focus on a set of events: official interest-rate changes in the UK in the period before and after the introduction of the inflation target. We measure conditional variability by looking at the 'surprise' – or unexpected – component in the yield curve at the time of each official rate change. This allows us to condition on all information embodied in the yield curve up to the point of the rate change. Any surprises must therefore reflect news about the authorities' reaction function (path of future short-term rates). For example, in a world in which the authorities' reaction function was known with perfect certainty at every future date and was fully credible – reaction-function transparency was perfect – this interest-rate surprise would equal zero at all points along the yield curve. So improvements in transparency can be measured by the extent to which the economy is approaching that first-best.

We measure 'surprises' along the yield curve using the following set of regressions,[36]

$$\Delta i_{t,j} = a_j + \beta_j(L)\Delta i_{t,j} + \gamma_j \Delta i_t^c + \delta_j D\Delta i_t^c + e_{t,j} \tag{16}$$

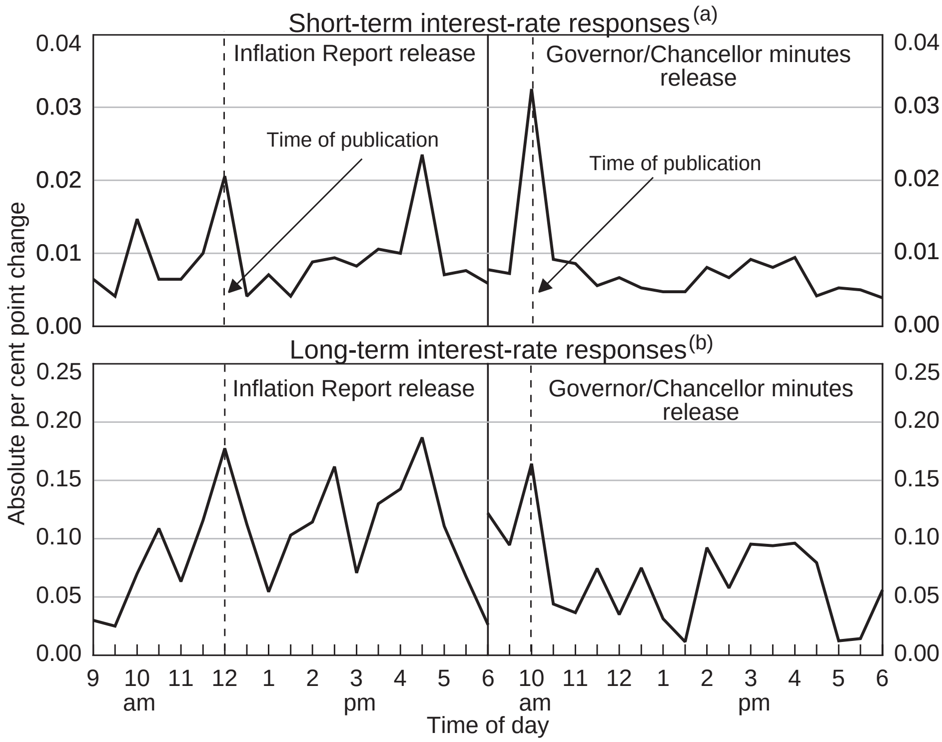
where *j* indexes the forward interest-rate maturity and *t* indexes time. So $\Delta i_{t,j}$ is the change in the *j*-periods ahead (one-month) forward rate corresponding with official interest-rate change Δi_t^c.[37] β_j is a polynomial in the lag operator (L). The lagged dependent variables

35. In the period prior to Bank of England independence.

36. An extended analysis is presented in Haldane and Read (1997).

37. The methodology here is similar to that in Cook and Hahn (1989) in a US context, except that we use a daily time series rather than explicit event-study approach, and use forward rates rather than yields to maturity. We look explicitly at *one-month* forward rates as this is (proximately) the interest-rate maturity of open-market operations in the UK over the period studied. In other countries, such as the US, an overnight forward rate might be more appropriate.

Figure 7: Intra-day Rate Responses



Notes: (a) Change in the implied interest rate from the short-sterling futures contract.
(b) Change in the implied interest rate from the long-gilt futures contract.

here aim merely to mop up any remaining residual autocorrelation. *D* is a regime-shift dummy, taking the value zero in the pre–inflation target regime (up to October 1992) and unity thereafter.[38] We measure surprises at 9 maturities along the yield curve: spot (1 month) yields, and forward rates at 1 month, 3 months, 6 months, 2 years, 5 years, 10 years, 15 years and 20 years. For official interest rates, i_t^c, we use commercial banks' base rate, which moves *pari passu* with the Bank of England's official dealing rate in its open-market operations (Dale 1993). The sample period is January 1985 to March 1997, covering around 3 338 observations.

The key parameter vectors are γ_j and δ_j. The vector γ_j measures the mean interest-rate surprise at forward-rate maturity *j* measured over the full sample. Were an official rate change to be fully anticipated in existing market interest rates, then $\gamma_0 = 0$: there would be no reaction in spot-market interest rates to the official interest-rate change. If the whole of the authorities' perceived reaction function was unaffected by the official interest-rate change – not just this period, but every period thereafter too – then $\gamma_j = 0$ for

38. We also include an impulse dummy variable for the ERM period.

all j. There would be no forward-rate-curve – or expected reaction-function – surprise; transparency would be deemed perfect.

The vector δ_j measures the distinct effect of the move to an inflation target on mean interest-rate surprises. So $\delta_j = 0$ for all j would be a rejection of the hypothesis that the move to an inflation target has had any effect on interest-rate surprises. Or, put differently, $\gamma_j + \delta_j$ measures the size of the mean interest-rate surprise along the yield curve during the inflation-target period.

Table 3 reports the empirical results. Looking first at the full-sample results – the vector γ_j – on average around 40 to 50 per cent of any official interest-rate change has been a surprise at the short end of the yield curve, judging by the behaviour of spot and short forward rates. The short-run surprise is also strongly significant. As we might expect, the size of the surprise is decreasing in j. But official rate changes also cause significant shifts along the rest of the yield curve. For example, at 2 years the surprise is around 25 per cent – half that at the very short end of the yield curve. And for $j > 5$ years, γ_j is negative. This pattern is exactly as we would expect if monetary policy is working in the desired fashion: raising short-term *real* interest rates, with a view to lowering expected inflation in the medium term. There is forward-rate pivoting. All in all, these

Table 3: Measuring Interest-rate Surprises

January 1985–March 1997

	Coefficients							
Maturity j	α_j	β_{1j}	β_{2j}	β_{3j}	γ_j	δ_j	R^2	D.W.
Spot	-0.10	-0.13	-0.15	0.02	0.46	-0.41	0.12	2.10
	(0.42)	(7.64)	(8.81)	(0.98)	(18.57)	(5.03)		
1 month	-0.13	-0.23	-0.14	-0.06	0.47	-0.52	0.13	2.10
	(0.48)	(13.96)	(8.49)	(3.77)	(16.70)	(5.79)		
3 months	-0.14	-0.26	-0.13	-0.07	0.30	-0.39	0.09	2.09
	(-0.44)	(15.25)	(7.30)	(4.40)	(9.42)	(3.73)		
6 months	-0.12	-0.20	-0.10	-0.05	0.35	-0.29	0.10	2.09
	(0.47)	(11.66)	(5.64)	(2.88)	(13.64)	(3.50)		
2 years	-0.17	-0.39	-0.07	-0.04	0.24	-0.23	0.15	2.02
	(0.52)	(22.69)	(4.03)	(2.56)	(7.41)	(2.22)		
5 years	-0.17	-0.33	-0.15	-0.08	0.14	-0.16	0.11	2.00
	(0.61)	(19.45)	(8.49)	(4.57)	(5.11)	(1.79)		
10 years	-0.13	-0.50	-0.31	-0.10	-0.13	0.04	0.22	2.02
	(0.38)	(29.33)	(16.60)	(5.67)	(3.79)	(0.32)		
15 years	-0.02	-0.53	-0.30	-0.13	-0.16	0.05	0.22	2.02
	(0.05)	(30.64)	(15.80)	(7.54)	(3.49)	(0.36)		
20 years	0.07	-0.58	-0.36	-0.18	-0.08	-0.01	0.26	2.05
	(0.08)	(33.98)	(18.94)	(10.67)	(0.92)	(0.04)		

Note: Numbers in parentheses are t-ratios.

results indicate that reaction-function transparency has been far from perfect on average over the period since 1985.

The regime-shift effects embodied in δ_j are, however, the most striking diagnostic. The vector δ_j is significant and negative at all maturities up to around five years ahead. This indicates that the transparency innovations which have accompanied the introduction of the UK's inflation-target regime have had a significant impact in lowering the size of interest-rate forecasting revisions. These regime-shift effects are large as well as significant. Empirically, $\delta_j \approx -\gamma_j$, implying that surprises along the yield curve are little different than zero during the inflation-target regime.

This is strong evidence to suggest that the transparency innovations accompanying the introduction of the UK's inflation target have reduced conditional term-structure variability – just as theory would predict. Those are effects we might reasonably expect to show up in other inflation-targeting countries, given the similar transparency innovations evident among them too. Their effect is clearly Pareto-improving. A stabler term structure ought to lower the risk premium and, in the long run, boost the capital stock. That capital-stock adjustment will be a long time coming. But its first manifestation – a stabler term structure – seems already to be evident.

5. Conclusions

A theme of this paper has been that the design of inflation targets is linked umbilically to the welfare costs of inflation. Some of those costs have been reasonably well-understood for some time and are quantifiable using the welfare-theoretic analysis of Bailey (1956). But the costs of unanticipated inflation, and the trade-off between inflation and output variability, are much less well researched in a welfare context. Because these costs determine the answers to such fundamental design questions as the optimal targeting horizon for monetary policy and the preferred degree of shock stabilisation, there is a pressing need for further work on them.

There is another, less tendentious, reason why some further quantification of the costs of inflation might be desirable. The price-stability consensus is now so deep-rooted that at some stage an intellectual backlash must be likely. There are echoes currently of the late 1920s, when there was a widespread consensus, intellectually and practically, favouring price stability. The experience of the Great Depression shattered that consensus. The influential recent contribution by Akerlof *et al.* (1996) is perhaps an early warning shot across the bows. Rebuffing that backlash calls for a reasoned quantification of the costs of inflation.

A second factor which might induce some unravelling of the price-stability consensus is demographics. The recent episode of global disinflation has come during a period when the policy-makers responsible can still remember high and volatile inflation. Many older-generation Germans, for example, still remember hyper-inflation. But that will not be the case for the next generation of policy-makers, whose collective will to fight inflation many hence be weakened. Shiller's (1996) survey of the general public found evidence of just this: inflation aversion was far greater among the old than among the young. That too might pose a risk to the price-stability consensus.

The best way of countering these inflation risks, and of ensuring a durable monetary framework, is by quantifying the costs imposed by inflation and, perhaps most important, explaining these costs to the public at large. In the past, central banks have performed poorly on both fronts. But recent transparency innovations – in particular among inflation targeters – offer some encouragement for the future.

References

Abel, A. (1996), Comment on 'The Costs and Benefits of Going from Low Inflation to Price-Stability', M. Feldstein (1996), NBER Working Paper No. 5469, mimeo.

Akerlof, G.A., W.T. Dickens, and G.L. Perry (1996), 'The Macroeconomics of Low Inflation', *Brookings Papers on Economic Activity*, 1, pp. 1–76.

Almeida, A. and C.A.E. Goodhart (1996), 'Does the Adoption of Inflation Targets Affect Central Bank Behaviour?', London School of Economics, mimeo.

Andersen, P. (1992), 'OECD Country Experiences with Disinflation', in A. Blundell-Wignell (ed.), *Inflation, Disinflation and Monetary Policy*, Reserve Bank of Australia, Sydney, pp. 104–173.

Bailey, M. (1956), 'The Welfare Cost of Inflationary Finance', *Journal of Political Economy*, 64(2), pp. 93–110.

Bakhshi, H., A.G. Haldane, and N. Hatch (1996), 'Some Costs and Benefits of Price-Stability in the United Kingdom', Bank of England, mimeo.

Ball, L. (1994), 'What Determines the Sacrifice Ratio?', in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 155–182.

Ball, L. (1996a), 'Disinflation and the NAIRU', NBER Working Paper No. 5520.

Ball, L. (1996b), 'Efficient Rules for Monetary Policy', NBER Working Paper No. 5952.

Ball, L., N.G. Mankiw, and D. Romer (1988), 'The New Keynesian Economics and the Output-Inflation Trade-Off', *Brookings Papers on Economic Activity*, 1, pp. 1–65.

Barnett, W. (1980), 'Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory', *Journal of Econometrics*, 14(1), pp. 11–48.

Barro, R.J. (1995), 'Inflation and Economic Growth', *Bank of England Quarterly Bulletin*, 35(2), pp. 166–176.

Barro, R.J. and D. Gordon (1983), 'Rules, Discretion and Reputation in a Model of Monetary Policy', *Journal of Monetary Economics*, 12(1), pp. 101–122.

Boskin Commission (1996), 'Toward A More Accurate Measure of the Cost of Living', *Final Report to the Senate Finance Committee*, Washington, D.C.

Briault, C.B. (1995), 'The Costs of Inflation', *Bank of England Quarterly Bulletin*, 35(1), pp. 33–45.

Briault, C.B., A.G. Haldane, and M.A. King (1995), 'Independence and Accountability', in I. Kuroda (ed.), *Toward More Effective Monetary Policy*, Bank of Japan, Tokyo, forthcoming.

Brunner, K. (1981), 'The Art of Central Banking', Centre for Research in Government Policy and Business, Working Paper No. 81-6.

Card, D. and D. Hyslop (1996), 'Does Inflation "Grease the Wheels of the Labor Market"?', NBER Working Paper No. 5538.

Cecchetti, S.G. (1995), 'Inflation Indicators and Inflation Policy', NBER Working Paper No. 5161.

Chadha, J., A.G. Haldane, and N.G. Janssen (1998), 'Shoe-Leather Costs Reconsidered', *Economic Journal*, (forthcoming).

Clark, P., D. Laxton, and D. Rose (1995), 'Capacity Constraints, Inflation and the Transmission Mechanism: Forward-Looking Versus Myopic Policy Rules', IMF Working Paper No. 95/75.

Cook, T. and T. Hahn (1989), 'The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s', *Journal of Monetary Economics*, 24(3), pp. 331–351.

Cooley, T.F. and G.D. Hansen (1989), 'The Inflation Tax in a Real Business Cycle Model', *American Economic Review*, 79(4), pp. 733–748.

Cooley, T.F. and G.D. Hansen (1991), 'The Welfare Costs of Moderate Inflations', *Journal of Money, Credit and Banking*, 23(3), pp. 483–503.

Crawford, A. (1994), 'Measurement Biases in the Canadian CPI: A Technical Note', Bank of Canada Technical Report No. 64.

Crawford, A. and C. Dupasquier (1994), 'Can Inflation Serve as a Lubricant for Market Equilibrium?', in *Economic Behaviour and Policy Choice Under Price Stability*, Bank of Canada, Ottawa, pp. 49–80.

Cukierman, A. and A. Meltzer (1986), 'A Theory of Ambiguity, Credibility and Inflation Under Discretion and Asymmetric Information', *Econometrica*, 54(5), pp. 1099–1128.

Cunningham, A.W.F. (1996), 'Measurement Biases in Price Indices: An Application to the UK's RPI', Bank of England Working Paper No. 47.

Cutler, D., M.B. McClellan, J. Newhouse and D. Remler (1996), 'Are Medical Care Prices Declining?', NBER Working Paper No. 9570.

Dale, S. (1993), 'The Effects of Changes in Official UK Rates on Market Interest Rates Since 1987', *The Manchester School*, 61(1), pp. 76–94.

Deacon, M. and A. Derry (1994), 'Estimating Market Interest Rates and Inflation Expectations from the Prices of UK Government Bonds', *Bank of England Quarterly Bulletin*, 34(3), pp. 232–240.

Debelle, G. (1997), 'Inflation Targeting in Practice', IMF Working Paper No. 97/35.

Debelle, G. and D. Laxton (1996), 'Is the Phillips Curve Really a Curve? Some Evidence from Canada, the United Kingdom and the United States', IMF Working Paper No. 96/111.

Debelle, G. and G. Stevens (1995), 'Monetary Policy Goals for Inflation in Australia', in A.G. Haldane (ed.), *Targeting Inflation*, Bank of England, London, pp. 81–100.

Dolado, J.J., J.M. Gonzalez-Paramo and J. Vinals (1997), 'A Cost-Benefit Analysis of Going from Low Inflation to Price Stability in Spain', Banco de Espana, mimeo.

Dotsey, M. (1987), 'Monetary Policy, Secrecy and Federal Funds Rate Behaviour', *Journal of Monetary Economics*, 20(3), pp. 463–474.

Dotsey, M. and P. Ireland (1996), 'The Welfare Cost of Inflation in General Equilibrium', *Journal of Monetary Economics*, 37(1), pp. 29–47.

Duguay, P. (1994), 'Some Thoughts on Price-Stability Versus Zero Inflation', Bank of Canada, mimeo.

Driffill, J., G.E. Mizon and A. Ulph (1990), 'Costs of Inflation', in B.M. Friedman and F.H. Hahn (eds), *Handbook of Monetary Economics*, Volume 2, North-Holland, Amsterdam, pp. 1013–1066.

English, W.B. (1996), 'Inflation and Financial Sector Size', Board of Governors of the Federal Reserve System Finance and Economics Discussion Paper No. 96-16.

Feldstein, M. (1979), 'The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy', *Journal of Political Economy*, 87(4), pp. 749–768.

Feldstein, M. (1995), 'Would Privatising Social Security Raise Economic Welfare?', NBER Working Paper No. 5281.

Feldstein, M. (1996), 'The Costs and Benefits of Going From Low Inflation to Price-Stability', NBER Working Paper No. 5469.

Fischer, S. (1981), 'Toward an Understanding of the Costs of Inflation: II', *Carnegie-Rochester Conference Series on Public Policy*, 15, pp. 5–42.

Fischer, S. (1993), 'The Role of Macroeconomic Factors in Growth', *Journal of Monetary Economics*, 32(3), pp. 485–512.

Fischer, S. (1994), 'Modern Central Banking', in F. Capie, C. Goodhart, S. Fischer and N. Schnadt (eds), *The Future of Central Banking: The Tercentenary Symposium of the Bank of England*, Cambridge University Press, Cambridge, pp. 262–308.

Fischer, S. and F. Modigliani (1975), 'Towards an Understanding of the Real Effects of the Costs of Inflation', *Weltwirtschaftliches Archiv*, 114(4), pp. 810–833.

Fisher, I. (1911), *The Purchasing Power of Money*, MacMillan, New York.

Fuhrer, J. and B. Madigan (1994), 'Monetary Policy When Interest Rates are Bounded at Zero', Federal Reserve Bank of Boston Working Paper No. 94-1.

Freeman, R.T. and J.L. Willis (1995), 'Targeting Inflation in the 1990s: Recent Challenges', Board of Governors of the Federal Reserve System International Finance Discussion Paper No. 525.

Goodfriend, M. (1986), 'Monetary Mystique: Secrecy and Central Banking', *Journal of Monetary Economics*, 17(1), pp. 63–97.

Goodhart, C.A.E. (1994), 'What Should Central Banks Do? What Should Be Their Macroeconomic Objectives and Operations?', *Economic Journal*, 104(427), pp. 1424–1436.

Gordon, R. (1996), 'Comment' on Akerlof *et al.*, *Brookings Papers on Economic Activity*, 1, pp. 60–66.

Groschen, E. and M. Schweitzer (1997), Inflation's Grease and Sand Effects in the Labour Market, paper presented at the NBER Conference, 'Costs and Benefits of Achieving Price Stability', New York.

Haldane, A.G. (ed.) (1995), *Targeting Inflation*, Bank of England, London.

Haldane, A.G. (1997), 'On Inflation-Targeting in the United Kingdom', *Scottish Journal of Political Economy* (forthcoming).

Haldane, A.G. and V. Read (1997), 'Private Information and the Yield Curve', Bank of England, mimeo.

Haldane, A.G. and C.K. Salmon (1995), 'Three Issues on Inflation Targets', in A.G. Haldane (ed.), *Targeting Inflation*, Bank of England, London, pp. 170–201.

Hall, S. and A. Yates (1997), 'Are There Downward Nominal Rigidities in Product Prices?', Bank of England Working Paper (forthcoming).

Hausman, J. (1997), 'Cellular Telephones: New Products and the CPI', NBER Working Paper No. 5982.

Judson, R. and A. Orphanides (1996), 'Inflation, Volatility and Growth', Board of Governors of the Federal Reserve System Finance and Economics Discussion Paper No. 96-19.

Keynes, J.M. (1923), *A Tract on Monetary Reform*, MacMillan, London.

King, M.A. (1994), 'Monetary Policy in the UK', *Fiscal Studies*, 15(3), pp. 109–129.

King, M.A. (1996), 'How Should Central Banks Reduce Inflation? Conceptual Issues', *Bank of England Quarterly Bulletin*, 36(4), pp. 434–448.

Kohn, D. (1995), 'Comment', in B. Bernanke and J. Rotemberg (eds), *NBER Macroeconomics Annual*, MIT Press, Cambridge, Massachusetts, pp. 227–233.

Laxton, D., G. Meredith and D. Rose (1995), 'Asymmetric Effects of Economic Activity on Inflation', IMF Staff Papers, 42(2), pp. 344–374.

Lebow, D.E., J.M. Roberts and D.J. Stockton (1992), 'Economic Performance Under Price-Stability', US Board of Governors of the Federal Reserve System Working Paper No. 125.

Leiderman, L. and L.E.O. Svensson (eds) (1995), *Inflation Targets*, CEPR, London.

LeRoy, S.F. and R.D. Porter (1981), 'The Present-Value Relation: Tests Based on Implied Variance Bounds', *Econometrica*, 49(3), pp. 555–574.

Longworth, D. and C. Freedman (1995), 'The Role of the Staff Economic Projection in Conducting Canadian Monetary Policy', in A.G. Haldane (ed.), *Targeting Inflation*, Bank of England, London, pp. 101–112.

Lucas, R.E. (1995), 'On the Welfare Costs of Inflation', Stanford University Center for Economic Policy Research Discussion Paper Series No. 394.

Lucas, R.E. (1996), 'Monetary Neutrality', *Journal of Political Economy*, 104(4), pp. 661–682.

Mayes, D. and B. Chapple (1995), 'Defining an Inflation Target', in A G Haldane (ed.), *Targeting Inflation*, Bank of England, London, pp. 226–245.

McCallum, B.T. (1983), 'On Uniqueness in Rational Expectations Models: An Attempt at Perspective', *Journal of Monetary Economics*, 11(2), pp. 139–168.

McCallum, B.T. (1995), 'Inflation Targeting in Canada, New Zealand, Sweden, the United Kingdom, and In General', in I. Kuroda (ed.), *Toward More Effective Monetary Policy*, Bank of Japan, Tokyo, forthcoming.

McCandless, G.T. and W.E. Weber (1995), 'Some Monetary Facts', *Federal Reserve Bank of Minneapolis Quarterly Review*, 19, pp. 2–11.

Mulligan, C.B. and X.X. Sala-i-Martin (1996), 'Adoption of Financial Technologies: Implications for Money Demand and Monetary Policy', NBER Working Paper No. 5504.

Nolan, C. and E. Schaling (1996), 'Monetary Policy Uncertainty and Central Bank Accountability', Bank of England Working Paper No. 54.

Nordhaus, W. (1994), 'Do Real Output and Real Wage Measures Capture Reality? The History of Lighting Suggests Not', Cowles Foundation Discussion Paper No. 1078.

Orphanides, A. and R.M Solow (1990), 'Money, Inflation, and Growth', in B.M. Friedman and F.H. Hahn (eds), *Handbook of Monetary Economics*, Vol. 1, North-Holland, Amsterdam, pp. 223–261.

Persson, T. and G. Tabellini (1993), 'Designing Institutions for Monetary Stability', *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 53–84.

Phelps, E.S. (1972), 'Inflation in a Theory of Public Finance', *Swedish Journal of Economics*, 75(1), pp. 67–82.

Rae, D. (1993), 'Are Retailers Normal? The Distribution of Consumer Price Changes in New Zealand', Reserve Bank of New Zealand Discussion Paper No. G93/7.

Ramsey, F.P. (1928), 'A Mathematical Theory of Saving', *Economic Journal*, 38(152), pp. 543–559.

Rogoff, K.S. (1985), 'The Optimal Degree of Commitment to an Intermediate Monetary Target', *Quarterly Journal of Economics*, 100(4), pp. 1169–1190.

Romer, C. and D. Romer (1996), 'Federal Reserve Private Information and the Behaviour of Interest Rates', NBER Working Paper No. 5692.

Rudin, J.R. (1988), 'Central Bank Secrecy, "Fed Watching", and the Predictability of Interest Rates', *Journal of Monetary Economics*, 22(2), pp. 317–334.

Sarel, M. (1996), 'Nonlinear Effects of Inflation on Economic Growth', *IMF Staff Papers*, 43(1), pp. 199–215.

Sargent, T.J. and N. Wallace (1975), 'Rational Expectations, the Optimal Monetary Instrument and the Optimal Money Supply Rule', *Journal of Political Economy*, 83(1), pp. 241–254.

Shapiro, M.D. and D.W. Wilcox (1996), 'Mismeasurement in the Consumer Price Index: An Evaluation', NBER Working Paper No. 5590.

Shiller, R. (1996), ‘Why Do People Dislike Inflation?’, NBER Working Paper No. 5539.

Siklos, P. (1997), ‘Charting a Future for the Bank of Canada: Inflation Targets and the Balance Between Autonomy and Accountability’, in J. Grant, P. Howitt and P.L. Siklos (eds), *Inflation Targets in Canada’s Monetary Policy Regime*, C.D. Howe Institute, Toronto.

Sims, C.A. (1992), ‘Interpreting the Macroeconomic Time-Series Facts: The Effects of Monetary Policy’, *European Economic Review*, 36(5), pp. 975–1011.

Smyth, D.J. (1994), ‘Inflation and Growth’, *Journal of Macroeconomics*, 16(2), pp. 261–70.

Summers, L.H. (1989), ‘How Should Long-Term Monetary Policy Be Determined?’, *Journal of Money, Credit and Banking*, 23(3), pp. 625–631.

Svensson, L.E.O. (1994), ‘Estimating and Interpreting Forward Interest Rates: Sweden 1992–93’, NBER Working Paper No. 4871.

Svensson, L.E.O. (1997), ‘Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets’, *European Economic Review*, 41(6), pp. 1111–1146.

Tabellini, G. (1987), ‘Secrecy of Monetary Policy and the Variability of Interest Rates’, *Journal of Money, Credit and Banking*, 19(4), pp. 425–136.

Taylor, J.B. (1993), *Macroeconomic Policy in the World Economy: From Econometric Design to Practical Operation*, W.W. Norton, & Company, New York.

Todter, K-H. and G. Ziebarth (1997), ‘Price Stability Versus Low Inflation in Germany: An Analysis of Costs and Benefits’, Deutsche Bundesbank, mimeo.

Walsh, C.E. (1995a), ‘Optimal Contracts for Central Bankers’, *American Economic Review*, 85(1), pp. 150–167.

Walsh, C.E. (1995b), ‘Is New Zealand’s Reserve Bank Act of 1989 an Optimal Central Bank Contract?’, *Journal of Money, Credit and Banking*, 27(4), pp. 1179–1191.

Woodford, N.G. (1994), ‘Non-Standard Indicators for Monetary Policy: Can Their Usefulness be Judged From Forecasting Regressions?’, in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 95-115.

Yates, A. (1995), ‘On the Design of Inflation Targets’, in A.G. Haldane (ed.), *Targeting Inflation*, Bank of England, London, pp. 135–169.

Yates, A. (1997), ‘What Goes Up Must Come Down: Downward Nominal Rigidities and Monetary Policy’, Bank of England, mimeo.

Discussion

1. Don Brash

The range of issues relevant to the design of an inflation-targeting framework means that a fully comprehensive review is a very substantial task. Haldane has wisely narrowed down his field of discussion to three questions: what level to set an inflation target?; over what horizon?; and should inflation forecasts be published? Haldane makes a very welcome contribution to all of these topics.

The paper covers a sufficiently wide scope of empirical and practical issues to preclude a detailed discussion of them all in the space available. The comments below therefore focus on the twin themes of goals versus operational policy and the role of transparency. In terms of the latter, I comment on some practical issues associated with the Reserve Bank of New Zealand's recent moves to increase the transparency of its operations. Finally, some brief comments are offered on the literature on the costs of inflation and disinflation.

Goals, operational independence and transparency

Haldane's organising framework is based on how to specify the monetary authority's policy reaction function (his Equation (1)). While useful in many respects, this approach does not itself distinguish clearly between goals and operational policy. The implicit assumption made is that it is feasible and desirable for the *legislative* framework for monetary policy to specify the parameters of the policy reaction function. This approach therefore does not explicitly consider issues of incentives, pre-commitment, and verifiability and accountability.

An alternative view is that the design of an inflation-targeting framework would ideally take place in two steps. The first step would be to determine the most appropriate (socially optimal) policy reaction function based on the structure of the economy and the known frequencies (joint probability distribution) of demand and supply disturbances. The second step would be to design an inflation-targeting framework that *induces* the central bank to implement the desired outcome.

However, a critical problem with this alternative approach is that it assumes the designers have much more knowledge about the economy than is the case. In particular, the approach requires an extremely good knowledge of the structure of the economy and how it may change over time due to the new monetary regime or other factors. Our lack of knowledge about these matters means that inflation-targeting frameworks have in practice been designed with specific focus on the goals of policy, rather than on operational policy. Central banks have been given operational independence so that the policy reaction function may be altered as we learn more about the economy and how it is changing over time.

Yet, clearly, the central bank should be obliged to reflect society's preferences ('tastes'), including preferences over inflation variability and output variability. In this respect, Haldane observes that no inflation-targeting country has written into legislation an explicit targeting horizon for their policy framework. This is certainly true in the sense used by Haldane; no country has legislation specifying the number of leads (j) on projected inflation ($E_t\pi_{t+j}$) and the size of the response coefficient in the policy reaction function.

As indicated above, there are good reasons for the absence of such legislation. In addition to our lack of knowledge about the fundamental structure of the economy, any legislative framework would need to take proper account of the different types of disturbances to the economy. At the broadest level, monetary policy may appropriately react quite differently to supply shocks than to demand shocks. Yet the ability of the central bank to tailor its responses to each type of shock may be unduly inhibited by legislation that seeks to average across demand and supply shocks.

Responses to these issues are likely to differ from country to country. The New Zealand framework seeks to overcome them by specifying a target *range* for inflation and a list of caveats whereby inflation may temporarily go outside the target range in response to certain types of supply shock.[1, 2] This approach clearly gives the Reserve Bank of New Zealand discretion to set the instruments of policy.

With discretion comes an obligation that actions be consistent with the goals agreed in the *Policy Targets Agreement* (PTA). Formal monitoring occurs via the Board of the Reserve Bank and six-monthly statements to Parliament, while informal monitoring derives from the public nature of these statements. In this context, Haldane is correct to ascribe a highly significant role to transparency. Indeed, I would go further and argue that a highly transparent operational policy is as important as the explicit democratic accountability achieved by legislating the goals of monetary policy.

Transparency in practice

Haldane suggests that New Zealand comes closest to the level of transparency necessary for outsiders to verify the objectivity of policy operations. Recently, the Reserve Bank of New Zealand has advanced its transparency a step further. For the first time, the Bank's June 1997 *Monetary Policy Statement* published projections showing an endogenous path for monetary conditions.[3, 4] In Haldane's terminology, the new approach to projections solves the dual of the inflation-control problem.

1. The list is non-exhaustive and includes changes to indirect taxes, 'significant' terms-of-trade movements, and natural disasters.
2. Haldane reports a number of empirical studies of the trade-off between inflation variability and output variability. It is worth noting, however, that none of these studies takes account of the role of the caveats for supply shocks and so their results are not relevant to the setting of the inflation target range in New Zealand.
3. These projections were based on the macroeconomic model in our new Forecasting and Policy System (FPS), to be published on 4 August. See Black *et al.* (1997a,b) for further details on FPS.
4. Prior to June 1997, the Bank published economic projections that made highly simplistic and sometimes mutually inconsistent assumptions about the paths of nominal interest rates and the exchange rate. In recent projections, these assumptions took the form of both the 90-day bank bill rates and the trade-weighted exchange-rate index held constant for the entire three years of the projection at approximately their prevailing spot rates.

The decision to publish an endogenous path for monetary conditions was made after weighing the advantages of increased transparency against a number of potential disadvantages. Three advantages are worth particular mention:

- An endogenous path for monetary conditions would almost certainly be closer to the actual evolution of monetary conditions than the previous practice of holding nominal monetary conditions constant for the entire projection period. This should reduce forecast errors and render them unbiased, increasing the informational value and credibility of the projections. Some evidence to support this is presented below.
- The path for monetary conditions enables the Bank to communicate more clearly when, and by how much, monetary conditions may need to change to be consistent with inflation returning to the middle part of the target range. Correspondingly, it encourages a shift in focus away from the level of conditions desired for the current quarter to a more balanced view of the *path* of monetary conditions (though, of course, current desired conditions will always remain highly relevant).
- The projection would always result in balanced growth over the medium to long term and inflation returning to the middle part of the target range. This is an important advantage for the Bank as it explains to the public that low inflation does not reduce prospects for economic growth.

The potential disadvantages were seen to be mainly at the practical or operational level. The two most important were that the financial markets might respond prematurely to projected future changes in the stance of policy, and that the Bank might be forced to comment or take actions more frequently in response to even small differences between data outturns and forecasts. With less than a month passing since the first endogenous projections were published, it is clearly not possible to comment on the extent to which these disadvantages are likely to occur over time. However, market responses thus far have been reasonably favourable.

Aside from these advantages and disadvantages, publishing endogenous projections has raised several other practical issues. One practical issue was whether the path of monetary conditions should represent the Bank's official view of desired monetary conditions or whether the projected path should somehow be quite separate from the Bank's official view. One possibility considered, in response to concerns about premature market actions, was to use market forward rates for 90-day bills and the TWI for the first two quarters of the projection. However, the principle of transparency suggested that it would be unsatisfactory to publish projections that did not incorporate the official view.

A further issue was whether to publish the paths for interest rates and the exchange rate, or only a weighted combination of the two as a monetary conditions index (MCI).[5] Despite the risk of being accused of meddling with the mix of monetary conditions, the Bank decided to publish the projections for both interest rates and the exchange rate in addition to the MCI. This was decided for two reasons. First, doing so would reduce the risk of vague and confusing explanations of the forces operating in the projections.

5. Monetary conditions indices may be defined in various forms. The MCI published in the June 1997 *Monetary Policy Statement* was defined using a 2:1 ratio on the 90-day interest rate and the trade-weighted exchange rate, both in real and nominal terms. The formulae and brief discussion are provided in the Notes to Table 1 and Box 3 in the June 1997 *Monetary Policy Statement*.

Second, other information published in the projections allows market analysts to derive an approximate path for interest rates and then use the MCI to derive the path for the TWI.[6]

The above has briefly described the steps the Bank has taken recently to enhance transparency. Nevertheless, further advances are possible. In particular, the Bank of England's practice of publishing the distribution of plausible inflation outcomes is an attractive approach and may be an area for our further development.

Evidence on transparency

Haldane presents a number of interesting tests for the effects of transparency, focusing on bond yield differentials and term-structure event studies.[7] However, in a highly open economy the behaviour of the exchange rate may also serve as a test of the effects of transparency.

Orr and Rae (1996) present evidence for the effects of transparency on exchange-rate behaviour. The starting point for their analysis is that Canada and New Zealand are very similar in having highly transparent inflation goals, but that operating procedures are much less transparent in Canada than in New Zealand. Unlike the Reserve Bank of New Zealand, the Bank of Canada does not publish inflation projections or the key parameters used as the basis for projections.

Orr and Rae's empirical analysis produced two key results:

- In both countries the relationship between movements in exchange rates and the domestic/foreign differential in short-term interest rates changed dramatically after the start of inflation targeting. Prior to inflation targets there was no significant relationship between interest-rate differentials and the exchange rate. Since the start of inflation targeting the Uncovered Interest Parity relationship has become highly significant. This shift in behaviour is interpreted as being consistent with inflation-target bands inducing corresponding exchange-rate bands (due to the role of exchange rates in the inflation process).
- The two countries differ in the changes in financial-market volatility (Schwert measure) following the introduction of inflation targets. In New Zealand the volatility of both the exchange rate and short-term interest rates has been lower since inflation targeting began. In Canada the volatility of the exchange rate has remained unchanged while volatility of interest rates has increased.

6. This is possible because of our history of (and therefore implicit commitment to continue) publishing both headline CPI and underlying inflation. The former includes the direct effects of interest-rate changes while the latter excludes these effects.

7. Haldane's use of the bond data is problematical. For both Australia and New Zealand, calculations using quarterly data differ substantially from those reported in Table 2 (which are based on bond yields on just two particular days). For example, New Zealand's bond differential with the US and Germany was lower than Australia's throughout 1989–95. Also important is that Haldane dates the beginning of inflation targeting in New Zealand as March 1990, following the signing of the first PTA. In fact, inflation targeting began at least as early as 1988. For example, Orr and Rae (1996) date the start of inflation targeting as September 1988.

On the basis of these two results, Orr and Rae conclude that being transparent about the final goals of monetary policy is not enough; a central bank must also be clear about its operating procedures to avoid unnecessary financial volatility.

Costs of inflation and disinflation

Haldane presents a full discussion of the empirical evidence on the costs of inflation and disinflation. My main comment is that, in general, the literature takes insufficient account of structural change from one inflation regime to another and that more attention needs to be given to the differing results for small open economies as compared to larger economies.

A fully comprehensive analysis of the effects of inflation would measure distortions to consumption/savings decisions, consumption/leisure decisions, asset allocation, and productive efficiency. Some of these distortions will have welfare-reducing timing effects, while others will affect the level and growth rate of output. The Feldstein-based estimates reported by Haldane focus on distortions to household consumption/savings and asset-allocation choices, with no explicit account taken of consumption/leisure distortions and productive inefficiencies. They are therefore likely to be lower bounds on the total welfare cost of inflation. Evidence is available to suggest that these other sources of distortion are quantitatively significant, and that they may be larger for small open economies (Desai and Hines 1997; Cohen *et al.* 1997).

In terms of the potential costs of price stability, Haldane makes the plausible assessment that the Summers Effect and the degree of nominal wage rigidity are unlikely to be sufficient to offset the efficiency benefits identified above. In addition to Haldane's generic arguments, the Summers Effect will almost certainly be less relevant in small open economies (than in larger economies) because in most circumstances it will be feasible to reduce interest rates to levels sufficient to depreciate the nominal exchange rate significantly. The main circumstance where this may not be possible is where economic cycles are closely synchronised across countries, so that a world-wide recession leads to very low world interest rates. History shows these to be rare events.

Similarly, evidence in favour of downward inflexibility of nominal wages in periods of positive inflation does not necessarily imply that price stability will distort factor reallocation. For example, Hutchison and Walsh (1996) derive an equilibrium model to show that the degree of nominal wage rigidity and the sacrifice ratio are related to the institutional structure of monetary policy. Using New Zealand data, they present tentative evidence that the sacrifice ratio has *increased* since the passage of the *Reserve Bank Act 1989*. This seems counter-intuitive at first sight. However, they also find evidence that the 1989 Act improved the credibility of policy and this effect tended to reduce the sacrifice ratio. Their analysis suggests that lower average inflation increases nominal wage rigidity and that, at least for New Zealand, this has dominated the credibility effect.

A key lesson from the Hutchison and Walsh evidence is that the degree of nominal rigidity is chosen by the joint behaviour of firms and workers to maximise the total value of their contractual relationship. Thus, if lower inflation leads to a *voluntary* increase in rigidity we need to understand why this occurs before concluding that welfare has been reduced.

Finally, at the micro level, empirical simulation models also need to allow for sources of firm-level flexibility. These may derive from productivity growth, labour turnover, bonus-payment structures, and probationary contracts (whereby new employees are initially paid less than their expected marginal product until on-the-job observation confirms their productivity). For these reasons, the value of many existing studies may be more questionable than suggested by Haldane.

References

Black, R., V. Cassino, A. Drew, E. Hansen, B. Hunt, D. Rose and A. Scott (1997a), *The Forecasting and Policy System: An Introduction*, Reserve Bank of New Zealand, August and *Reserve Bank Bulletin* (forthcoming).

Black, R., V. Cassino, A. Drew, E. Hansen, B. Hunt, D. Rose and A. Scott (1997b), 'The Forecasting and Policy System: The Core Model', Reserve Bank of New Zealand Research Paper No. 43.

Cohen, D., K. Hassett and R.G. Hubbard (1997), Inflation and the User Cost of Capital: Does Inflation still Matter?, paper presented at the Federal Reserve Bank of New York Conference, 'The Costs and Benefits of Achieving Price Stability', New York, February.

Desai, M.A. and J.R. Hines (1997), Excess Capital Flows and the Burden of Inflation in Open Economies, paper presented at the Federal Reserve Bank of New York Conference, 'The Costs and Benefits of Achieving Price Stability', New York, February.

Hutchison, M.M. and C.E. Walsh, 'Central Bank Institutional Design and the Output Cost of Disinflation: Did the 1989 New Zealand Reserve Bank Act Affect the Inflation-output Trade-off?', Reserve Bank of New Zealand Economics Department Discussion Paper No. G96/6.

Orr, A. and D. Rae, (1996), 'Exchange Rate Behaviour under Inflation Targets', National Bank of New Zealand Economics Division Financial Research Paper No. 6.

Reserve Bank of New Zealand (1997), *Monetary Policy Statement*, June.

2. Guy Debelle

Andy Haldane raises a number of questions about the appropriate design of inflation targets. In practice, the supposed differences across countries in the design features of their inflation targets appear to me to be overstated. I will concentrate my comments on the three areas where the differences appear the greatest: the choice of horizon for the inflation target; the optimal target bandwidth; and whether the inflation forecasts should be published. I will consider whether the differences in these aspects of inflation-target design are real or apparent, and whether they are important to the effective operation of an inflation target. In doing so, I will focus on the inflation targets of the participants in this session: the UK, New Zealand and Australia.

Choice of horizon

The choice of horizon for the inflation target is posed in the paper as choosing the appropriate value for j, where the reaction function of the central bank is defined in terms of the difference between $E_t\pi_{t+j}$ and the target π^*. While this may be a simple way to represent the inflation target in an analytical model, it does not capture the reality, at least as inflation targeting is practised in Australia, and also, I suspect, in other countries.

Rather than focusing on a single value for the target horizon, the whole time path for inflation is considered over the relevant policy horizon, which might be a number of years. From an optimal-control perspective, if one is aiming to minimise the variability of inflation and output over time, the best result can be achieved by reacting to the whole future path of inflation and output, rather than reacting to the expected value of inflation in a particular period. This is especially the case, given that monetary policy affects inflation over a number of periods, rather than at one unique time horizon (although its influence may be greatest at a particular horizon).

Diagram 1 which suggests a trade-off between inflation and output variability, strikes me as misleading in this respect. Generally such curves reflect the impact of varying the weights on inflation and output in the objective function, rather than the time horizon of the central bank. Gordon de Brouwer and James O'Regan's paper at this conference shows that varying the time horizon of the central bank shifts the whole trade-off curve toward (or away from) the origin for a given set of relative weights on inflation and output.

Optimal bandwidth

The most obvious difference between the inflation-target regime in Australia, that in New Zealand, and the new regime in the UK, is the specification of the width of the inflation target band, and the related penalties for breaching the band. The band in New Zealand has been viewed as an electric fence, where the Governor is shocked for any breach of the band. In Australia, we did not adopt such a hard-edged band, because of concerns that the resulting discontinuity in the payoff function might induce instability in the instruments of monetary policy, and further may result in policy-induced business cycles. More recently this seems to also have been recognised in New Zealand, with the widening of the band and with the edges of the band being interpreted more as a trigger for review than a trigger for dismissal – the voltage on the electric fence has been lowered so that the shock is no longer necessarily fatal. A similar use of a band as a trigger point for a review has been adopted in England, although no explicit penalties for 'inappropriate' conduct have been specified.

In Australia, there is no band specified. Rather, the objective of monetary policy is to achieve an average inflation rate between 2 and 3 per cent, over the course of the cycle. In practice, the Bank is likely to become increasingly uncomfortable at an increasing rate as inflation moves away from this desired level. The assessment of whether central banks have performed satisfactorily in providing a low-inflation environment can only be fully answered over the medium term.

The differences between the three systems are principally in the process of review of the conduct of monetary policy, specifically: the frequency of the review; the reviewing body; the penalty that may be imposed as a result of the review; and on whom the penalty is imposed.

The review is triggered periodically in the UK and New Zealand when the inflation rate moves outside the designated range. In Australia, the review is semi-annual, when the Governor is required to testify before a parliamentary committee on the performance of monetary policy. Both New Zealand and the UK have similar processes. In terms, then, of the frequency of the regular reviews, there seems to me to be little difference in the three systems. Each submits the conduct of monetary policy to review at a satisfactorily high frequency.

In New Zealand, the review is conducted by the Reserve Bank Board which then reports to the Minister of Finance. In the UK, the reviewer is the Chancellor, to whom the Bank of England is required to write a letter, justifying its actions whenever inflation deviates by one percentage point from the central target of 2.5 per cent. In Australia, the regular review is conducted by a committee of parliamentarians (as it is in the other two countries). Questions that are raised here include:

- Should the reviewing body be comprised of 'monetary-policy experts' or politicians?
- Would a review body (particularly a political one) ever conclude that monetary policy should have been even tighter than was actually implemented, or is there a bias towards only penalising or criticising excessive tightness in monetary policy?

New Zealand is the only one of the three that imposes an explicit penalty for breaching the inflation target: the Governor can be sacked if the Reserve Bank Board concludes that his/her performance has been unsatisfactory. Whether there is an improvement in inflation outcomes induced by an explicit performance contract is debatable. The principal-agent literature on central-bank independence tends to support the conclusion that explicit penalties make a difference (Walsh 1995a,b; Persson and Tabellini 1993). However, even if there is no explicit penalty, central banks are subject to public censure for unsatisfactory performance and the Governor can suffer the penalty of not being reappointed to another term. It is arguable that these penalties are sufficient to induce 'appropriate behaviour' for a group of individuals who value their reputation for inflation control, particularly among their central-banking peers.

In both Australia and the UK, there would need to be a wide-ranging reform of the central bank structure to introduce a penalty similar to that in New Zealand. In both countries, monetary policy is the responsibility of a committee or board rather than the responsibility of one particular individual. To impose a penalty for inappropriate inflation performance would seem to require that this structure be changed to place ultimate responsibility for monetary-policy decisions in the hands of a single individual (as it is in New Zealand). I will take this issue up again shortly, in discussing whether inflation forecasts should be published.

If a penalty were adopted, it would appear preferable to impose the penalty only if there was any *ex ante* foreseeable error in the conduct of monetary policy. The reviewing body should not be given the benefit of hindsight in determining whether the actions of the policy-maker were appropriate. This seems to be the approach taken in New Zealand when they were reviewing the performance of my co-discussant in 1996. The Board came to the conclusion that while *ex post* monetary policy was not sufficiently restrictive to prevent inflation breaking the band, a marginal breach of the band should not call into question the Governor's performance, which had been very successful.

Publishing inflation forecasts

Both the Reserve Bank of New Zealand and the Bank of England publish quarterly forecasts for inflation. In comparison, the RBA provides less information on the exact quarterly profile for inflation, instead focusing on the broad, qualitative assessment of the outlook for inflation. For example, in the May 1997 *Semi-Annual Statement on Monetary Policy* (which is the basis of the Governor's testimony before the parliamentary review committee), it was stated:

> 'the Bank expects underlying inflation during 1997 to remain low, probably declining slightly below 2 per cent for a while. Some pick-up in inflation is likely in 1998 as the favourable exchange rate effects pass but, provided growth in labour costs is not excessive, price inflation should remain within the 2 to 3 per cent range'.

Is there much to be gained from supporting such a statement with a more explicit numerical profile for inflation? In particular, the very adoption of an inflation-target regime may render the publishing of inflation forecasts somewhat obsolete. The central bank would not be publishing an inflation forecast which lay outside the desired range at the policy horizon, for in doing so, it would be admitting that the current settings of monetary policy were inappropriate. Andy dismisses this argument as a *non-sequitur* in his paper but it still strikes me as a valid point.

The Bank of England's decision to publish its forecasts is more a result of its lack of independence before the recent reforms (Briault, Haldane and King 1996). When the final responsibility for monetary policy still rested with the Chancellor, the Bank's inflation forecasts were a major part of its armory in the policy debate. Such a role is now likely to have diminished with its newly bestowed independence.

A qualitative forecast for inflation maintains the focus of discussion on the critical issue of the inflation outlook at the broader level, without the discussion becoming hung-up on the more technical issues of forecasting. This may be more important for the role of inflation targets as an anchor for inflation expectations. If inflation forecasts were published, would the public be able to appreciate the reasons why the central bank needed to continually revise its forecasts, or would their confidence in the central bank's competence decline? It may be easier to explain the monetary-policy decision to the public in more qualitative terms.

From a technical point of view, there is the interesting question of the appropriate assumptions for the path of monetary policy when compiling the forecasts. Should monetary policy be assumed to maintain an unchanged interest rate or should an optimal path of monetary policy be incorporated into the forecasts? If one adopted the latter approach, should one also publish the underlying interest-rate path? This may run the risk of again diverting attention from the inflation outlook toward the interest-rate outlook.

Finally, there is the question of whose forecasts should be published. The forecast should be that of the policy-maker, rather than that of the economic department of the central bank, or the forecast of a particular model of inflation. The policy-maker's forecast is clearly the most relevant as that is the one on which the monetary-policy decision is made. Such a forecast is likely to involve some idiosyncratic adjustments to any model-derived forecast, incorporating knowledge about the residuals in an inflation equation that may reflect the peculiarities of current economic circumstances, or more generally embody the lessons of experience accumulated by the professional policy-maker.

If the published forecast is that of the policy-maker, it becomes more problematic to publish the underlying framework. It may be difficult to specify or quantify the (necessary) *ad hoc* adjustments that the policy-maker feels is appropriate. The Bank of England makes some attempt to do this in publishing probability distributions around the central point forecast. However, it is less clear what the approach should be if the policy-maker feels the central point should be adjusted rather than the balance of risks.

Again, as discussed above in relation to the penalties for breaching target bands, if inflation forecasts are published, their accuracy should be assessed in relation to other contemporaneous forecasts, rather than with the benefit of hindsight. For example, as discussed in the paper by Steve Grenville, while some have argued that the RBA's monetary policy was overly restrictive in 1989, this should be taken in the context that the Bank was generally in the 'weaker' part of the distribution of the outlook for activity.

In general, there must be an expected net benefit from publishing quantitative forecasts which outweighs the learning costs of changing the existing regime, to justify such an approach.

Other issues

I will turn briefly to other issues that are raised in the paper. The key conclusion to take away from the first half of the paper that addresses the optimal level for an inflation target, is that while growth-rate effects of inflation clearly are of great importance, one should not ignore level effects. This applies both in assessing the costs and benefits of moving to a lower inflation target. It is a critical question whether the costs of disinflation are transitory or permanent, but these also must be weighed against the permanent effects on the level of output of lower inflation.

In assessing which price index should be targeted, the paper raises the interesting question that if welfare is most dependent on a measure of inflation that includes volatile items, then that is the most appropriate measure to target. However, it must be kept in mind that monetary policy can only have a marginal impact on these prices, the volatility of which is primarily determined by exogenous factors such as the weather. Hence, targeting an underlying rate of inflation is likely to be more satisfactory from an operational perspective. In other words, the underlying rate of inflation functions as an operational definition of the final objective of stability in the consumer price inflation rate.

Finally, a couple of minor points: first, the figure on the linkage between money and inflation seems to me to be nearly completely a story of velocity, so it is difficult to draw any inference about the neutrality of money from it. Second, convexity of the Phillips curve affects the appropriate speed of disinflation, not the decision whether to disinflate or not.

References

Briault, C., A. Haldane and M. King (1996), 'Central Bank Independence and Accountability: Theory and Evidence', *Bank of England Quarterly Bulletin*, 36(1), pp. 63–68.

Persson, T. and G. Tabellini (1993), 'Designing Institutions for Monetary Stability', *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 53–84.

Walsh, C. (1995a), 'Optimal Contracts for Central Bankers', *American Economic Review*, 85(1), pp. 150–167.

Walsh, C. (1995b), 'Is New Zealand's Reserve Bank Act of 1989 an Optimal Central Bank Contract?', *Journal of Money, Credit and Banking*, 27(4), pp. 1179–1191.

3. General Discussion

The discussion focused on how an inflation target should be designed. The primary issues were:

- the appropriate mean rate of inflation;
- the speed with which the central bank should return inflation to the target after a shock; and
- whether publication of forecasts by the central bank was desirable.

While there was a broad consensus that low and stable inflation is necessary for sustainable economic growth, participants generally agreed that, on the basis of current knowledge, a number like 2½ per cent is better than zero. Most thought that in Australia, there have been benefits from reducing inflation from its 1980s average of 8 per cent to its 1990s average of about 2½ per cent. These included longer planning horizons, greater focus on business fundamentals and attention to the management of costs. But the existence of additional benefits from further reducing inflation to zero was considered much more doubtful by most participants. Various arguments were advanced. First, at times, it may be necessary to reduce real interest rates to low, even negative, values, and a zero-inflation target would make this difficult. It was, however, noted that this argument was weakened if fiscal policy could be used to stimulate aggregate demand. Second, low, non-zero inflation facilitates real-wage adjustment if nominal rigidities – such as resistance to nominal wage reductions – exist (though such rigidities could themselves be a product of inflation). Third, it is important to avoid deflation since this can seriously undermine financial stability.

It was noted that these considerations mean that central banks need to take the bottom of their inflation-target bands as seriously as they take the top of their bands. Despite these arguments, a degree of caution in drawing strong conclusions about the benefits of zero inflation was suggested, as no economy in recent times has operated for an extended period with zero inflation. Some participants felt that as experience with price stability builds, some of the arguments against zero inflation might need to be rethought.

One of the rationales for an inflation target is that it helps solve some of the political-economy, or time-inconsistency, problems associated with monetary policy.

Some speakers saw these problems emanating from the central bank's desire to reduce the rate of unemployment below sustainable levels. Others argued that forward-looking central bankers understood that, in the medium term, there was little to be gained from pushing unemployment lower if this simply caused higher inflation. Instead they argued that the time-inconsistency problem comes from political pressures which can be brought to bear even on independent central banks. It was argued that an inflation target which is endorsed by the government was one way of reducing these pressures, as politicians would find it relatively difficult to criticise the central bank if it was achieving its inflation target.

On the question of how quickly inflation should be brought back to target after a shock, the discussion focused on general principles rather than simple rules. It was noted that in assessing the appropriate speed of return it was important to take account of why inflation moved away from the target in the first place. In general, it was thought that policy could be reasonably aggressive in response to demand shocks, since inflation and output responses are in the same direction. Deciding the appropriate response to adverse supply shocks is more difficult, as the tighter policy needed to reduce inflation is likely to exacerbate the decline in output. Most thought that this suggested a slower return of inflation to target, in the interests of minimising costs. However, it was noted that if a slower return led to a significant rise in inflation expectations, this could itself make the process of disinflation even more costly.

In the discussion of whether central banks should publish their forecasts, it was widely accepted that good monetary policy requires the central bank to be forward-looking and that there are benefits from the central bank explaining its view of the future to the public. The debate centred on how that view should be communicated. Some saw value in the central bank publishing detailed numerical forecasts of inflation. It was also suggested that these forecasts should be accompanied by probability distributions in order to convey a sense of uncertainty. Others questioned this approach on the grounds that any medium-term forecast should be the same as the target; in that case the issue could quickly become whether the central bank should publish the interest-rate path that it thought consistent with its inflation objective. Most participants thought this undesirable.

The discussion concluded with the observation that the practice of inflation targeting is comparatively new, and that this makes it difficult to make definitive assessments of exactly what design features represent best practice.

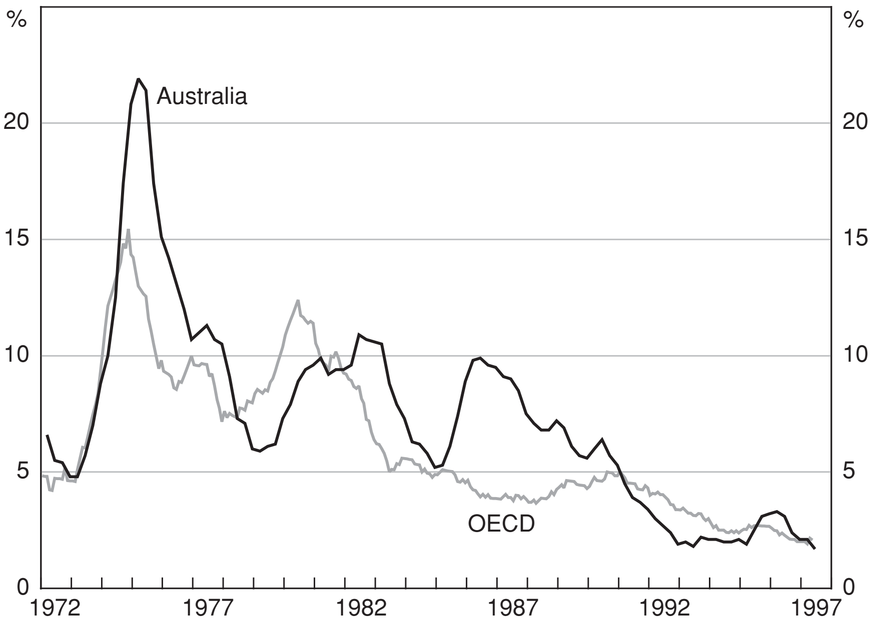
The Evolution of Monetary Policy: From Money Targets to Inflation Targets

Stephen Grenville*

1. Introduction

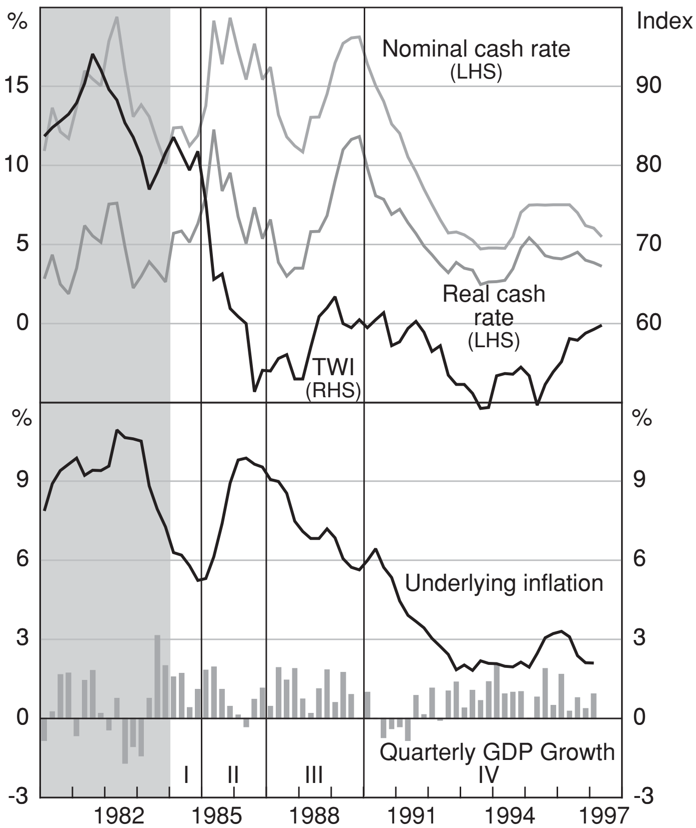
This paper sets out a chronology of Australian monetary policy during the past decade or so. The events themselves are often important, but the main focus here is on the evolution of the monetary-policy framework. Australia began the 1980s with monetary policy based on money targeting, and by the early 1990s this had been replaced by an alternative framework – inflation targeting. This transition took time and reflected a response to the changing set of problems, to the evolving perceptions of the way the economy works, and to the constraints on policy – mainly in the form of conflicting objectives that legitimately were required to be taken into account. The policy framework was influenced by the academic literature, but the academic debate on monetary policy has not run parallel with the problems faced by practitioners, and has provided few relevant answers for them. Having a well-articulated monetary framework was not enough, in itself, to ensure price stability. While most OECD countries achieved price

Figure 1: Australian and OECD Inflation



* Troy Swann and Amanda Thornton helped greatly in the preparation of this paper. Other RBA colleagues gave valuable comments.

Figure 2: Monetary Indicators, 1980–97



Note: The real interest rate is the nominal interest rate less the underlying inflation rate. Prior to 1984, the interest rate is the 90-day bank bill rate.

stability by the mid 1980s, it eluded Australia during the monetary-targeting phase – and for the rest of the 1980s. Late in the decade, the costs of inflation became increasingly apparent, and policy was set with a view to winding it back. Inflation was well contained during the period of rapid growth in 1989/90. But it was not until 1990 that Australia had the combination of commitment, understanding and cyclical circumstances to bring about a structural reduction in inflation.

As we trace through the evolving policy framework, the issues can be brought into sharper focus if the framework, in each episode, is evaluated against a set of common characteristics or criteria:

- While discretion in policy-making would seem to be desirable to cope with the complexities and unknowns of the economy and the variety of shocks which hit it, many countries constrain policy-makers' flexibility by imposing rules. There is a perceived need to discipline the policy-makers, to offset their inflationary biases: rules, so the argument goes, force the authorities to make better decisions. As well, a rules-based framework, backed up by accountability, lets the public know how the authorities will behave, giving the public confidence about the future path of prices: the economy, it is argued, works better with rules. Where did the Bank stand on the 'rules versus discretion' spectrum? What were the 'rules' which constrained and guided the Bank's behaviour? Was there a defined final objective or objectives, against which the outcomes should be judged? Was there an intermediate target and/or an operating rule which guided day-by-day decisions and which allowed the public to continuously monitor the authorities' performance? Who set the rule – the Bank or the Government?

- Second, how did the Bank view the *transmission* of monetary policy? How did the Bank think the economy worked?
- Third, the policy *context*. What was the place of the Bank and monetary policy in the overall macro-policy scheme? Was monetary policy constrained by other policies (or deficiencies in other policy areas), or seen as a 'stand-alone' instrument? Was the Bank free to pursue its objectives (was it independent)?

2. Phase One: 1984 – The End of Monetary Targets

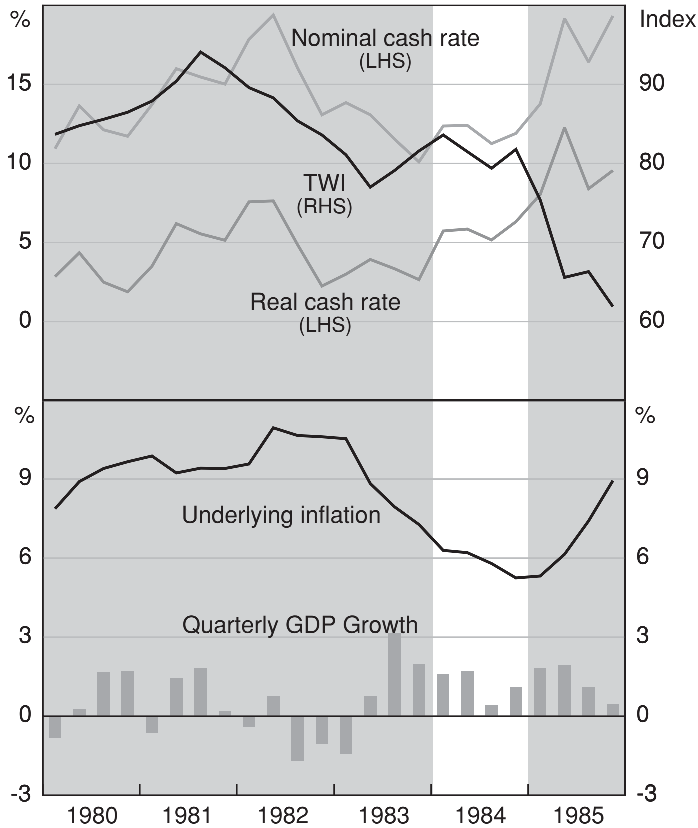
In explaining the evolution of policy, there is always a temptation to go back a little further in history to explain a particular event in terms of its antecedents. This account breaks into the time continuum in the last year of the monetary-targeting phase (which, for Australia, began in 1976 and ended in February 1985). This provides a useful starting point, because the lessons of this phase affected the subsequent period.

Among the industrial countries, pragmatic monetarism was, almost universally, the basis of monetary policy at this time (Goodhart 1989, p. 295). The widespread acceptance of the monetarist framework was a reaction to the perceived failures of the earlier Keynesian approaches. Policy-makers turned to a framework which seemed tailor-made for the problem of price stability. Goodhart (1989) records eight countries as adopting the monetarist framework (see also Argy, Brennan and Stevens 1989).

The characteristics of the monetarist approach in its rigorous form fit neatly into the three-fold classification suggested above:

- In terms of *rules*, money was an intermediate target, but the ultimate target was inflation. While the theoretical apparatus, built around a stable money-demand function, might have suggested that the ultimate target would be nominal income, monetarism came to be associated with the idea that monetary policy should have one single objective – price stability. Abhorrence of inflation was not an essential element of the monetarist framework, but in practice was an important part of the rhetoric. This framework seemed to provide very clear *operational* guidance for day-to-day policy-making – the policy-makers' task was to ensure that the chosen money aggregate remained on its pre-determined track. While ideas of *time inconsistency* had not entered the general debate at this stage, Milton Friedman had a more intuitive view of the pernicious interaction of politics and discretionary policies. One of the most useful (and enduring) contributions of monetarism was to emphasise that monetary policy was more about the *behaviour* of the authorities, rather than about how the economy worked.

Figure 3: Monetary Indicators – Phase One



- While the *transmission* process was not explicit, money was assumed to affect prices quite directly without much effect on activity (the 'classical dichotomy'). There were 'long and variable lags': hence, finetuning the cycle was seen as futile or counterproductive. In any case, the economy was seen to have well-developed self-equilibrating forces which would iron out business cycles reasonably quickly. *Price expectations* were the driving force in the persistence of inflation.
- On *context*, monetary policy had no linkages or synergy with other policies. It was the specialised instrument for achieving price stability, and it should be assigned this 'stand-alone' role. This contrasted with the less rigorously specified Keynesian framework which had the simple notion that excess demand (whether caused by the budget, excess money growth or some non-policy shock) would put pressure on capacity and cause inflation.

This was the rigorous textbook version: the Reserve Bank of Australia's brand of monetarism was rather different – pragmatic rather than doctrinal.[1] It can be characterised in the following way.

1. As Corden (1989, p. 160) notes: 'Contrary to images created during the stabilisation period, Australian policy was not really monetarist in any true sense of the term… There was no suggestion that the projections imposed a constraint on policies'. Others saw money in a more central role in policy, and judged the outcome *solely* in terms of whether the monetary target was achieved (Sieper and Wells 1991).

The rule. The M3 target (more correctly, a 'conditional projection') was set down, in the Budget, by the Treasurer (not the Bank). In addition to the money target, the Bank was still bound by the specific objectives set out in the Act – price stability and employment. The Labor Government which came to power in 1983 specifically renounced monetarism in its rigorous form.[2] This was, in large part, because they saw wages policy as the principal means of achieving price stability. M3 was an intermediate target, with some mix of real output and prices as the final objective, implicitly set so as to be consistent with the wages/incomes outcome ('maximise non-inflationary growth'). The Bank certainly did not see the money target as providing day-by-day operational guidance for policy. In the newly evolved operational procedures, monetary policy was implemented via the cash rate (Macfarlane 1984). This, not a money aggregate, was the operational focus, as it was in virtually every country with a monetary target. To the extent that price expectations were part of the thinking at the time, they were anchored more by the Accord than by the money target.

Transmission. While textbook monetarism saw a direct transmission of monetary policy from money to prices and there were individuals in both the Reserve Bank and Treasury who were firm adherents to the rigorous monetarist viewpoint, Australian policy-makers in general retained their Keynesian view of transmission: inflation depended largely on the state of demand.

Policy context. With the election of the Labor Government in 1983, it was quite explicit that monetary policy was seen as closely integrated with other macro-policy 'arms' – wages policy and fiscal policy. The Bank accepted this: the *Annual Report* (1983, p. 8) noted: 'Because it should entail a lower cost in terms of unemployment, income restraint achieved through processes of consultation is much to be preferred to restraint enforced through tough monetary and other policies'. This period began with a clear perception that real wages were too high. Getting *real* wages down was the task of the Wages Pause (introduced in 1982 – the last year of the Fraser Government) and, subsequently, the Accord. With wages set in this way, monetary policy was constrained: to achieve greater-than-expected success on inflation would actually *worsen* the structural real-wage problem. So monetary policy was set to support wages policy, accommodating a reasonable growth in nominal income.[3]

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2. The flavour is captured by this quote from the first Accord: 'Many countries, including Australia, adopted monetarist policies, on the assumption that they would gradually bring inflation down to low levels, thus breaking inflationary expectations, and enabling a non-inflationary expansion of the economy to then occur. In practice, monetarism proved disastrous… It is with this experience in mind that a mutually-agreed policy on prices and incomes (has been developed)…to enable Australia to experience prolonged high rates of economic and employment growth, without incurring the circumscribing penalty of high inflation, by providing for resolution of conflicting income claims at lower levels of inflation than otherwise would be the case. With inflation control being achieved in this way, budgetary and monetary policies may be responsibly set to promote economic and employment growth, thus enabling unemployment to be reduced and living standards to rise' (ACTU Statement of Accord, February 1983, pp. 1–2).

3. It could be argued that monetary policy *always* faces the same dilemma in reducing inflation: because of sticky wages, it will take some time for markets (especially the labour market) to adjust prices for the new low-inflation policy setting, and in the meantime output suffers. A centralised system, however, can greatly exacerbate this problem. 'To the extent that the Accord has put a narrow band around nominal wage increases, it has flattened the trade-off between output and inflation available to other policies… The rigidity of wages simply means that the deviation of price inflation from wage inflation would carry with

The exchange-rate float of December 1983 provided, for the first time, the technical capacity to enforce the target. But the same institutional changes which made this *possible* also brought into question whether it was *desirable*.[4] The Bank's *Annual Report* of 1984 talks of the new opportunities to control the money supply, but also notes the constraints in doing this. If the general course of inflation and economic activity seemed broadly appropriate, the Bank's non-doctrinal adherence to monetarism made it reluctant to cease observing the economy as it saw it outside the window, and rely solely on the 'blind-flying' instruments of monetary growth. With this fuzzy rule in place, it provided no basis for policy discipline, for accountability, or as an anchor for price expectations.

As it turned out, 1984 was a relatively good year for the economy, with strong recovery coming out of the recession of 1982, but with inflation falling quite sharply, so that by the end of the year it was running at 5 per cent (down from a peak of 12 per cent). Given the wage restraint of the time, there were prospects of it falling further. These were hardly the circumstances in which the authorities were going to tighten policy enough to achieve the monetary target. By February 1985, it was clear that the monetary target would be substantially exceeded, and the target was 'suspended'.

Such a breakdown of the relationship between nominal income and money might have been anticipated: it was certainly not difficult to explain after the event. While some of the discussion was in terms of measurement problems and 'disintermediation', the real problem was much deeper. Regulation had led to 'financial repression', and as people had the opportunity to borrow more, they did so. Australia entered a period – beginning late in 1983 and lasting for about five years – when credit grew on average by more than 20 per cent per year (i.e. much faster than nominal income). With the benefit of hindsight, this was not a sign that monetary policy was loose; it was a sign of the breakdown of the velocity relationship.[5]

The question, in judging policy of the period against current perceptions of the central bank's role, is whether more rigorous implementation of monetarism would have achieved a better outcome on inflation without unacceptable high costs in terms of lost economic output. What explains the difference between Australia's readiness to miss –

it substantial real effects on output and employment' (Carmichael 1990a, p. 4). It might have been possible to devise an Accord which explicitly targeted both real and nominal wages, and set these to achieve price stability. Starting with a real-wage overhang, however, it would have been difficult to achieve simultaneous agreement for a winding back of real wages *and* nominal unit labour costs. The greatest progress in reducing real wages was made, in practice, in those periods when inflation was higher than expected. Later, the Accord helped to contain the wage impact of strong demand in the late 1980s, but it also built further rigidity into the wage/price nexus, as it coped with immediate wage demands by pushing them into the future, creating the 'wages pipeline', which put a floor under wages extending out a year or more.

4. The Governor was to note: 'virtually all the instruments, and the power to use them flexibly, which my predecessors sighed for, are now available to the central bank' (Johnston 1985b, p. 3).

5. It was not until later that the full degree of the breakdown in the money-demand functions was apparent, because continual re-estimation and redefinition could keep the money-demand equations in some degree of stability *ex post*. 'It was an era when econometric studies of demand for money functions multiplied like rabbits. Rarely have so many equations been claimed to have stable and satisfactory properties one moment and have collapsed the next' (Goodhart 1992, p. 314). The RBA Conference of 1989 set the seal, for Australia, against the idea that money demand could be the basis of monetary policy. But, in practice, it had been abandoned three years earlier. The Bank came to see money as endogenous, with nominal income causing money to increase, rather than *vice versa* (Carmichael 1990a, p. 12).

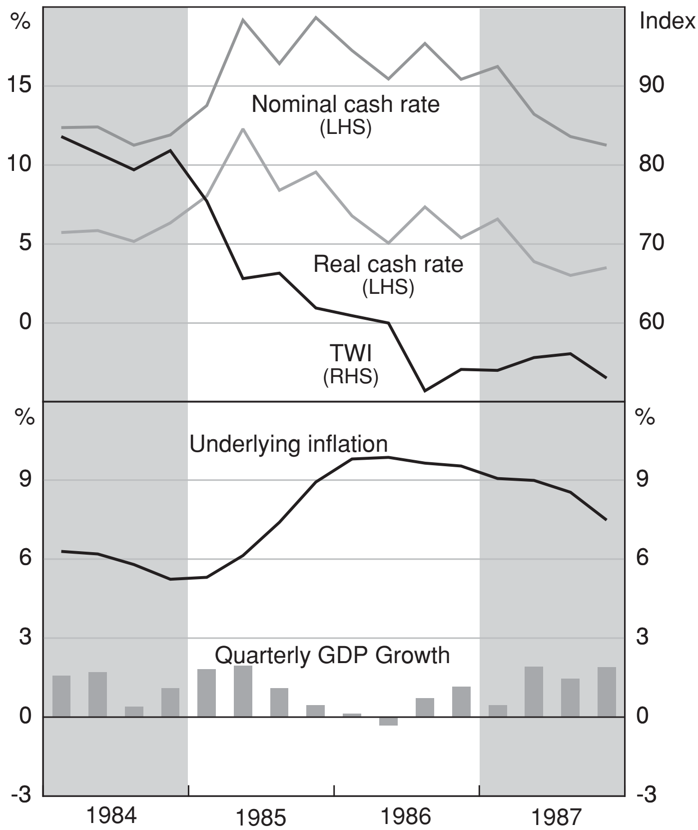
and then abandon – its monetary targets, while in the United States the short-lived monetarist period saw the definitive re-establishment of price stability during the 'Volcker deflation' of 1979–82? Much of the answer lies in the perceived urgency of the inflationary problem. American inflation had reached an annualised rate of more than 15 per cent, and inflation was recorded as a major concern in public opinion surveys of this time (Fischer 1996, p. 24). In Australia, inflation, which had reached nearly 20 per cent in 1975, reached 12 per cent in its second peak in 1982 and by 1984 it was moderate and seemed likely to fall further. Its solution was, in any case, seen to lie largely with wages policy. The American authorities probably had no more faith than their Australian counterparts in the ability of rigorously applied monetarism to achieve price stability at a low cost to economic activity, but monetarism provided the framework (Blinder described it as a 'heat shield') to implement policies which would otherwise have been unacceptably restrictive. As Goodhart (1989, p. 296) said: 'The policies adopted in the early 1980s allowed the authorities freedom to raise interest rates to levels that did subdue inflation, and the accompanying check to output growth, though severe, was indeed temporary. Certainly, the credibility (of Volcker and the Fed) was probably based more on their demonstrated willingness to accept a painfully high level of (real) interest rates and a sharp downturn in output, rather than on the achievement of a particular monetary target… Central bankers appreciated the function of a monetary target in providing them with 'a place to stand' in warding off calls for a premature easing of policy'. Australia at the time had no such determination to return to low inflation, nor to allow interest rates to remain at the high levels experienced in the United States (and, much more briefly, in Australia). If Australia had not experienced the large exchange-rate fall of 1985 and 1986, it is quite possible that inflation would have fallen significantly below the 5 per cent recorded in 1984, and price stability might have been established. If it had, the cost (in terms of lost output) would have looked quite favourable, compared with the Volcker deflation. But this is hypothetical. The combination of circumstances needed for price stability did not recur for a further five years.

By the time Australia 'suspended' monetary targets in February 1985, many other countries had abandoned or downgraded them. 'By the latter part of the 1980s the technical elements (of monetary targets) were deemed by the generality of policy-makers to have comprehensively failed' (Goodhart 1989, p. 296). The main reason was, as in Australia, a breakdown of the relationship between money and nominal income. As Governor Bouey of the Bank of Canada said: 'We didn't abandon monetary targets, they abandoned us'.

3. Phase Two: 1985 and 1986 – *Ad hoc* Policy 'Holding the Line'

The over-riding impression, looking back on this period, is of monetary policy being used as a stop-gap measure to buy time while other policies were put in place to handle the more deep-seated problems which had emerged and which were not amenable to monetary-policy actions. The *Annual Report* (1987, p. 12) put it this way:'Monetary management through the domestic and foreign exchange markets sought to provide a generally stable financial environment while policies of more fundamental adjustment took hold'. With the Accord process working, over time, to reduce real wages and the

Figure 4: Monetary Indicators – Phase Two



budget gradually shifting from deficit to surplus, it was left to monetary policy to cope with the cycle and whatever other macro problems came along. The most pressing macro issue was the external problem – the large current account deficit – which put major downward pressure on the exchange rate (and thus upward pressure on inflation). Monetary policy could not fix the basic problem (the savings/investment imbalance), but had to respond to the symptom – inflation.

This period can be put within the three-fold classification quite briefly:

- There was no explicit rule (other than the on-going guidance of the Act), and the degree of discretion was high. The objective was described as 'to achieve non-inflationary growth' (Johnston 1985a, p. 810).
- The transmission channels still had inflation as an outcome of excessive demand. The new element in this period was the overwhelming importance of the exchange rate in determining inflation.
- Monetary policy was fully integrated into the overall policy-making framework, without a clear independent role.

With the sudden ending of monetary targeting in February 1985, there was little or no formal framework to guide monetary policy. The first priority was to put in place *some* alternative. The resulting 'check-list' was an *ad hoc* mixture of intermediate objectives, final objectives and objectives that did not directly belong in a monetary framework. The check-list was described in Johnston (1985a, p. 812): 'The relevant indicators include all the monetary aggregates; interest rates; the exchange rate; the external accounts; the current performance and outlook for the economy, including movements in asset prices, inflation, the outlook for inflation and market expectations about inflation'. This check-list might be seen as a step backwards, as it was moving from a nominal rule to a framework where a wide degree of discretion was, at least in theory, available.[6] But the rule had broken down, and in the absence of any obvious alternative rule, 'look at everything' seemed sensible.[7, 8] Other central banks which had abandoned monetary targets in much the same period also found themselves searching for an appropriate target, and few succeeded in finding an alternative, at least in this period.[9] 'We do not live in a world in which one can confidently rely on market forces to restore the economy to a stable unique equilibrium, so long as the authorities themselves do not rock the boat. In this context, the authorities have reverted to discretionary intervention' (Goodhart 1989, p. 335).

6. Goodhart (1989, p. 334) described it this way: 'Supporters would describe it as sensible pragmatism; detractors as a reversion to a muddled discretion which, once again, allows the authorities more rope than is good for them, or us'.

7. The *Annual Report* (1987, p. 7) said: 'Theoretical debates about the setting of monetary policy have been overborne in Australia as elsewhere by the pressure of events stemming, for the most part, from financial deregulation and imbalances in international payments… One consequence is that norms for monetary growth, which hitherto had served as intermediate objectives for policy, have been progressively discarded in many countries. In their place there is now routine reference to a wide range of financial and non-financial indicators to be weighed and judged in determining the appropriate direction for monetary policy and the intensity with which it is to be applied; in short, considerable pragmatism'. For an example of the Bank searching for a balance between discretion and rules, see Jonson (1987). Having observed that different types of shocks require different responses, Jonson (1987, p. 12) observed: 'The monetary authorities should have the freedom to choose among the various possible responses to specific circumstances. That is what I mean by discretion'.

8. Perhaps less defensible is the Bank's reluctance to admit its control over short-term interest rates, for example: 'Although interest rates should not be targeted, short-term interest rates could be used as one important indicator of the stance of policy' (RBA 1985, p. 3). 'That does not mean we have an interest-rate objective. Changes in interest rates are important indicators of the change in financial conditions' (Phillips 1985, p. 12). 'I would, however, like to deal with an assertion that the Bank is "interest-rate targeting". This is not so. The Bank's day-to-day actions are in terms of quantities and are designed to affect quantities at the end of the transmission chain. Of course, interest rates are a vital element in the transmission mechanism but are not the policy objective' (Johnston 1985a, p. 810). No doubt the thinking was that, if the Bank admitted to being able to influence interest rates, then it would come under pressure to move them to settings which it considered inappropriate. This might be defensible enough in terms of political economy, but did nothing for transparency of policy. In relation to the reductions in interest rates in the early part of 1986, the Governor noted that: 'Monetary policy has acquiesced in interest-rate falls, rather than trying to lead the market' (Johnston 1986b, p. 3).

9. As an example: 'In the eyes of many economists, the Federal Reserve System has been steering without a rudder ever since it effectively abandoned its commitment to monetary growth targets in 1982. The visible success of monetary policy during the past half-decade is therefore all the more puzzling' (Friedman 1988, p. 52).

A more practical defence of the policy of the time would note that, conceptually flawed as the approach was, a more precisely defined monetary-policy framework would have reacted to the events in much the same way. The problems were so pressing, and the threat to price stability so clear, that the broad response of policy was obvious. Beginning in February 1985 (i.e. almost immediately after the ending of monetary targets), the exchange rate fell by 35 per cent over the next 18 months: it coincided with a terms-of-trade decline and an increase in the current account deficit. With hindsight, this looks like a structural adjustment of the exchange rate, which has been more-or-less maintained over the ensuing 10 years. In this world, the best policy was to accept the first-round impact on inflation, and to attempt to prevent second-round effects. This was done, including some wage discounting in the Accord process.[10]

The exchange-rate fall was symptomatic of growing concerns (especially in financial markets) about the current account deficit – which reached 6 per cent of GDP (for the second time in five years), compared with a traditional 2–3 per cent of GDP in earlier decades. The Bank saw this in terms of the Twin Deficits analysis – the current account deficit reflected a savings/investment imbalance, and the answer was to improve domestic saving by shifting the budget towards surplus.[11] While this adjustment was occurring, policy needed to hold the line to minimise the impact of the current account on the exchange rate, with its inflationary consequences.

Exchange-rate weakness was the preoccupation of policy between February 1985 and around September or October 1986.[12] Interest rates reached their decade high in November 1985 (higher than they were to go in 1989). While the exchange rate was the focus of monetary policy, interest rates were not set as they would have been in a fixed exchange-rate regime – to defend a specific exchange-rate level, with the full impact of this defence being reflected in the money supply. The foreign-exchange intervention was always 'sterilised'. Whatever movements there were in interest rates (and these were almost unprecedented) were a conscious choice of policy, not the incidental result of some change in base money. Even though the exchange rate was a preoccupation of this time, it was not seen as an active instrument to be used in reducing inflation, particularly as a lower exchange rate was seen as an important element in improving the external position. Visiting Brookings economists (in 1984) captured the thinking of the time: 'We believe it is unwise to allow the exchange rate too much independence in a small open economy. Real depreciation is inflationary and real appreciation…should be banned on the grounds of its effects on unemployment' (Caves and Krause 1984, p. 73).

10. The attempt to contain the impact to its first-round effects was only modestly successful. Using current (1997) equations, we can judge that, even excluding the first-round effects, inflation rose in 1985 and 1986. Analysis at the time, however, expected a larger, quicker pass-through (and was therefore readier to accept the rise in inflation in 1986) and expected a sharper falling away in inflation in 1987.

11. The *Annual Report* (1986, p. 7) noted: 'With other policies unable to respond quickly…monetary policy was tightened substantially. This step had elements of a holding action… The more deep-seated they appeared, the more obvious it became that responses need to be found beyond monetary policy… The period of adjustment appears likely to be longer and more difficult than previously thought. In particular, the need to further restrain public spending and borrowing is likely to persist for some time yet'.

12. It could be argued that the exchange rate was an intermediate target, and inflation the ultimate objective, but this probably implies more formalisation than was present at the time. The *Annual Report* (1987, p. 6) noted that: 'A key operating objective throughout 1986/87 was to maintain a degree of stability in the foreign exchange market'.

At the same time that policy-makers in many countries were groping to establish some new framework to replace 'pragmatic monetarism', the previous concordance between the academic and practical frameworks was lost. 'Many macro-theorists are apparently loath to accept any dilution of their earlier image of the economy, partly because it raises questions about the adequacy of their models, and the meaning of such accepted concepts as rational expectations. This has led to an increasing divide between a state-of-the-art macro-theory and practical policy analysis' (Goodhart 1989, p. 335). The mainstream academic theory retained strong elements of monetarism, although commentators such as Ben Friedman recognised its comprehensive failure as a practical guide to policy. Some of the developments in the academic world remained entirely remote from the practical policy-making world (most notably the development of real business cycle theory, which had no role for monetary policy). Other elements *did* influence practical thinking, although often obliquely. The 'rational expectations' revolution made policy-makers think about the interaction of their policy-making framework with private decision-making (although, in all probability, no central banker ever accepted the view that monetary policy had no impact unless it involved 'surprises').[13] The gradual popularisation of the time-inconsistency critique of policy-making brought much greater interest in the *institutional framework*, particularly the issue of the relationship between politics and monetary-policy setting, and the issue of central bank independence. That said, central bankers, by and large, did not see themselves as 'congenitally inclined to administer inflation surprises' (Grenville 1996, p. 34) to an unsuspecting economy.

4. Phase Three: 1987 to 1989 – The Asset-price Boom

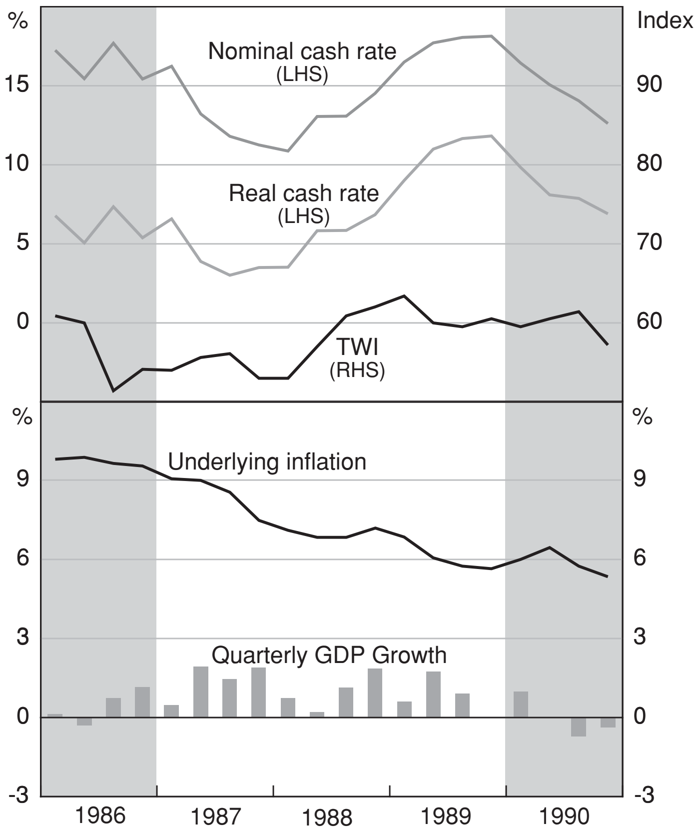
This period represents a transition in policy thinking, not fully developed or articulated until the next phase. The motivation was a growing discomfort (within and outside the Bank) with the degree of policy discretion, combined with the recognition that most other OECD countries had succeeded in getting inflation down: Australia, with inflation not far short of 10 per cent, looked out of step, and there were increasing calls for the Bank to 'do something about it'. At the start of the period, policy-makers still thought that general downward pressure on inflation would be enough to restore price stability. By the end of this phase, there was a recognition that monetary policy would have to take a more active role in re-establishing price stability. Perhaps the defining characteristic of this phase is the asset-price inflation, which demonstrated more clearly than before how inflation had pervaded economic decisions. The damage this did to resource allocation was clear, and the need to correct it became more obvious.

How does the half-formed transitional framework of this period fit the three-fold classification of characteristics?

- The final objective was not more explicit than set out in the Act, but inflation came to be seen as the serious problem, so there was a greater determination to lower it, without specifying an exact objective: 'While monetary policy can and does affect

13. 'Lucas, Sargent, Sargent and Wallace and Barro develop Rational Expectations models with striking conclusions. Systematic, and therefore anticipatable, monetary policy would have no real effects even in the short run' (Begg 1985, pp. 132–133).

Figure 5: Monetary Indicators – Phase Three



activity in the short run, its ultimate goal should be price stability' (Macfarlane and Stevens 1989, p. 8).

- The transmission was still seen as being via income/output to inflation. The exchange rate, over time, assumed greater importance as a positive force for inflation control, less inhibited by concerns about loss of international competitiveness.
- The main instrument in winding down inflation was still seen as the Accord, with various wage/tax trade-offs used as 'circuit breakers' to try to shift the wage/price nexus to a lower level.[14]

Was this period a simple continuation of the check-list framework of 1985 and 1986? The check-list had been an immediate response to the suspension of monetary targeting.

14. The emphasis in getting inflation down was still on co-ordinated policies. Fraser (1989, p. 13) stated: 'Fighting inflation might be what monetary policy does best but, however good it is at that, monetary policy alone will not beat inflation in Australia other than at extremely high cost in terms of output and employment forgone'.

Its lack of rigour (and confusion between intermediate and final targets) became obvious over time, and there was clearly some discomfort with the degree of discretion it gave to policy. There was also a growing perception that inflation had not come down as much as expected and was now out of line with the international norm. With the greater degree of international financial integration, this was seen to make us more vulnerable (Erskine 1990).

The main response was an attempt to sharpen up the *ad hoc* processes of 1985 and 1986. The main specific step forward was a more precise view about the role of intermediate and final objectives (this discussion was reflected in papers by Macfarlane (1989b) and Grenville (1990)). The guidance of monetary aggregates had been abandoned only reluctantly: 'However, for automaticity to be better than discretion, you need a *relevant* rule which effectively links operating objectives to final objectives. We have not been able to find a simple quantitative rule that will work in practice… Once the idea of a firm, consistent money/prices relationship is abandoned (however reluctantly), perhaps the most difficult issue is the *calibration* of monetary policy' (Grenville 1989, pp. 9, 14). The desirability of an intermediate target was acknowledged, but the possible intermediate targets (monetary aggregates or the exchange rate) were rejected as being inappropriate to the circumstances (Macfarlane 1989a). The conclusion was drawn that the instrument needed to be set with the final objective as its guide (and there was a recognition that this needed to be forward-looking – later to be re-styled as 'pre-emptive').[15] There was a sharper recognition of the important time dimension of the Phillips-curve framework – the short-run trade-off and the long-term absence of a trade-off – which led policy-makers to realise that they would have to do more than simply smooth the cycle to achieve price stability. There was a recognition of the possible biases in mistaking the operating instrument (nominal interest rate) for the ultimate objective (Macfarlane 1989b, p. 15).[16]

While the framework was being sharpened, there was a growing realisation that inflation was seriously distorting decisions. By 1989, a greater emphasis on inflation is apparent in the *Annual Report* (p. 8): 'The vital key is inflation. Restructuring is much more difficult, even impossible, in a high inflation environment which destroys competitiveness and discourages saving. Altering this situation must have top priority'. By November 1989, the Governor was saying: 'Every central bank should have as a medium-term economic goal the reduction in – indeed, the elimination of – inflation. In Australia we are seeking to achieve this goal without incurring unacceptable recessionary costs' (Fraser 1989, p. 13). As one economic commentator said: 'Australia's central bank had lost its credibility as an independent inflation fighter during the great inflation of the 1970s and 1980s. But, reflecting an international shift in central bank thought, the Reserve Bank gradually articulated a new economic policy rationale for itself that placed low inflation as the overriding target for monetary policy' (Stutchbury 1992, p. 64).

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15. 'Actual inflation is not a good guide for monetary policy: leading indicators of inflation are much more useful. The main leading indicator is the strength of domestic demand. Monetary policy should aim to keep domestic demand growing at a rate that is consistent with future restrained inflation. Indicators of inflationary expectations are also very important. In this scheme of things, indicators of future inflation have become a quasi-intermediate objective' (Macfarlane 1989b, p. 154).

16. Research papers written at this time (see, in particular, Edey (1989)) demonstrate that nominal interest rates can be an effective instrument of monetary policy, provided there is some nominal anchor (either nominal income or inflation).

So much for the evolving policy framework: what of the events of the time? By late 1986, the downward pressure on the exchange rate was over and, apart from one very brief period of weakness early in 1987, the exchange rate strengthened. The combination of slower economic growth, a stronger overseas environment, firmer commodity prices, the prospect of lower inflation and the acceptance by financial markets that the Budget was on the right track, all combined to change the tone in the foreign-exchange market. The settings of policy which had been necessary to support the dollar were no longer needed. There was subsequent criticism that monetary policy in 1987 was unduly lax: the question for policy at the time (and with the benefit of hindsight, still is) not so much whether interest rates should be eased, but by how much.

The framework in place at the time gave no guidance on this: but it was not clear what monetary framework *would* have provided such guidance. By this stage, the evidence on money-demand instability was irrefutable – and in any case, even in the period of monetary targeting, the target was never considered to be sufficiently precise to offer specific guidance on the day-by-day policy settings.[17] Credit had continued to grow at close to 20 per cent in 1986, even with the real economy recording almost no growth, so there was also no guidance to be had from this.

In the event, common sense was the guide. While inflation had been the clear priority in the 1985 and 1986 period (because it was the main threat), in 1987 activity and inflation were both relevant. With the economy quite weak and inflation coming down, nominal interest rates were eased to 11 per cent – representing a real interest rate of around 4 per cent. The exchange rate may also have been a factor: there was no great enthusiasm to see the exchange rate strengthen very substantially (some saw the newly competitive exchange rate as an important requirement for the structural change that would diminish the chronic structural current account deficit).[18] But the main influence of this time was a perception that interest rates had been abnormally high in 1985 and 1986, and they needed to be adjusted to the different economic circumstances of 1987, even though inflation had not yet fallen to an acceptable rate. There were no signs, until the June-quarter accounts were released in August 1987, that the economy had any strength. The only 'outlier' in the uniformly lack-lustre data set was stock-market prices – which had risen 25 per cent in the first half of 1987. These equity prices were a foretaste of what was to come: a two-year period of very strong asset prices, not closely connected with the real economy, but largely driven by the response to financial deregulation and the interaction of inflation and the tax system. The monetary framework in place at this time had no specific guidance on how monetary policy should respond to asset prices, in a world where other measures of inflation were coming down, albeit slowly.

Before policy-making took aboard the evidence that the economy was speeding up in the second half of 1987, the stock market shake-out of October occurred. There was, in fact, almost no further easing of monetary policy in the aftermath of the shake-out

17. Macfarlane (1988, p. 12) in the SEANZA lecture, set out the degree of accuracy that would be required of the money-demand function before it could provide operational guidance, and this degree of accuracy was clearly not even remotely approached.

18. The *Annual Report* (1988, p. 14) reflects this tension: 'It was not possible for interest rates to be used simultaneously to dampen domestic demand and demand for the Australian dollar'.

(Macfarlane 1991, p. 189), although policy-makers were on tenterhooks, watching the impact on the financial sector in particular. In the event, there were no obvious knock-on effects to other sectors: to the extent that there were important effects, these tended to work themselves out in slow motion, with the balance-sheet damage done to some corporations not being apparent for a couple of years. The stock-market shake-out did, however, delay consideration of an interest-rate increase which would otherwise have been on the agenda. By April 1988, it was clear that the economy was quite strong, and that inflation was not coming down as fast as had been expected. Interest rates were raised by some 200 basis points in April/May 1988 (historically, a very large initial increase) and this was the start of a process which, over the next 15 months, took interest rates up by a further 500 basis points. This was a response to excess demand growth – towards the end of 1988 and early in 1989, demand was growing at an annualised rate of over 10 per cent – (which manifested itself, also, by spilling over into the current account deficit, leading some observers to say that it was the deficit that was motivating policy – see below). Unlike in some earlier periods, there was a notable readiness to raise interest rates in response to an economy which was running too fast.[19] The absence of any calibration made it hard for the Bank to be 'pre-emptive' in setting rates, but the determination of the Bank to slow demand is reflected in Governor Johnston's comments in March 1989: 'Over the past month or so, there have been some tentative signs of moderation in the strength of demand but…we will have to hold to the tougher policies until it is clear that results are on the board. This might well entail further turbulence and take a bit longer than expected earlier' (Johnston 1989a, p. 9).

The strength of demand (and the potential effect of this on inflation) would have been enough to explain the tight settings of policy.[20] But asset-price inflation strengthened the Bank's resolve to reduce inflation. Although the Bank did not target asset prices (Macfarlane 1991, p. 187), the Bank took much greater interest in asset prices in 1989, noting the interaction between inflation and the tax system, and the greater gearing up for asset purchase which had been made possible by financial deregulation and international integration: 'the fundamental reason is that after nearly two decades of relatively high inflation, the community has concluded that the road to increased wealth has been to become the owner of assets that increase in value' (Macfarlane 1989, pp. 28-30). The Bank knew the dangers of bursting an asset-price bubble, although the most recent example – the October 1987 share-market shake-out – did not seem to have

19. The exchange-rate crisis of 1985 and 1986 had shown policy-makers that interest rates could be shifted sharply without dramatic consequences for activity. After the high interest rates of late 1985, the Governor noted: 'In a deregulated system, interest rates need to be higher to produce any desired degree of monetary "tightness"'. We have had to await interest rates reaching a level where resistance by borrowers and concern by lenders about borrowers' capacity to use funds emerged before monetary policy recovered its effectiveness' (Johnston 1986a, p. 4).

20. As Governor Johnston said in March 1989: 'In broad terms, we could say that the unexpectedly powerful economic growth has cost us a year in a strategy for winding down price increases and improving the balance of payments'. With the calibration of policy so difficult at this stage, there was no notion of looking forward to anticipate the slower economy and lower inflation. 'Growth has been so rapid as to be seriously underestimated by the policy-makers'. 'The policy setting has tightened. But are we doing enough, quickly enough? We know that if macro policies are pursued with sufficient toughness, long enough, they will slow the economy. But there can be no precise, scientific answers to these questions' (Johnston 1989a, pp. 8–9).

had any immediate wider impact on activity.[21] While the asset-price increases were not specifically incorporated into the monetary framework, they reinforced the growing view that inflation had now been incorporated into widespread economic behaviour, and this was distorting many economic decisions. It emphasised that policy could no longer rely on the fading-away of the inflationary impulse, but would have to take a more active role in restoring price stability. The 'mind-set' had changed, and policy was being set with lower inflation as the objective but the opportunity to achieve this had not yet arrived. While policy did not succeed, at this time, in achieving price stability, the problem (as Hughes (1994, p. 148) points out) was that there was a gap between the *effectiveness* of policy and its *intent*: the Bank was not able to make significant progress on inflation, on the 'easy wicket of fast growth'. But policy was tight enough to ensure that inflation (properly measured)[22] continued to fall throughout the period, despite the strength of demand and the asset-price inflation. With no upward slippage in inflation (or wage break-out) during this period of economic exuberance, the scene was set for inflation to fall significantly when the economy slowed.

While monetary policy at this time is criticised for incorrect focus on the current account deficit, the Bank's Annual Reports emphasise that the current account deficit required *structural* change: 'Monetary policy remains a potent demand management tool, though its effects are distributed unevenly. It will reduce, or even reverse, a surge in aggregate demand if applied vigorously enough and for long enough. This should, with a lag, cut into the demand for imports and thus the current account deficit. However, this is not the primary objective. In fact, in the short run, there may be perverse effects on the balance of payments if higher interest rates produce an exchange-rate appreciation. On its own, monetary policy will not produce the longer-term structural benefits Australia is seeking. Beyond a point, it may even inhibit the structural change because of the effect of high interest rates on investment of all types. Nevertheless, monetary policy has an essential role in supporting structural reform' (*Annual Report* 1989, p. 7).[23] Clarity of analysis, however, was not helped by some of those involved in the policy discussion who did see monetary policy as the appropriate instrument to address the current account deficit – this may have encouraged policy to stay firmer longer into the second half of 1989, in the face of a recognition on the part of the Bank that the economy was slowing. For further discussion see Edwards (1996).[24]

21. The *Annual Report* (1991 p. 4) later described this as 'an inevitable collision of strategies based on high gearing and rising asset prices on the one hand, and the arithmetic of high funding costs on the other'.

22. Those who insisted on focusing on the distorted headline inflation rate missed the trend. For example, Stemp and Murphy (1991, p. 22) commented: 'No sustained reduction in inflation has been achieved over the past five years'.

23. See also Phillips (1989).

24. Tingle (1994) observed: 'There was a growing rift between the Treasury and the Reserve Bank on the appropriate use of policy. Treasury was more aligned with Keating's position of explaining changes in interest rates in terms of the balance of payments, a position that some of the Reserve Bank thought was ridiculous'. For other discussions on the politics of the time, see Kelly (1992) and Toohey (1994).

5. Phase Four: 1990 to Date – The Fall in Inflation

1990 represents the watershed for inflation, with the high rates of the previous two decades quickly replaced by an average of 2–3 per cent.

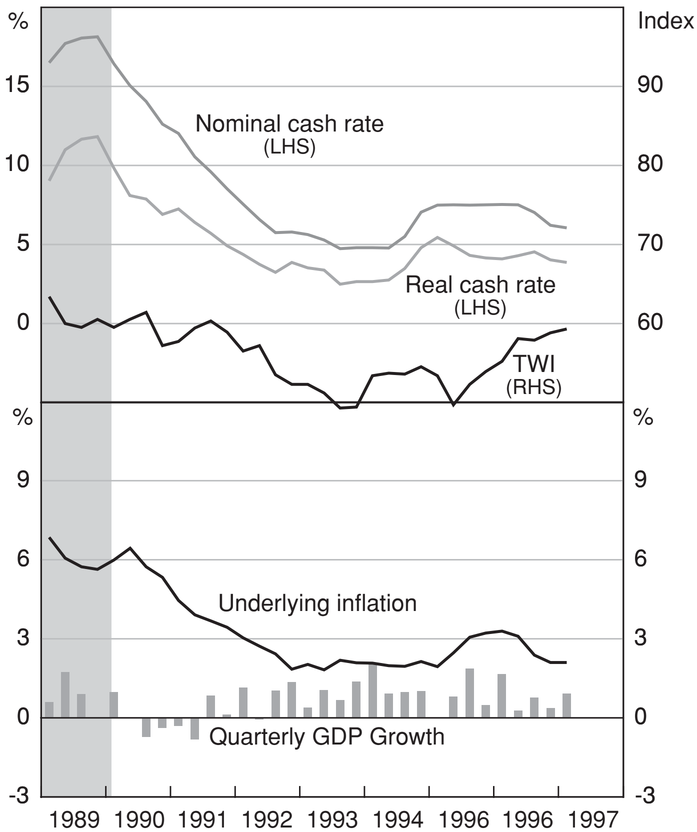
There is little doubt that inflation would have fallen in the early 1990s: policy had been set tightly enough during the late 1980s to prevent inflation from rising during a period of very strong activity (in fact, it continued to come down). The *extent* of the fall in the 1990s, however, reflects the unexpected severity of the 1990/91 recession. As one journalist noted: 'In the late 1980s, economists repeatedly were surprised by the Australian economy's vigour. They were equally caught out by the severity of the economy's slump in 1990 and 1991' (Stutchbury 1992, p. 17).[25] The Bank did not set policy with a view to producing the sort of inflation-busting downturn that had occurred in the United States in 1979–82 (the Volcker deflation). Nor was there in place the sort of 'heat shield' monetarist rule that would have supported the authorities during such a process. But when the recession came, the inflation focus of the late 1980s meant that the policy response was quite different from the recession of 1982/83 and the slowdown of 1986, when the Bank had been a passive player in the unfolding events – in 1990, the Bank was prepared to use the opportunity to achieve a *structural* downward shift in inflation.[26]

This recession could be relied on to reduce inflation, as always happened in a cyclical downturn. The central issue, in evaluating this period, was that the cyclical fall in inflation also provided an opportunity for a structural change as well – to shift to a world of price stability. This required that policy should focus, much more sharply than before, on inflation. 'To reduce inflation in a structural permanent way – as distinct from a temporary, cyclical improvement – requires the prevailing inflation psychology to be fractured' (*Annual Report* 1991, p. 3). Some have argued that the Bank's inflation focus came as a *result* of the (implicitly accidental) success in reducing inflation (Pitchford 1993, p. 7 and White 1992, p. 16). The clearest refutation of this view is in the mid 1990 *Annual Report*, with its singular attention to inflation, at a time when inflation had not yet

25. This may be a chronic problem in cyclical assessments. Quoting Keynes, Skidelsky (1997, p. 35) says: 'The forces of optimism may triumph over an interest rate "which in a cooler light would seem to be excessive: conversely", "the collapse of the marginal efficiency of capital may be so complete that no practicable reduction in the rate of interest will be enough"'.

26. Why did inflation fall much more sharply than the Bank (or other forecasters) expected? There was, initially, some help from the exchange rate and world prices (which reflected the weakness of international demand). Macfarlane (1992a) notes, too, that (unlike earlier downturns) this one was not preceded by a profits squeeze, so margins could be cut as demand fell. Wages, too, were quicker to reflect falling demand than might have been expected, given the wages pipeline left over from earlier Accord arrangements. Wage/tax trade-offs may have helped (throughout 1990 and 1991, they were still given an important role in the Bank's anti-inflation framework – see Fraser (1990a)). 'Whereas the Accord seemed to put a "floor" of about 7 per cent under the inflation rate during the 1980s, recent events have confounded this pessimistic interpretation. The rate of growth of earnings has come down *pari passu* with the rate of inflation. In the event, there turned out to be no "floor"; what was left of the centralised system was flexible enough to adjust to the recession and the sharp fall in consumer prices' (Macfarlane 1992a, pp. 10–11). In April 1990, the IRC rejected Accord VI, agreeing to a smaller wage increase, reflecting the economic circumstances. In October 1990, the opportunity was taken to use a further wage/tax trade-off to reduce further the wage growth and empty out the 'wage pipeline' of impending increases. From October 1991, enterprise bargains (i.e. a decentralised system) became the key principle of wage policy.

Figure 6: Monetary Indicators – Phase Four



fallen.[27] From the front cover, to the anti-inflation quotations introducing each chapter, the focus was inflation. Having acknowledged that 'the crucial adjustments – particularly in terms of reduced inflationary pressures and import demand – are starting to come through', the *Annual Report* (1990, pp. 4–5) went on to argue that 'the task of monetary policy is not completed with the removal of excess-demand pressures; rather, monetary policy will need to remain relatively tight to help wind down inflation'.[28, 29]

27. The emphasis on inflation had been highlighted earlier, in a speech in April by the Governor called 'Inflation', which argued that: 'We would do better to try to eliminate inflation than to try to live with it: and the policies to be pursued to get inflation down must avoid the "cure is worse than the disease" problem' (Fraser 1990a, p. 19).

28. Phillips (1990, pp. 15–17) provides another example of the sharper focus on inflation. Having acknowledged that inflation was running at 'around 7 per cent', he went on to say that '7 per cent is not really good enough. Our judgment is that the costs are clearly big enough that inflation must be reduced'. There was also a new emphasis on breaking inflationary expectations. 'To the extent that we can influence expectations by more clearly communicating our objectives, we should hopefully be able to speed up the process of adjusting expectations and therefore lower the cost of reducing inflation. (But) people will only confidently adopt

Within the Bank, the belief at the time was that the broad profile of the cyclical trough was not, by 1990, much amenable to changes of monetary policy, having been largely determined by earlier settings and by the unfolding world slowdown.[30] The *Annual Report* (1991, p. 3) noted: 'it was clear that the slowing in activity was greater than had been expected', but went on to note that 'too rapid a reduction in interest rates would risk suggesting to a sceptical public that here was another round of 'stop/go' policies. In that event, price expectations would not go lower and the opportunity to achieve a lasting reduction in inflation would be lost'. 'Monetary policy is not just about smoothing out the business cycle. That would mean just accepting whatever the inflation rate happens to be now' (Phillips 1990, p. 17). The important policy objective, then, was to achieve some 'gain from the pain'.[31] The Governor said: 'When the economy is running hot, everyone can agree on tighter policies: it is when the economy slows and the stance of policy remains relatively firm that policy-makers demonstrate their resolve to wind back inflation' (Fraser 1991a, p. 1). In November 1990, he said: 'There is now the very real prospect of Australia joining the ranks of the low inflation countries. We must not allow this once-in-a-decade opportunity to slip through our fingers' (Fraser 1990c, p. 4).

Once the downturn began, the settings of policy were quickly adjusted, beginning in January 1990.[32] A significant slowing of the excessive growth rates of 1988/89 was needed (and policy aimed to bring it about), but there was no recognition, in 1990, of the magnitude of the downturn.[33] Nor, given the surprisingly high real interest rates needed

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much lower expectations for inflation when they actually see it come down and stay down'. 'After two decades during which prices have increased overall by just on five times, it seems to me worthwhile to step up our efforts.' There was a recognition that policy had to do more than stabilise the cycle: 'the problem with an exclusive focus on the business cycle was that we may well stabilise the real side of the economy without stabilising the price side of the economy'. Macfarlane (1990, p. 34) focused on asset aspects: 'It was the mentality of seeking wealth through geared asset accumulation that drove the real excesses of the system. This was the delayed product of the inflationary 1970s and should abate as lower inflation rates and higher real interest rates leave their mark on people's experiences'.

29. One interesting aspect of this is that when the former Treasurer became Prime Minister at the end of 1991, 'he continued to invest considerable political capital in the low inflation goal' (Stutchbury 1992, p. 65). In the February 1992 One Nation speech he said: 'The bedrock of the great post-War economies has been low inflation. It must be ours too. Labor will never surrender the inflation fight' (Keating 1992).

30. As the *Annual Report* (1991, p. 4) put it: 'Past experience has made policy-makers wary of attempting to finetune the economy…given the lags between events and the effect of any policy response, even a sharp easing of policy could not have done much to avoid the emerging weakness'.

31. The *Annual Report* (1992, p. 3) noted: 'Everyone supports action against inflation in boom periods, but the authorities must also demonstrate their anti-inflation commitment during downturns if they are to influence long-term price expectations. A clear message was therefore conveyed that lower inflation was an abiding objective of policy, not simply an accidental by-product of economic downturn'. The Deputy Governor, in talking about this period, said: 'At no stage was there an attempt to turn all the guns around and focus only on propping up the economy, at the expense of the medium-term objectives. In our view, this would probably have been misguided and risked us ending up with the worst of possible worlds – forfeiting the inflation gains for, at most, a negligible pick-up in activity' (Macfarlane 1992b, p. 15).

32. The adjustment was, in fact, faster than had been urged by Harper and Lim (1989, p. 24).

33. One of the other strong impressions from this period is that policy was backward-looking in *two* senses. First, the conventional one, in which policy is based on past data rather than the future. Second, the policy thinking and framework depends on past experiences. There are a number of examples of this, where past experience proved an unhelpful guide to the future:
    - Prior to the 1990/91 recession, downturns had invariably been associated with excessive wage increases or sharp falls in Australia's terms of trade (and commodity prices): neither seemed to be present early

to restrain growth in 1989, was there much empirical guidance on what a 'neutral' interest rate would be. As one economic journalist put it at the time: 'Quite simply, there is little historical guide to the interaction of high interest rates, financial deregulation, and a debt-burdened corporate sector, a bad-debt-exposed banking system and asset-price disinflation' (Stutchbury 1991, p. 9). Many commentators criticised the reductions, as premature or electorally inspired (or both).[34] Two other factors complicated the policy assessments of the time. Of course it was recognised that policy should be forward-looking and should be assessing *prospective* inflation rather than actual inflation, but neither the Bank nor market commentators foresaw how quickly inflation would fall. The second factor was the weakness of the exchange rate, beginning towards the end of 1990. While such weakness was consistent with the weakening of the terms of trade (in fact, in the middle of 1990, the exchange rate had seemed too *strong*), past 'feed-through' relationships would have suggested a large impact on inflation from the exchange-rate fall. This did not occur.[35] From 1991 onwards, the exchange rate continued to be a constraint on downward interest-rate adjustment. There was a 15 per cent fall in the exchange rate over the 12 months to August 1992.[36] The Bank 'sought to facilitate the process of exchange-rate adjustment in an orderly way so as not to undermine confidence in the coherence of policy'. The *Annual Report* (1993, p. 5) notes that a '20 per cent real depreciation, which has occurred without the crisis atmosphere often characterised in international foreign exchange markets, is a significant achievement which augurs well for Australia's future competitiveness'.

In a mechanical sense, nominal interest rates were moved down in 1990 at about the same rate (and from much the same level) as they had been moved down in 1987 (when many commentators criticised the Bank for moving down too far and too fast). The rate of reduction was also about the same as in the 1983 recession. The similarity of the movement is, however, just a coincidence: the speed of reduction was influenced by judgments about how the markets' inflation expectations were moving – as measured by the exchange rate and long bond rates (the slope of the yield curve) (*Annual Report* 1991, p. 13). For most of this time, the Bank was pushing at the edge of what the market would

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in 1990, although world growth turned out to be significantly slower than expected.

- The high interest rates of 1985 and 1986 had not produced a sharp downturn in the economy (although these had been in place more briefly).
- The share-market shake-out of 1987 suggested that an asset-price bubble could burst without doing much harm to the real economy.

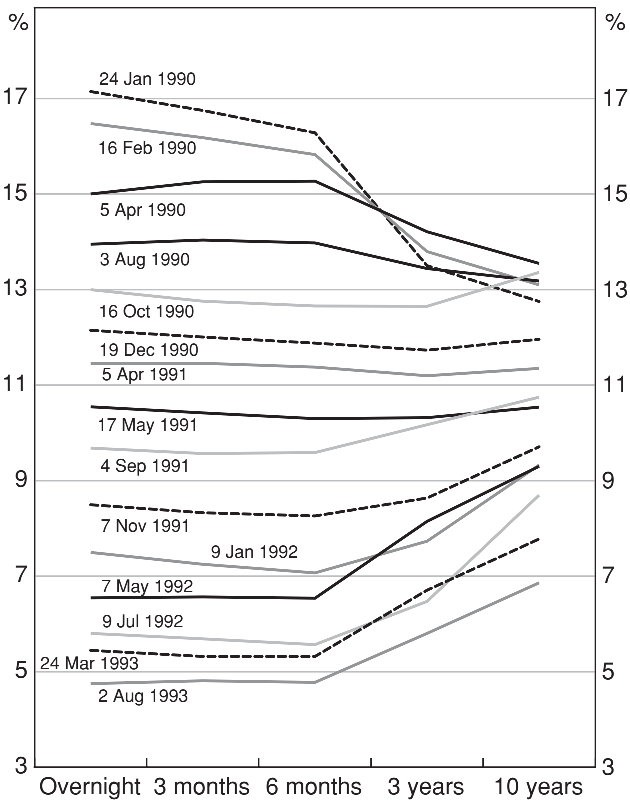
34. Notable, but by no means atypical, was the reaction of Paddy McGuinness in *The Australian* (25 January 1990): 'There is room for a lot of criticism of the…Reserve Bank Board in agreeing to start bringing interest rates down just now. For there was a good case to be made for an increase rather than a cut in interest rates'.

35. For a discussion on the different relationship between import prices and the CPI in this episode, see RBA (1993).

36. The degree of concern can be gauged from the *Annual Report* (1993, p. 4), which noted that: 'the Board considered but did not pursue the possibility of raising interest rates to help counter pressures on the Australian dollar', but it rejected any 'substantial tightening aimed at supporting the exchange rate…because this would have further burdened an already struggling recovery'. As with many of the issues of this period, there were antecedents: the 35 per cent fall in the exchange rate in 1985 and 1986 had put an end to the progress made in 1984 in getting inflation down.

Figure 7: Yield Curve

Day after monetary-policy easings

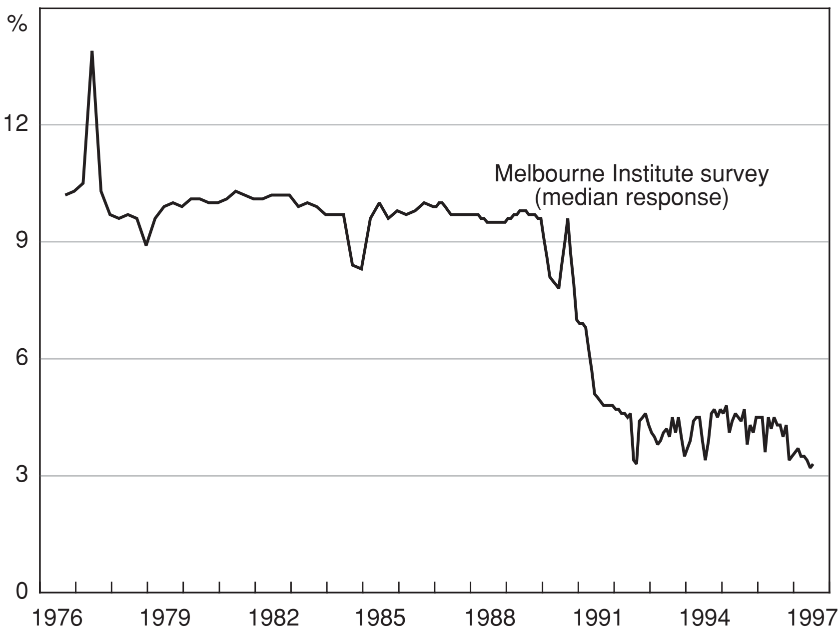


accept, in terms of rate reductions (*Annual Report* 1992, pp. 3–4). The first five easings in 1990 (which took interest rates down by 500 basis points) brought no change at the long end of the yield curve, suggesting there had been no change in longer-term price expectations. From late 1990 to mid 1991, cash rates and long-term bond rates moved down together – evidence of a structural break in inflation. After then, again, the interest-rate reductions ran ahead of longer-run expectations, as embodied in bond rates.[37]

While this policy adjustment was underway, the inflation environment was transformed. By the time the September-quarter 1990 CPI was released, inflation had taken a significant fall. There were other early indicators of change: there was a sharp fall in the Melbourne Institute's measure of consumer price expectations in late 1990 (in marked contrast to the 1984 experience). The new world of low inflation was not, at that stage, firmly established. Price expectations fell only slowly, and the new framework was to be put to the test in 1994, with a surge in demand which required a sharp tightening of policy to contain inflation. But, by May 1992, the Bank could say: 'it has been our view

37. For a discussion of the role of bond rates and the yield curve in setting policy, see Fraser (1991b).

Figure 8: Consumers' Inflation Expectations



for some time that we have made a structural downward shift in inflation' (Macfarlane 1992a, p. 9). In mid 1992, the *Annual Report* (p. 2) noted: 'Inflation has declined in periods of cyclically weak economic activity in the past. On this occasion, however, there are good grounds for believing that a critical threshold has been breached and that Australia can sustain a low inflation environment… All indicators of inflationary expectations suggest that there has been a real breakthrough over the past two years'. With hindsight, low inflation was achieved in the second half of 1990 and has been maintained since then at an annual average rate of 2$^1/_2$ per cent. Such was the improvement in inflation that the nature of the task changed, from inflation reduction to price-stability maintenance. For this, a new element – an inflation target – was added to the policy framework.

6. The Current Policy Framework

While these events were underway, the process of reformulating a 'rule-based' framework (which had begun in 1989) was completed. This framework can be seen, in terms of the three-fold classification, in the following way:

Rules and objectives. By 1993, there was a specific final objective ('2–3 per cent inflation over the course of the cycle'). This had been formulated by the Bank and was subsequently endorsed by the Treasurer. There was no specific intermediate objective or operational rule.

The **transmission** channel was seen, as before, as being via output to inflation, with the exchange rate having an important role. In a revival of an element of the monetarist phase, *price expectations* came to be seen as the central factor in determining how successful policy would be in maintaining low inflation.

The **context** had monetary policy as a 'stand-alone' instrument, directed principally to the objective in which it had a comparative advantage – price stability. The relationship with wages policy had almost been reversed: in the 1980s, monetary policy had supported wages policy in putting downward pressure on inflation; in the 1990s, monetary policy was directed primarily towards price stability and, in doing this, had an important influence on the economic climate in which wages were determined. The other important element, in the policy context, was the specific re-affirmation by the Treasurer of the Bank's independence to make monetary policy.

This framework was not put in place instantaneously. While price stability had always been an important objective for the Bank, until the 1990s it had been on a 'best endeavours' basis. And, as we have seen, there were other over-riding priorities which distracted policy in the 1980s. The evolution has some 'chicken-and-egg' elements to it: the new framework greatly enhanced the Bank's ability to maintain price stability, but it was not feasible, in Australia, to put the framework in place until a reasonable degree of price stability had been established. This section explores this in more detail.

Inflation targeting was pioneered by New Zealand, in 1989, closely followed by Canada. Quite quickly, there were calls for its adoption in Australia. The idea of an inflation target was rejected by the Governor in November 1990 (Fraser 1990c, p. 6). Why was Australia slow to adopt this framework? Why, when this broad framework was adopted in 1993, was the specification somewhat different from New Zealand's?

While inflation became the principal focus of policy in 1989, there was no question, then, of fixing on a particular inflation rate and ensuring that policy was set to achieve this. Rather, the downturn would run its course and whatever lower rate of inflation came out of that would be accepted, for the time being, at least. The Bank accepted that there might have been a 'credibility bonus' in defining the inflation objective beforehand, but was too uncertain about what rate of inflation would come out of this episode.

A second factor which inhibited the introduction of a specific inflation-targeting framework at this stage was the political debate. The then Opposition had proposed the re-writing of the Reserve Bank Act to give it a single price objective, and require it to pursue a New Zealand-style inflation-targeting regime.[38] Given the vigorous debate between the two political parties on this issue, the Bank was unable to make a useful contribution without getting itself deeply politicised in the process.

A third factor was a reluctance to accept some aspects of the New Zealand model. In particular, it seemed unlikely that Australia could realistically target an average rate of inflation as low as 1 per cent (which was the New Zealand objective until 1996) unless policy consciously worked to make the recession deeper. As well, the view in the Bank was that any inflation target should focus on the mean rather than the *range*. Considering the regular terms-of-trade shocks which Australia experienced, and looking at the history of cyclical fluctuations in inflation in Australia (going back to the period of price stability in the 1950s and 1960s), it was clear that these variations were greater than the 2 per cent

38. Liberal National Party (1991a, pp. 37–38); Liberal National Party (1991b, pp. 129–130).

range in the New Zealand specification.[39] In time, as other countries adopted inflation targets which were not the same as the New Zealand model, it became more feasible for Australia to adopt its own variant (including focus on the mean rather than the range, and with a clearer role for economic activity, as required by the Act) without invidious comparisons with the pioneering New Zealand model.

Even before the inflation target was defined explicitly, other elements in the framework were developed. The first was towards greater accountability. The most important change was the announcements of policy changes, beginning in January 1990.[40] The Bank had, over time, already increased the frequency of its communication via speeches, and these became more frequent still. The regular assessments of the economy contained in the Bank's *Bulletin* were made more complete and rigorous, so that they became, in effect, more like the 'inflation reports' of the type produced by the Reserve Bank of New Zealand and the Bank of England. The final element was the RBA's semi-annual appearances before a parliamentary committee.

As for the exact inflation target, it was defined when it became clear what was feasible after the recession of 1990/91. A number of variations of inflation targets were considered about this time. From the Government and union side, the usual format was a rate of inflation which matched our trading partners.[41] The One Nation proposals of February 1992 aimed for 3–4 per cent. But the Bank recognised that the case for low inflation relied on domestic considerations, not international comparisons; as well, it had something lower in mind. The Governor, in a speech in April 1990, said he hoped that inflation could be running at less than half the then current rate of 6–7 per cent. When the underlying inflation rate went below 3 per cent, this was progressively more firmly defined as the basis of the inflation target. By August 1992, the Governor was saying 'there is no reason why the current underlying inflation rate of 2–3 per cent cannot be sustained' (Fraser 1992, p. 7). By April 1993, the formulation was: 'If the rate of inflation in underlying terms could be held to an average of 2–3 per cent over a period of years, that would be a good outcome' (Fraser 1993a, p. 2). By October 1993, the formulation was: 'We believe the underlying rate will be held around 2–3 per cent. This belief reflects several factors, not least being the determination of the Reserve Bank and the Government to see that Australia stays in the low inflation league' (Fraser 1993b, p. 16). A more policy-oriented aspect was clear by 1994: 'If, however, shortcomings in one or more of these areas were to threaten to push underlying inflation noticeably above the 2–3 per cent range, corrective action would have to be implemented' (Fraser 1994, p. 28).

39. In the same speech that introduced the objective of achieving 'underlying inflation held to an average of 2–3 per cent over a period of years', the Governor also said that 'an inflation target of the narrow "0-2 per cent" variety would, I believe, do us more harm than good. In particular, such targets are apt to bias policy responses to shocks which impinge on prices. Such shocks are probably best absorbed by changes in both prices and activity but if the authorities are bound to a narrow inflation target then virtually all of the shock has to impact on activity' (Fraser 1993a, p. 4). For a discussion on the merits of the Australian specification and the historical degree of variation experienced internationally, see Grenville (1996).

40. Partly, this reflects the experience of 1988, when the effects of the initial increases in interest rates had been muted by misunderstandings about the Bank's policy intentions.

41. The agreement between the Government and the ACTU in the context of the August 1991 Budget was: 'The parties agree to work towards wage outcomes consistent with keeping Australia's inflation at levels compatible with those of our major trading partners'.

While there were many advocates of a single objective (inflation) at this time (see, for example, Morgan (1990), Jonson (1990), Cole (1990) and Stemp and Murphy (1991)),[42] the Bank was never much interested in shifting to a single goal of price stability. Eichbaum (1993, p. 5) described the Bank's position as 'exceptional' among central banks, but this point had been well understood by an earlier generation of economists: 'It is disingenuous, to say the least, for central bankers to pretend that their actions have no effects on real interest rates, unemployment rates, and other variables of concern. Time will eliminate the inertia of price and wage adjustments. But there are no long-run steady states whose properties are independent of the paths by which they are reached' (Tobin 1983, p. 511). The Act specified two objectives, and any re-writing of the Act seemed infeasible. But it also seemed undesirable: former Governor Johnston, speaking in 1992, described the combination of central bank independence and a single (inflation) objective as 'bestowing on the Bank all the freedom of the prison exercise yard' (Johnston 1992, p. 18). Throughout the period, there was a denial of the 'Tinbergen proposition' – i.e. that one policy instrument must be used exclusively to achieve a single policy objective (Fraser 1990b,c). There was also a feeling that, taken literally, it made the task of monetary policy too simple – or simplistic. Artis (1992, p. 176) said: 'Any fool, it might seem, can disinflate. The interesting thing is how to minimise the cost of doing so'. Friedman (1988, p. 65) had noted: 'Everyone had always known that sufficiently tight monetary policy, maintained for a sufficiently long time, could halt even the most deeply rooted inflation. The reluctance to proceed in that fashion lay not in disbelief that such a policy would do its job, but in concern for the resulting real costs'. The Bank understood that, for the most part, there would be no conflict between activity and price objectives (and, in fact, activity would be a principal forward indicator of inflation): when there *was* a conflict (in the case of a supply-side shock, or when a structural reduction in inflation was needed), this could not be resolved by the simplistic expedient of giving an absolute over-riding priority to prices (Grenville 1996). Over time, the idea that output could not be ignored gained more credibility. In the Australian context, John Taylor's paper at the Bank's 1992 Conference made the case that if the authorities try to smooth out variations in inflation too much, this will increase the variability of output (just as the attempts to smooth out variations in output lead to greater variations in inflation) (Taylor 1992).[43] Events of the early 1990s, too, served to remind the Bank that the economy was quite prone to shocks (including those arising from financial deregulation) and that the self-equilibrating properties of the economy were not strong. Perhaps the most compelling argument, at this time, for the reluctance to endorse

42. 'The Australian economy over the past decade seems to have fluctuated more, not less, widely than otherwise because of activist monetary policy. The large discretionary swings occurred in response to what were, in hindsight, generally self-correcting phenomena… The key issue is not so much whether the Reserve Bank is independent of political control, but whether it should be prevented from frequently and somewhat haphazardly intervening on ill-defined grounds. Because the Reserve Bank has clearly made major policy mistakes, the solution is not to remove the institution from the political process, but to curtail its capacity to repeat such mistakes. To this end, a fixed money growth rule should be adopted in place of the existing unbounded monetary policy discretion' (Makin 1993, p. 12) (see also Weber (1994)). There had been earlier proponents: 'Proposition 1: From the perspective of maximising the rate of economic growth and avoiding business cycles, activist monetary policy typically does more harm than good' (Hartley and Porter 1988, p. 2).

43. See also Debelle and Stevens (1995).

a single (price-stability) target was the realisation that, had such a framework existed in the early 1990s, the main effect would have been to delay the interest-rate reductions – in practice, interest rates were lowered by 400 basis points before there was a clear sign (or any recognition) that inflation was on the way down. The Governor argued that an inflation target would have caused the Bank to 'drag its feet' in lowering interest rates and 'the fall in output in the present recession would have been more pronounced than it was' (Fraser 1991c, p. 12).

The debate on independence was somewhat constrained by the belief within the Bank that it had always had a high degree of independence. The Reserve Bank Act refers to the monetary policy *of the Board*, and the rather elaborate Section 11 provisions for disagreement with the Government are a clear indication of the intended independence (Phillips 1992; Macfarlane 1996). This independence, however, was irrelevant during the period of financial regulation, as the fixed prices (interest rates and exchange rates) were set by committees in Canberra. With deregulation came the opportunity for the Bank to have the sort of *de facto* independence that it had *de jure*, but independence was taken in a consensual rather than assertive way.[44] By 1988, the Bank's independence was more clearly stated: 'The Reserve Bank Act puts a duty on its Board to formulate and carry out its monetary policy – not as agent for, or adviser to, Government, but on its own responsibility' (Johnston 1988, p. 1).[45] The emphasis, in this period, was on what Governor Johnston described as an Act 'which encourages consultation and co-operation between the Bank and the Government' (Johnston 1989b, p. 16). Governor Fraser, too, rejected the idea of 'gladiatorial notions of independence – as something to be displayed like a warrior's shield, raised in constant battle with the government of the day. Nowhere do such romantic notions ring true' (Fraser 1993a, p. 4).

Without confrontation, the Bank's enhanced independence emerged as a natural product of events. There is a marked contrast between the current position and the earliest period covered in this paper. Whereas the Treasurer used to announce M3 targets and the Bank's public profile was inconspicuous, policy changes now clearly centre around the Bank's comprehensive announcements of changes, with the decision clearly resting with the Bank's Board. The Bank's profile is reinforced by the Governor's regular appearances before a parliamentary committee, and the Bank plays a prominent role in public commentary on monetary policy. While these snapshot comparisons of two different periods emphasise the extent of the change, it is less easy to identify the exact moment when these major shifts occurred. The shift from regulation to market-based policies (with the Bank having the technical expertise in these) was clearly an important on-going force. Just as clearly, personalities (the Treasurer and the Governor) have been an

44. In 1984, Governor Johnston quoted approvingly of Dr Coombs' earlier views on independence: 'A central banker should be aware that independence, if too highly prized, can lead to isolation in which his influence can become limited and ineffective. He will do better to seek a partnership with government in which his role is significant but in which he accepts the limitations imposed by the need to maintain the partnership as an effective working arrangement… Indeed, the less frequently the central bank seeks to assert or remind the government of its independence the more successfully the central bank will be able to function' (Johnston 1984, p. 768).

45. With independence goes responsibility – Governor Johnston (1989b, p. 16) said: 'It is true that there have been policy misjudgments from time to time. The Bank must – and does – accept most of the criticism'.

important part of the story.[46] The increasingly prominent role given, worldwide, to central bank independence – and the enhanced role of central banks in most OECD countries – was also important in shaping people's views on what was normal for central bank/government relations. The academic debate was not prominent, but it worked in the same direction. There were successive compilations of independence rankings, and while the validity of the early rankings was quite dubious, Australia's shifting ranking probably reflected changing public perceptions of the Bank's independence: in the early rankings, the Bank rated (inexplicably) behind the Bank of Japan and the Bank of England, but by the time more sophisticated and well-based measures were formulated, Australia appears in the middle of the rankings.[47]

While it is not possible, now, to identify an exact moment when the Bank's independence was widely acknowledged, 'the Reserve Bank emerged from the recession publicly conspicuous for the first time in its forty-year history as a separate source of advice to the Government' (Tingle 1994, p. 307). This was formally recognised in the agreement between the Treasurer and the Governor in August 1996, but had been achieved, *de facto*, earlier than this.

7. Conclusion

Given that low inflation was an important objective throughout the period (Hughes 1994, p. 147), why was Australia slow in achieving this? In particular, why was more progress not made in the *1980s*? There seem two main reasons – continuing distractions from other policy problems, and an unwillingness to accept the loss of output involved in getting inflation down.

The distractions were pressing, and the progress which was made in solving them during the 1980s was considerable. There was:

- a very substantial wage overhang, which had to be wound back by the painful process of reductions in real unit labour costs;
- the external imbalance, with its on-going threat to price stability;
- related to this, the need to absorb a very significant fall in the real exchange rate; and
- the deregulation of financial markets, with its disruptive (although ultimately beneficial) effects on financial stability.

In an absolute sense, none of these problems precluded policy settings which would have made more progress on inflation, but they created an environment in which firm policy settings (and a continuing output gap) were needed just to hold the line on inflation. Real interest rates averaged 5.9 per cent during the 1980s. The practical question is: when were the specific opportunities to achieve price stability? Could it have been done in 1984, before the exchange rate shock of 1985 and 1986? Was there an opportunity in 1987 to press more strongly? The counterfactual is unknowable, but in

46. On the role of the then Treasurer and his influence on the Bank, it is interesting to read the full transcript of the 'they are in my pocket' speech, given in Gordon (1993, p. 10).

47. See Bade and Parkin (1982), Grilli, Masciandro and Tabellini (1991), and Cukierman (1993).

each of these periods, while there was a general desire to get inflation down, there was no sense of pressing urgency. Low inflation was not an overwhelming priority in the overall macro-policy picture.

Inflation was never seen to be 'out of hand' in the 1980s (as it was seen to be in, for example, the United States in 1979 and New Zealand in the mid 1980s – or, for that matter, in Australia in 1974). Even when it was high, it was always believed that steady pressure would erode it over time, as the various shocks which pushed it up receded (notably, the exchange rate fall of 1985/86). When the visiting Brookings economists reported on the Australian economy in 1984, monetary policy played a minor part in their analysis: their view was that 'unemployment is intolerably high in Australia and dramatic inflation fighting should not be a priority… Living with inflation is not the ultimate evil' (Caves and Krause 1984, p. 78). There was never a clear readiness to incur the significant output cost that was required to shift inflation down in a definitive way. 'People generally feel that inflation is bad but, for the most part, not so bad that they want the authorities to get too serious about eliminating it' (Fraser 1990a, p. 20). Even those who criticised policy for not containing inflation did so on the basis that there was a low-cost (in terms of lost output) panacea, of one kind or another. Corden (1989, p. 160) noted that, even with the Treasury's early-1980s 'inflation first' strategy, 'there were no costs but only benefits, from reducing inflation'. Then there was the promise of monetarism (at least in its rigorous form): a sufficiently emphatic commitment to low money growth would, more-or-less instantaneously, cause price expectations to fall and the economy would shift, more-or-less painlessly, to a low-inflation path. When this promise failed, there were the experiments with wage/tax trade-offs as circuit breakers. The attraction was clear: if everyone would simultaneously agree that inflation was going to be lower, then they could be (at least) as well off without the pain of a significant period of deflation (Fraser 1990c). Even inflation targets were sometimes put forward with the same promise: if everyone understood exactly the time profile of inflation reduction, it could be achieved painlessly. But by the late 1980s, the uncomfortable reality was clear: whether because of inflexible prices (e.g. wage contracts) or sticky price expectations, a sizeable output gap would have to exist for some time to persuade people that a world of low inflation had arrived. 'If inflationary expectations could be changed by decree, the economy could be shifted down the long-run Phillips curve to achieve lower inflation with unchanged real activity. But if inflation expectations cannot be changed by fiat, there may be a long, painful, slow grind of gradually wearing down inflation expectations by having the economy run at higher levels of unemployment' (Grenville 1989, p. 15).

The key to establishing price stability was that the 1990/91 recession provided an opportunity to shift price expectations down, and the monetary framework was ready (in a way it had not been in earlier recessions, such as 1982/83) to use the opportunity. Does this mean that the Bank's policies were 'opportunistic'? Central banks are quick to deny the pejorative overtones, but if this means simply that there are certain moments in the business cycle that lend themselves to progress on *structural* inflation, then this seems no more than simple common sense. 'Reducing inflation has tactical, as well as purely economic, aspects. With the economy turning down in 1990 and asset prices declining sharply, circumstances were conducive to getting inflation down and keeping it down. By the same token, it would have been inopportune to have tried to rein in inflation during 1985 and 1986, given the sharp fall in the Australian dollar' (Fraser 1991c, p. 13).

Was the monetary framework, as it had evolved by 1990, inherently more suited to seizing the opportunity? Australia began the period examined in this paper with a rule-based framework – M3 targets – which seemed to provide discipline on policy-makers and a clear accountable system to anchor price expectations. But it did not, in practice, provide discipline, nor did the Bank feel that it had the primary responsibility for achieving price stability. The check-list provided less discipline still. But it would be expecting too much of any rule-based framework to see it as the single-dimensional answer to price stability, providing easy solutions to the complexities of monetary policy. It does not provide an operational rule to guide day-by-day or month-by-month policy-making. An ideal rule should relate to the *operational instrument*: how else can it provide firm discipline on policy-makers, and provide the public with a method of monitoring the authorities on a continuing basis? But such a framework does not fit (and has never fitted) the real-world economy. Any practical framework will still be a mixture of rules with some discretion. The M3 rule relied on the stability of a single simple relationship and was susceptible to the breakdown of that relationship. The inflation target is more robust, because it focuses directly on the final objective. But no simple rule can handle the complexities of the economy and the variety of shocks which hit it. The current framework still requires difficult policy choices: it requires good forecasting; it provides no specific operational guidance; and there is no calibration on the operating instrument. At times, there will be difficult decisions to be made between inflation and economic activity. That said, the Bank has considerable confidence that low inflation can be maintained. Why?

- Most importantly, the painful step-down of inflation has been achieved. Whatever debate there might have been about the cost of reducing inflation, there is little argument about the value of keeping low inflation, once achieved.
- It should also be easier to maintain, as a fair amount of credibility has been built up, both from the established record of the past seven years, and from a monetary framework which has wide international acceptability.
- We have a better, more flexible institutional structure. The floating exchange rate is an important element, but there are many changes (spelt out in Grenville (1997)) which make the economy less inflation prone.
- Having been through the experience of the 1970s and 1980s (including financial deregulation, which was one element in the disruptive asset-price inflation of 1988/89), lessons have been learnt. The Bank has a better understanding of the relationship between the instrument of monetary policy (short-term interest rates) and the final objectives, with perhaps the greatest advance being the clarifying of the *time dimensions* involved in these objectives – in the long run, all monetary policy can do is achieve price stability; in the short run, it may also be able to help in cyclical stabilisation.
- The Bank now has a greater feeling that it (rather than other 'arms' of policy) is responsible for inflation. The Bank is now centre-stage on inflation control, separated to some extent from other elements of macro policy, with clearly defined independence and a 'place to stand', provided by the inflation target.

References

Argy, V., A. Brennan and G.R. Stevens (1989), 'Monetary Targeting: The International Experience', in I.J. Macfarlane and G.R. Stevens (eds), *Studies in Money and Credit*, Reserve Bank of Australia, Sydney, pp. 10–52.

Artis, M. (1992), Discussion on P. Andersen, in A. Blundell-Wignall (ed.), *Inflation, Disinflation and Monetary Policy*, Reserve Bank of Australia, Sydney, pp. 176–180.

Australian Council of Trade Unions (ACTU) (1983), Statement of Accord by the Australian Labor Party and the Australian Council of Trade Unions Regarding Economic Policy.

Bade, R. and M. Parkin (1982), 'Central Bank Laws and Monetary Policy', unpublished. Results reproduced in A. Alesina and L. Summers (1993), 'Central Bank Independence and Macroeconomic Performance', *Journal of Money, Credit and Banking*, 25(2), pp. 151–162.

Begg, D. (1985), *The Rational Expectations Revolution in Macro Economics*, Johns Hopkins University Press, Baltimore.

Carmichael, J. (1990a), Rules for Monetary Policy: Checklists, Interest Rates and Money Base Targeting, paper presented at a conference, 'Short-term Money Markets, Deregulation and Monetary Policy', Sydney, 25 May.

Carmichael, J. (1990b), 'Inflation: Performance and Policy', in S. Grenville (ed.), *The Australian Macro-Economy in the 1980s*, Reserve Bank of Australia, Sydney, pp. 288–342.

Caves, R.E. and L.B. Krause (eds) (1984), *The Australian Economy: A View from the North*, The Brookings Institution, Washington, D.C.

Cole, W. (1990), 'A More Independent Reserve Bank?', Australian Institute for Public Policy Economic Witness, No. 45.

Corden, W.M. (1989), 'Australian Macroeconomic Policy Experience', *The Economic Record*, 65(189), pp. 152–164.

Cukierman, A. (1992), *Central Bank Strategy, Credibility, and Independence: Theory and Evidence*, MIT Press, Cambridge, Massachusetts.

Debelle, G. (1996), 'The Ends of Three Small Inflations: Australia, New Zealand and Canada', *Canadian Public Policy*, 21(1), pp. 56–78.

Debelle, G. and G. Stevens (1995), 'Monetary Policy Goals for Inflation in Australia', Reserve Bank of Australia Research Discussion Paper No. 9503.

Edey, M.L. (1989), 'Monetary Policy Instruments: A Theoretical Analysis', Reserve Bank of Australia Research Discussion Paper No. 8905.

Edwards, J. (1996), *Keating: The Inside Story*, Viking Penguin, New York.

Eichbaum, C. (1993), 'Challenging the Intellectual Climate of the Times: Why the Reserve Bank of Australia is Too Independent', *Economic Papers*, 12(1), pp. 1–17.

Erskine, A. (1990), 'Comments on Parker', *Australian Economic Review*, 90, p. 92.

Federal Reserve Bank of Kansas City (1989), *Monetary Policy Issues in the 1990s*, Federal Reserve Bank of Kansas City, Kansas City, Missouri.

Fischer, S. (1996), 'Why Are Central Banks Pursuing Long-Run Price Stability?', in *Achieving Price Stability*, Federal Reserve Bank of Kansas City, Kansas City, Missouri, pp. 7–34.

Fraser, B.W. (1989), 'Reserve Bank Independence and All That', Reserve Bank of Australia *Bulletin*, December, pp. 8–13.

Fraser, B.W. (1990a), 'Inflation', Reserve Bank of Australia *Bulletin*, May, pp. 18–26.

Fraser, B.W. (1990b), 'Monetary Policy and the Banks', Reserve Bank of Australia *Bulletin*, November, pp. 1–5.

Fraser, B.W. (1990c), 'A Proper Role for Monetary Policy', Reserve Bank of Australia *Bulletin*, December, pp. 1–7.

Fraser, B.W. (1991a), 'Talk by Governor', Reserve Bank of Australia *Bulletin*, September, pp. 1–6.

Fraser, B.W. (1991b), 'Three Decades of Real Interest Rates', Reserve Bank of Australia *Bulletin*, October, pp. 6–12.

Fraser, B.W. (1991c), 'Some Observations on the Role of the Reserve Bank', Reserve Bank of Australia *Bulletin*, December, pp. 8–13.

Fraser, B.W. (1992), 'Two Perspectives on Monetary Policy', Reserve Bank of Australia *Bulletin*, September, pp. 1–8.

Fraser, B.W. (1993a), 'Some Aspects of Monetary Policy', Reserve Bank of Australia *Bulletin*, April, pp. 1–7.

Fraser, B.W. (1993b), 'Current Economic Developments in Australia – A Broad Perspective', Reserve Bank of Australia *Bulletin*, October, pp. 14–20.

Fraser, B.W. (1994), 'Managing the Recovery', Reserve Bank of Australia *Bulletin*, April, pp. 20–28.

Friedman, B.M. (1988), 'Lessons on Monetary Policy from the 1980s', *Journal of Economic Perspectives*, 2(3), pp. 51–72.

Goodhart, C. (1989), 'The Conduct of Monetary Policy', *Economic Journal*, 99(396), pp. 293–346.

Goodhart, C. (1992), 'The Objectives for, and Conduct of, Monetary Policy in the 1990s', in A. Blundell-Wignall (ed.), *Inflation, Disinflation and Monetary Policy*, Reserve Bank of Australia, Sydney, pp. 314–334.

Gordon, M. (1993), *A True Believer: Paul Keating*, University of Queensland Press, St Lucia.

Grenville, S.A. (1990), 'The Operation of Monetary Policy', *Australian Economic Review*, 90, pp. 6–16.

Grenville, S.A. (1995), 'The Monetary Policy Transmission Process: What Do We Know? (And What Don't We Know?)', Reserve Bank of Australia *Bulletin*, September, pp. 19–33.

Grenville, S.A. (1996), 'Recent Developments in Monetary Policy: Australia and Abroad', *Australian Economic Review*, 113, pp. 29–39.

Grenville, S.A. (1997), 'The Death of Inflation?', Reserve Bank of Australia *Bulletin*, May, pp. 34–41.

Grilli, V., D. Masciandro and G. Tabellini (1991), 'Political and Monetary Institutions and Public Finance Policies in the Industrial Countries', *Economic Policy*: *A European Forum,* 6(2), pp. 341–392.

Harper, I.R. and G.C. Lim (1989), 'Is Monetary Policy Too Tight?', *Australian Economic Review*, 86, pp. 15–24.

Hartley, P.R. and M.G. Porter (1988), 'Monetary Management in Australia', Centre of Policy Studies Discussion Paper Series No. D132, Monash University, Melbourne.

Higgins, C. (1989), 'Opening Address', in F.H. Gruen (ed.), *Australian Economic Policy*, Centre for Economic Policy Research, Australian National University, Canberra.

Hughes, B. (1994), 'Comment on Garry White', *Agenda*, 1(2), pp. 147–150.

Johnston, R.A. (1984), 'Talk by the Governor', Reserve Bank of Australia *Bulletin*, May, pp. 763–768.

Johnston, R.A. (1985a), 'Monetary Policy – The Changing Environment', Reserve Bank of Australia *Bulletin*, June, pp. 807–813.

Johnston, R.A. (1985b), 'The Monetary System in Transition', Reserve Bank of Australia *Bulletin*, November, pp. 1–8.

Johnston, R.A. (1986a), 'The Role of a Central Bank', Reserve Bank of Australia *Bulletin*, February, pp. 1–7.

Johnston, R.A. (1986b), 'Monetary Policy: Forecasting and Related Issues', Reserve Bank of Australia *Bulletin*, May, pp. 1–4.

Johnston, R.A. (1988), 'The Reserve Bank: Its Dual Role – Monetary Management and Financial Stability', Reserve Bank of Australia *Bulletin*, June, pp. 1–4.

Johnston, R.A. (1989a), 'Talk by Governor', Reserve Bank of Australia *Bulletin*, April, pp. 8–9.

Johnston, R.A. (1989b), 'The Reserve Bank's Role in Economic Management', Reserve Bank of Australia *Bulletin*, May, pp. 14–16.

Johnston, R.A. (1992), 'Comments on Professor Schedvin', *Economic Papers*, 11(4), p. 18.

Jonson, P.D. (1987), 'Monetary Indicators and the Economy', Reserve Bank of Australia *Bulletin*, December, pp. 5–15.

Jonson, P.D. (1990), 'Inflation: Its Costs, Its Causes and Its Cure', *Policy*, 6(2), pp. 2–8.

Jonson, P.D. and R.W. Rankin (1986), 'Some Recent Developments in Monetary Economics', *Economic Record*, 62(178), pp. 257–267.

Keating, P.J. (1992), *One Nation: Speech by the Prime Minister*, The Hon. P.J. Keating, 26 February, AGPS, Canberra.

Kelly, P. (1992), *The End of Certainty: The Story of the 1980s*, Allen & Unwin, St Leonards, NSW.

Liberal and National Parties (1991a), *Fightback!*, Liberal and National Parties, Canberra.

Liberal and National Parties (1991b), *Fightback!, Taxation and Expenditure Reform for Jobs and Growth*, Liberal and National Parties, Canberra.

Macfarlane, I.J. (1984), Methods of Monetary Control in Australia, paper presented to the New Zealand Association of Economists Annual Conference, Massey University, 22 August. Published in D.J. Jüttner and T. Valentine (eds), *The Economics and Management of Financial Institutions*, Longman Cheshire, Melbourne, 1987, pp. 603–616.

Macfarlane, I.J. (1988), 'Aims and Instruments of Monetary Policy', paper presented at 17th SEANZA Central Banking Course, Sydney, 7 November.

Macfarlane, I.J. (1989a), 'Money, Credit and the Demand for Debt', Reserve Bank of Australia *Bulletin*, May, pp. 21–31.

Macfarlane, I.J. (1989b), 'Policy Targets and Operating Procedures: The Australian Case', in *Monetary Policy Issues in the 1990s*, Federal Reserve Bank of Kansas City, Kansas City, Missouri, pp. 143–159.

Macfarlane, I.J. (1990), 'Credit and Debt: Part II', Reserve Bank of Australia *Bulletin*, May, pp. 27–34.

Macfarlane, I.J. (1991), 'The Lessons for Monetary Policy', in I.J. Macfarlane (ed.), *The Deregulation of Financial Intermediaries*, Reserve Bank of Australia, Sydney, pp. 175–199.

Macfarlane, I.J. (1992a), 'The Structural Adjustment to Low Inflation', Reserve Bank of Australia *Bulletin*, June, pp. 9–13.

Macfarlane, I.J. (1992b), 'Making Monetary Policy in an Uncertain World', Reserve Bank of Australia *Bulletin*, September, pp. 9–16.

Macfarlane, I.J. (1996), 'Making Monetary Policy: Perceptions and Reality', Reserve Bank of Australia *Bulletin*, October, pp. 32–37.

Macfarlane, I.J. and G.R. Stevens (1989), 'Overview: Monetary Policy and the Economy', in I.J. Macfarlane and G.R. Stevens (eds), *Studies in Money and Credit*, Reserve Bank of Australia, Sydney, pp. 1–9.

Makin, T. (1993), 'Reserve Bank Independence or a Monetary Growth Rule', *Policy*, 9(4), pp. 9–12.

McCallum, B.T. (1985), 'Bank Deregulation, Accounting Systems of Exchange, and the Unit of Account: A Critical Review', *Carnegie-Rochester Conference Series on Public Policy,* 23, pp. 13–45.

McTaggart, D. and C. Rogers (1990), 'Monetary Policy and the Terms of Trade: A Case for Monetary Base Control in Australia?', *Australian Economic Review*, 90, pp. 38–49.

Morgan, D.R. (1990), 'The Evolution of Monetary Policy Since Financial Deregulation', *Economic Papers*, 9(4), pp. 1–18.

Phillips, M.J. (1985), 'Monetary Policy From The Inside', Reserve Bank of Australia *Bulletin*, November, pp. 9–13.

Phillips, M.J. (1989), 'A Central Banking Triptych', Reserve Bank of Australia *Bulletin*, October, pp. 13–16.

Phillips, M.J. (1990), 'When the Music Stops', Reserve Bank of Australia *Bulletin*, July, pp. 14–16.

Phillips, M.J. (1992), 'Central Banking – A Parting View', Reserve Bank of Australia *Bulletin*, April, pp. 14–19.

Pitchford, J.D. (1993), 'Macroeconomic Policy and Recession in Australia, 1982–1992', The University of Queensland, Department of Economics Discussion Papers No. 124.

Porter, M. (1989), 'Monetary Policy', paper presented to IPA Economic Seminar, Melbourne.

Reserve Bank of Australia, *Annual Report*, various.

Reserve Bank of Australia (1985), 'Meeting on Monetary Issues', Reserve Bank of Australia *Bulletin*, December, pp. 1–4.

Reserve Bank of Australia (1993), 'Devaluation and Inflation', Reserve Bank of Australia *Bulletin*, May, pp. 1–3.

Sieper, E. and G.M. Wells (1991), 'Macroeconomics on the Left: Australia and New Zealand in the Eighties', in F.H. Gruen (ed.), *Australian Economic Policy*, Centre for Economic Policy Research, Australian National University, Canberra, pp. 235–280.

Skidelsky, R. (1997), 'Bring Back Keynes', *Prospect*, May, pp. 30–35.

Stemp, P.J. and C.W. Murphy (1991), 'Monetary Policy in Australia: The Conflict Between Short-Term and Medium-Term Objectives', *Australian Economic Review*, 94, pp. 20–31.

Stutchbury, M. (1991), *Boom to Bust,* The Financial Review Library, Sydney.

Stutchbury, M. (1992), *Gain from the Pain: Australia Recovers from its Economic Boom-bust*, The Financial Review Library, Sydney.

Taylor, J. (1992), 'The Great Inflation, The Great Disinflation, and Policies for Future Price Stability', in A. Blundell-Wignall (ed.), *Inflation, Disinflation and Monetary Policy*, Reserve Bank of Australia, Sydney, pp. 9–31.

Tingle, L. (1994), *Chasing the Future*, William Heinemann Australia, Port Melbourne.

Tobin, J. (1983), 'Monetary Policy: Rules, Targets, and Shocks', *Journal of Money, Credit and Banking*, 15(4), pp. 506–518.

Toohey, B. (1994), *Tumbling Dice: The Story of Modern Economic Policy*, William Heinemann Australia, Port Melbourne.

Weber, E.J. (1994), 'The Role of Money during the Recession in Australia in 1990/92', *Applied Financial Economics*, 4(5), pp. 355–361

White, G. (1992), 'Monetary Policy in the 1980s', in D. Moore (ed.), *Can Monetary Policy Be Made to Work?*, Institute of Public Affairs Ltd, Melbourne, pp. 10–19.

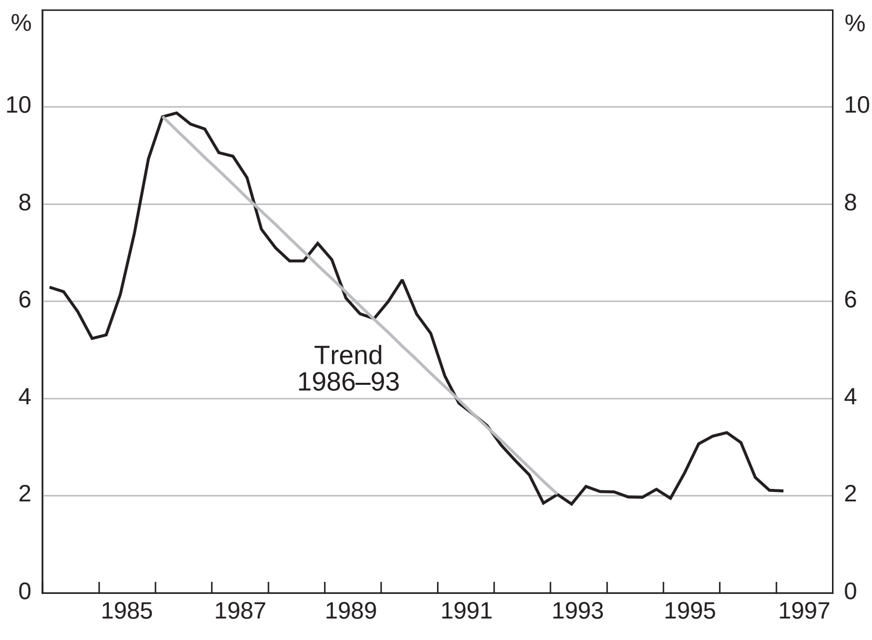
Discussion

1. Barry Hughes

This paper tip-toes skilfully through a field of undetonated mines left over from previous policy wars, defending the Bank's actions here and there, while pushing the message that the institution has now largely cleaned up its act in a series of steps from the late 1980s onwards culminating in the adoption of an inflation target earlier in the 1990s. From the late 1980s onward the Bank had become serious about stable low inflation. As Dr Grenville says, 'the mind-set had changed (in the late 1980s), and policy was being set with lower inflation as the objective but the opportunity to achieve this had not yet arrived' and 'while price stability had always been an important objective for the Bank, until the 1990s it had been on a "best endeavours" basis'.

It is not appropriate to re-fight old debates here, so I am given to understand, except insofar as they are ongoing issues. So my comments do not represent a critique of Stephen Grenville's economic history lesson, although there are disagreements with a number of slants here and there. Instead, I will attempt to place a different perspective on Dr Grenville's central message, claiming that both the numbers and the facts of history are open to a quite different interpretation of events than the one presented. I will then consider how much of the monetary-policy debate has changed from the start to end of Dr Grenville's period.

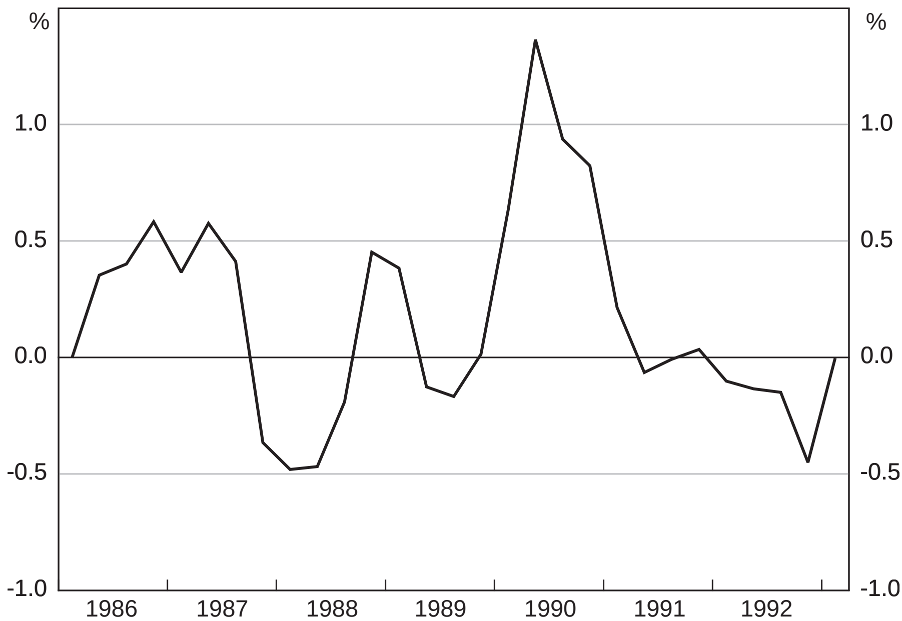
Figure 1: Annual Change in the Underlying CPI



History, it is said, is written by the survivors. Their predecessors might have a different view:

- Far from it being a dramatic happening since the late 1980s, disinflation of the underlying rate was remarkably consistent from 1986 to 1993. Figure 1 shows a linear trend alongside the underlying inflation time series. Figure 2 shows deviations from this trend line, which, save for a brief period in 1990, have never been greater than about one half of a percentage point.

Figure 2: Deviations from Trend Underlying Inflation



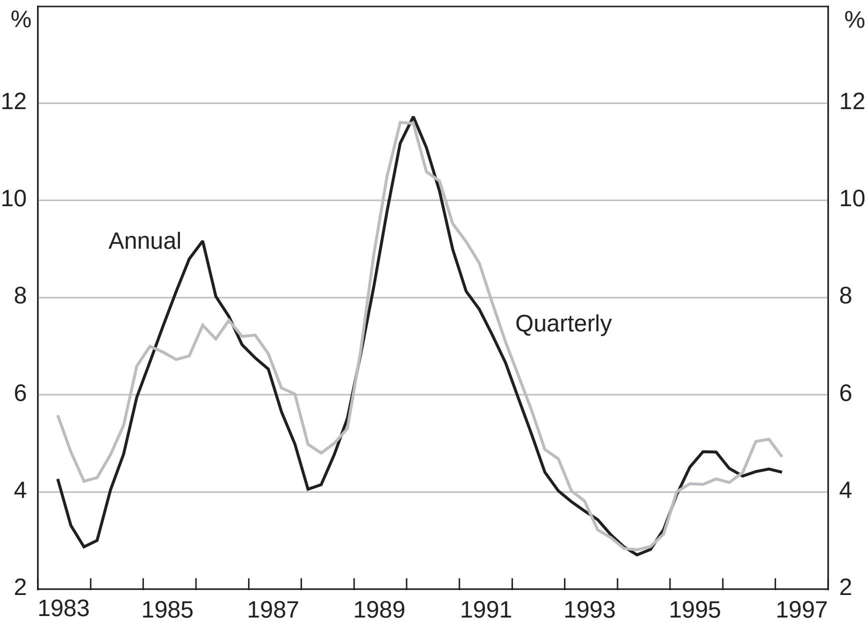
- Nor, with hindsight, should this be any great surprise. Whatever the opacity of the statements, and for whatever reasons, policy-makers behaved throughout the period since 1984 as sadistically as any Taylor rule would have demanded. Real rates (defined RBA-style[1]) were 5.95 per cent on average in 1984, and remained each quarter consistently above these levels, 1987–88 apart (when the fiscal-year average was 4.15 per cent), until December quarter 1991. (Figure 3 shows four-quarter moving averages of the real cash rate both on the RBA method and using contemporaneous quarterly deflation.) One wonders what the monetary policy-makers thought they were doing *throughout this period* (including substantial experience prior to the emergence of current-account concerns) if they were not serious about disinflation.

1. In times of disinflation, which is most of the period covered here, the RBA method of calculating real rates (i.e. deflating by trailing *annual* inflation), imparts a non-trivial downward bias. Compared to deflation by contemporaneous inflation changes, *ex post* real rates during the period of disinflation are downwardly biased to a non-trivial extent. For example, the average real rate in 1984 was 6.59 per cent when contemporaneous deflation is applied. Annual moving averages of real cash on this basis stayed above this figure until September quarter 1987.

- Moreover, from the outset in 1983, discarding the policy slogan of 'fighting inflation first' did not result in the dropping of disinflation ambitions. The new slogan was to 'fight inflation and unemployment simultaneously'. Both the Labor government (anxious to distance itself from the Whitlam-era reputation) and the key union leaders (for whom inflation was a nuisance) had strong reasons for pursuing disinflation.

Figure 3: Real Cash Rates

Four-quarter moving averages, deflated by trailing annual and compound quarterly changes in underlying inflation



Intent, actions and results added up to disinflation throughout the period. There is no suggestion that policy-makers had a schedule at the outset that called for steady disinflation (though the fact of the outcome suggests the need for some research into why disinflation happened this way despite some substantial outside influences). On the contrary, the plan was of the 'just do it' variety. The evidence that policy-makers had become serious about disinflation well before the late 1980s is compelling. Dr Grenville makes much of the monetary-policy response to the 1989–90 setback. But there are other contenders for the title of inflation dispersants during this period, and in any event the response to the larger setback in 1985–86 was even more impressive, both in containing the swelling and dispersing it. It is not at all obvious, even on the score of inflation alone, that monetary policy was uniquely or even especially successful after 1989.

But if Dr Grenville has not succeeded in making his case in this paper, he is surely right in saying that the Bank was much nearer centre-stage in the 1990s than in the earlier period. Part of this was due to the growing influence on policy of financial markets, from which the RBA has benefited at the expense of Treasury. But part of it was due to the tighter nature of the Accord in earlier periods, from whose periodic negotiations the Bank was largely excluded. The Bank was 'out of the loop' in the early days, its task being to advise on the implementation of monetary policy after Accord macroeconomic targets had been set. There was no clean break with the past, but for a variety of reasons (from troubles with the IRC over implementing the wages formula to the deep recession and the attainment of low inflation), the Accord was a very different animal in 1994 than it was in 1984. The transfer of Bernie Fraser from Treasury to the Bank in 1989 may also have helped make the Bank feel more at the centre of policy.

Dr Grenville is also correct in saying that the Bank has cleaned up its presentation considerably. There is little point in trying to defend the Bank's theoretical framework (the check-list) in the mid to late 1980s. It is close to indefensible. Adding to the difficulties existing then, the Bank carried some very heavy baggage from the earlier days of quasi-monetarism and commitments to free markets. The rhetoric about setting quantities and leaving markets to look after prices remained for some time after 1985, let alone 1983. This is one of the reasons why the Bank made such heavy weather of admitting its cash-rate decisions in the later 1980s. The fixing of a price stood out like an ugly outcrop in a sea of free markets. That hang-up having disappeared, the Bank no longer needs to dissemble.

What has changed?

The remainder of my comments consider the question of what has changed over the interval of Dr Grenville's period. At first glance a lot has changed. In more basic terms, however, the shades of policy differences remain, albeit about changed parameters. No perfect solution has been found, as indeed Stephen Grenville emphasises.

Elsewhere in this conference, Malcolm Edey has described money-supply targeting as a subset of the broader class of inflation targeting. Other papers examine Taylor rules in detail. The notion of going easy on real interest rates when there was a large output gap, while tightening up when inflation was rising (or threatened to be, as in the case of looming currency-induced inflation acceleration) would not have been the slightest bit foreign to the policy-makers of 1983, even if, obviously, they had never heard of a Taylor rule. As usual, the policy rub is over the emphases or the numbers (the targets or neutral rates and the Taylor weights) attached to the general approach (on which more in a moment).

Much is also made of the recent attack of the George Washingtons, or the outbreak of transparency. Without wishing to pass comment either on the worth of such policy at present, or on the correspondence of RBA practice with the aim, it seems fairly obvious that it is a lot easier to be transparent about maintaining low inflation than about the ultimate intent of disinflation when the rate is near double digits. It is frequently said of good politicians (whose ranks ought not to exclude RBA governors) that they had the ability to talk tough one way as cover for moving the other way. Some say that about aspects of the present Governor's speeches. It is an open question of what the public at large would have made of Bob Johnston had he said that ultimately he wanted inflation to be two-point-something in 1986. Certainly he would have made a rod for his back, and would have aroused major suspicions over the Bank's agenda. And he would have made another for Paul Keating (or Peter Costello had he been Treasurer at the time). More to the point, it is not at all obvious that such candour would have advanced the cause of monetary policy at the time.

Finally, not even the notion of inflation targets is new. What is different at first glance is the commitment to return to them if disturbed. An intrinsic part of policy-making in the mid to late 1980s was a very detailed consideration of wages targets, and public announcements of the result. It is true that aggregate wage movements were given more prominence than the CPI, but it was not very difficult to work out the latter from the former. More publicity was given when the government (and the unions) went into bat to argue in public for the numbers. The forecasts had a good track record, though it is true that occasionally they came unstuck. But so too have the forecasts under the new version of inflation targeting, to date under lesser provocation than their predecessors. As long ago as December 1984 policy-makers were contemplating inflation rates not far from today's level. It is the good fortune of the present incumbents that they can live in this era. Their predecessors were able to bring the vehicle back onto the rails without explicit commitments to do so. I note with interest the efforts of researchers, some at this conference, to evaluate the possible benefits of making explicit the promise to repair any damage.

What stays the same?

There can be disagreement, and there is, over whether the inflation norm should be two-point-something, or one-point-something, or even three-point-something. But it is hard to argue against stable, low inflation, especially when that happy state has been attained. The difficulty in the early 1980s, as now, is what to do about future departures from the norm *and* what weight to give now, and in the future to other considerations, especially output and unemployment. As mentioned earlier, the generic Taylor rule is broad enough to encompass almost all. The argument is about the numbers in the reaction function. It is still the same broad policy argument as in 1980; it is just couched differently.

What frightened some in the early 1980s about monetary targeting was that the enthusiasm for disinflation might be considerably greater than the economy's capacity for recuperating from it. As my former colleague, Mike Artis, said here five years ago, 'any fool can disinflate'; the trick is to do it without plunging the economy into chaos. Another British economist, Alan Budd, said that while it was considered legitimate for generals to use up whole regiments winning the Falklands war, the public did not have the same stomach for economic policy-making on a similar basis. The passions are not now running as highly as these last two sentences read, but it is a mistake to ignore the sentiments.

The papers for this conference are full of the damaging biases that 'well-meaning' policy-makers carry. But unless I have missed something, there is not a word to be seen about the opposite bias carried by the 'monetary-policy club', i.e. most of the participants to this conference and their counterparts elsewhere.[2] Two examples of the fear will

2. Unless members have been so immersed in its intricacies that perspective has been lost, the club is easily recognised as a lobby group. That they dress up their arguments in terms of the national interest is close to being proof positive for the case. And that what was derided as finetuning for decades has suddenly become acceptable as pre-emptive policy raises the suspicions further. But it is fairly obvious that here we have a club that puts a higher premium on avoiding inflation over other matters than most in society. Indeed, there are frequent calls, including at this conference, for the natural inclinations of the club to be ingrained further by the payment of rent as a reward for doing what would have been done anyway.

suffice. One concern is over the size of the neutral real short rate for Australia. Do we know what it is? Elsewhere, in the United States for example, estimates flow freely at around $2^1/4$ to $2^1/2$ per cent. Here, the corresponding number is conspicuous by its absence. It lives in this conference largely as an algebraic symbol. Since past Australian averages contain a premium for disinflation, presumably no longer relevant, there is a reasonable argument that a neutral real rate is now three-point-something. But, as Gordon de Brouwer and James O'Regan show in their paper, if an artificially high estimate is included in the reaction function, the RBA Research version of the result will be a temporary period of low activity and inflation until the 'mistake' is worked out of the system. Perhaps we have been going through one of these episodes recently? In general, how long and how damaging that mistake will be, depends in part on its arithmetic extent, but also on whether there are cohort effects in operation (by which I mean something broader than the usual macroeconomic hysteretic effects). There is also the matter of whether, in a changing world, there are repeat 'mistakes'. Of course, in principle, mistakes can go both ways. The fear is, given the attitudes of the club, the bias in the run of mistakes will be one way.

A second concern is with the forecasts to be plugged into forward-looking operational versions of the Taylor rule. Will the authorities be too optimistic about output and too pessimistic about inflation prospects, to the cost of suboptimal activity performance? Again, the reverse set of forecasting errors are conceivable, this time to the detriment initially of the inflation outcome. Here, unlike the problem with neutral real interest rates, estimates for which ought to settle down eventually, forecasting biases may be congenital. Given the priority attached to successful inflation outcomes, will central bankers be compelled perpetually to jump at wage and other prices shadows, with their suspicions being confirmed only occasionally? If so, the result will be a series of negative shocks of the sort described by de Brouwer and O'Regan.

Of course, the proof of the pudding is in the eating. Just as we can look back over the past decade in judgment on central bank actions, not necessarily in agreement with Dr Grenville, the same sorts of issues are likely to recur in the future. There may be a generic framework (the Taylor rule) to which all can subscribe in its algebraic version, but it seems dubious that it, or other developments, can provide the one perfect solution. These are seen not to exist in industrial relations. That is likely to be the case also with monetary policy. Nearly 20 years ago some colleagues and I published the first edition of a policy book about expansionists and restrictionists. There is likely to be plenty of work left mining that seam before the coal runs out. And it would be surprising if occasionally some heat were not vented.

2. General Discussion

The discussion focused primarily on the issue of the objectives for monetary policy during the 'check-list' period in the second half of the 1980s. Some argued that monetary policy had been directed primarily at curbing asset-price inflation, some the current account deficit, while others supported the paper's conclusion that inflation increasingly became the priority of monetary policy.

The argument that monetary policy had focused on curbing asset-price inflation led to a general discussion of the links between asset-price inflation and consumer price inflation and the issue of whether monetary policy should be concerned with asset prices *per se*. (This issue was also discussed following the paper by Frank Smets.) Some participants argued that rising asset prices could generate perceptions of increased wealth and thus stimulate private demand; they could also increase general inflation expectations. These developments might require a monetary-policy response. Others noted that if asset-price bubbles are allowed to continue unchecked, the eventual bursting of the bubble might cause serious deflationary forces through balance-sheet problems for corporations and financial institutions. Judging whether or not this possibility requires a monetary-policy response is complicated by the fact that it is difficult to assess whether changes in asset prices are underpinned by fundamentals or represent a bubble, particularly in the early phase. There was general acceptance of the idea that, in part, asset-price movements in the late 1980s represented a bubble, but some participants argued that taxation or prudential policy, rather than monetary policy, should have been used to deal with the problem.

There was considerable disagreement regarding the place of the current account in monetary-policy decisions in the latter part of the 1980s. Some saw the current account at centre-stage; others viewed it as making only periodic appearances, while still others saw it as having little, or no, role. There was, however, general agreement that a range of public statements at the time made it difficult to understand the Bank's strategy, and this probably diluted the desired impact of the tightening in monetary policy. Some thought that the comparison with today's framework was instructive. There is now a high level of understanding that the Bank's ultimate goal is medium-term price stability, with changes in interest rates explained in terms of creating an environment in which the economy can grow as quickly as is possible while maintaining low inflation.

Some participants argued that if inflation was the primary objective of monetary policy in the late 1980s, then the stance of policy at the time was too restrictive. In particular, their view was that the level of interest rates was not consistent with the stated preference for a gradual, rather than a rapid, disinflation; thus, the fall in inflation that occurred could be regarded as, in part, accidental. While there was little disagreement with the idea that the extent of the fall in inflation came as a surprise to most observers, it was noted that the public comments by the Bank at the time had expressed a clear desire for disinflation in advance of its occurrence. The process of financial deregulation and changing labour-market arrangements meant that there was no clear calibration of the linkage between interest rates and inflation, complicating any assessment of the appropriate stance of monetary policy.

There was also a discussion of the role of personalities in the conduct of monetary policy. It was argued that when assessing the history of policy, one must be careful not to overly personalise the decisions taken. Rather, one should compare the decisions with the benchmark of a generic monetary policy-maker. In this regard, it is interesting to consider the role of the monetary-policy framework. Is the choice of the framework dependent on the personality of the policy-maker? Is the critical element in the disinflation process the willpower of the policy-makers or is it the framework that is in place? Some participants wondered whether the inflation rate would have continued to fall in 1985/86 if the exchange-rate depreciation had not taken place, or whether given the monetary-policy framework in place at the time, inflation would have risen again.

Which Monetary-policy Regime for Australia?

Warwick McKibbin*

1. An Assessment

There is a vast literature on the choice of monetary regimes that spans both theoretical and empirical insights. In this paper I draw on some of this literature as well as a recent research project at the Brookings Institution in which I was involved with Dale Henderson from the Federal Reserve in Washington.[1] This project was intended to cover a wide theoretical and empirical literature on monetary-policy regimes and draw out implications for actual policy implementation. The outcome of some of that research was published in the Brookings volume on 'Evaluating Policy Regimes: New Research in Empirical Macroeconomics' (eds Bryant, Hooper and Mann 1993). What did we learn from that research that can guide the choice of a monetary-policy regime for Australia?

A casual observer (with an engineering bent) might ask why the Reserve Bank has not worked it out yet? If you have the right model of the Australian economy (such as the McKibbin and Sachs Global model, for example), why not write down the objectives of the policy-maker and maximise this objective function (or minimise the loss function depending on the personality of the policy-maker) subject to the constraints imposed by the structure of the economy. We have learnt in the past few decades that you may want to impose other constraints such as the desire to write the optimal policy as a closed-loop rule to make it more operational (i.e. a rule in which the instrument of policy is a function of all state and exogenous variables in the economy). You could even impose on the optimisation that the rule selected be restricted to the set of time-consistent policy rules to incorporate the insight of Kydland and Prescott (1977) and Barro and Gordon (1983). Indeed, this has been done using simple as well as complex econometrically estimated models (McKibbin and Sachs 1988, 1989, 1991). You could argue that this approach underlay the 'check-list' approach to monetary policy that was popular in the Reserve Bank in the 1980s (Jonson and Rankin 1986; Stemp and Turnovsky 1989). The outcome of such a constrained optimisation would be a complex feedback rule in which the policy instrument responds to a range of information (both domestic and foreign) available in a given period.

In practice, the presence of uncertainty about the 'true model' complicates the above derivation of the optimal feedback rule. Nonetheless, calculating optimal rules gives a benchmark against which to evaluate other rules. As well, the issue of credibility can be

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1. See Henderson and McKibbin (1993a,b) and McKibbin (1993). This has been extended in the Australian context on regime choice in McKibbin (1996).

very important when there is great uncertainty about which is the true model. If the Reserve Bank actually calculated the optimal rule (presumably trading off inflation and unemployment objectives), how do agents really know the Reserve Bank is not cheating on the rule when it is so complex as to be indistinguishable from complete discretion? One way to get around this problem is to simplify the rule so that the amount of information needed to monitor adherence to the rule is minimised and therefore trade off the gains from credibility against the loss from deviating from the fully optimal rule. In this case you could constrain the set of information in the feedback rule to a reduced set of variables which are observable or can be inferred in any given period. Thus you could compress the entire problem into an optimal but simple feedback rule for policy.[2] Simple rules for policy are very popular these days although the issue of optimal simple rules is dealt with less often.

A serious problem with any policy rule is its robustness. It is desirable that a policy rule not only perform well in the model that it was developed in but also does *not* perform disastrously in an alternative model of the economy. The robustness aspect of regime choice was one of the underlying themes of the Brookings research. Is there a robust policy rule that performs well across a range of alternative empirical representations of the economy?

Given that the current weight of opinion is on the desirability of simple rules either because of issues of credibility or because of doubts about what discretionary policy can achieve or doubts about the transmission mechanism (Grenville 1995), what issues emerge in the choice of a simple feedback rule? The first issue is what should be the instrument of monetary policy. The second is what variables should appear in the rule. The third issue is the size of the feedback coefficients or how quickly policy should respond to the deviation of intermediate targets from their desired values.

On the policy instrument, most economists agree that the current institutional arrangements for implementing monetary policy make a short-term interest rate the appropriate monetary instrument (Edey 1989, 1997). Issues of price-level indeterminancy with an interest-rate instrument are a real concern, but as shown in Gagnon and Henderson (1990) and Henderson and McKibbin (1993a), as long as there is some nominal anchor in the objective of policy, using the interest rate as the policy instrument is not such a problem.

The second issue is what should be the intermediate target or the variable(s) within the rule to which interest rates respond over some time period. This is where the debate becomes less clear. Going back through the literature on regime choice there is a variety of candidates. Indeed, the early literature of regime choice for monetary policy that underlies most current analytical evaluations can be traced back to the classic article by Poole (1970). Poole used a simple closed-economy theoretical model and compared the performance of a rule of a fixed stock of money with a fixed interest-rate rule, under shocks to money demand and goods demand. A number of papers have extended this form of analysis to open economies (Roper and Turnovsky 1980) and a wide range of shocks including oil price shocks and supply shocks (Henderson and McKibbin 1993b).

2. See McKibbin (1993) and de Brouwer and O'Regan (1997) for applications of this approach.

The set of possible regimes has also expanded from the fixed interest-rate and fixed money regime to regimes that target nominal income (Corden 1981; Meade 1978; Tobin 1980) and other forms of rules, such as rules with feedback on inflation and output gaps according to the Bryant, Hooper, and Mann (BHM) (1993) rules.

How should the variables that appear in the feedback rule be chosen? A crucial result from the Brookings project is that within the class of simple rules, the choice of the 'best rule' is an empirical question. In Henderson and McKibbin (1993a), we show that the choice depends on the *nature of the shocks* that hit the economy, the *structure of the economy* (in particular the degree of price stickiness which, in our case, was the degree of wage persistence) and the size of the feedback coefficient or what we referred to as the *degree of instrument adjustment*. In addition, the *ultimate policy targets* used to evaluate the regimes are important since we show that the ranking of regimes in terms of inflation variability differs from rankings for unemployment, which differs from rankings for output in the case of productivity shocks. The model simulations that were designed in the Brookings volume were then used to put some empirical flesh on the theoretical bones to see if a wide range of models could be used to pick out relatively robust policy rules.

In Henderson and McKibbin (1993a,b) we considered temporary shocks to money demand, goods demand and productivity under rules with varying degrees of instrument adjustment (under alternative degrees of wage persistence) to target: interest rates; a measure of the money stock; nominal income; and an unweighted sum of inflation and output deviation from potential. This last regime, which we called the CC regime with equal and unit weights on inflation and output gap (where the weights came from experiments with the MSG2 model), is currently known as the Henderson-McKibbin Rule in the Fed. A similar rule with a weight of 0.5 on output and inflation separately relative to desired is currently called the Taylor Rule in popular discussions. Both rules should really be called the BHM rule but actually significantly predate that identification. To be consistent with the notation in Henderson and McKibbin (1993a,b), I will refer to this regime as the CC regime where the results are weight-specific from our paper or I will refer to this class of rules generically as the BHM rule. The exact form of these rules is shown in Table 1.

It was clear from the theoretical results that we explored (before turning to the large-model simulations) that in the case of shocks to money demand, a fixed money rule was dominated by other regimes. For other shocks the results are ambiguous but a fixed money rule or a fixed interest-rate rule was usually dominated by the nominal-income and CC rules.

In the case where there is no wage persistence, the nominal-income and CC rules are equivalent and dominate the other regimes. For a global demand shock the nominal-income rule minimises employment and output deviations for low feedback coefficients but the CC rule minimises inflation deviations across all feedback coefficients. This contrasts with a country-specific demand shock in which the nominal-income regime dominates on inflation as well. For both global and country-specific productivity shocks the nominal-income rule works well for employment but is dominated by the CC regime for output and inflation.

Table 1: Alternative Rules

Money Rule:

$$i_t = \bar{i}_t + \beta(m_t - \overline{m}_t) \tag{1}$$

Nominal-income Rule:

$$i_t = \bar{i}_t + \beta(p_t + y_t - \overline{p_t + y_t}) \tag{2}$$

Bryant-Hooper-Mann Rules:

Henderson-McKibbin (or CC) Rule:

$$i_t = \bar{i}_t + \alpha(\pi_t + y_t - \overline{\pi_t + y_t}) \tag{3}$$

Taylor Rule:

$$i_t = \bar{r}_t + \pi_t + 0.5(\pi_t - \bar{\pi}_t) + 0.5(y_t - \bar{y}_t) \tag{4}$$

where:

i = nominal interest rate;
r = real interest rate;
π = inflation rate;
p = log of price level;
y = log of output;
m = log of money; and
a bar over a variable indicates a desired value.

Once wage persistence is introduced into the analysis, the results become less clear for the relative performance of the nominal-income rule and the CC rule. The equivalence of these rules breaks down. A clear result that emerges is that the CC rule handles the impact of a temporary global productivity shock on employment much better than the nominal-income rule in the MSG2 model over the full range of feedback coefficients. The reason for this is clear from the model specification. For a fall in productivity, as output falls and prices rise there is less adjustment under the nominal-income rule because nominal income is little changed. In contrast, under the CC regime as output falls interest rates fall which offsets the loss in employment. The rise in inflation is slow to emerge because of wage persistence. When inflation does begin to emerge, the recovery in output occurs while inflation is rising which causes interest rates to rise and dampen the inflationary impulse. In this particular case, the CC regime clearly dominates the nominal-income target because of the nature of the particular dynamic structure of the MSG2 model. This does not show up in the simpler theoretical models.

A final issue that emerged from the exploration of simple optimal rules versus fully optimal rules in McKibbin (1993) that is worth repeating, is that some simple rules such as the CC rule can dominate the fully optimal rule under some circumstances. In that paper the shocks were drawn from an estimated world variance-covariance matrix of shocks. In this case, the CC regime led to lower variance for a range of target variables than the fully optimal complex time-consistent policy rule. This result is possible when one considers that in that paper the optimal rule was chosen from the set of time-consistent policy rules. However, the simple rules evaluated in the Brookings project are not part of the optimal set of policy rules available under the condition of time consistency. The sustainability of these simple rules therefore depends crucially on the exogenously specified credible commitment of the central bank to the simple rule. This other aspect of credibility should be kept in mind, i.e. the simple rules are not necessarily time consistent unless there is some form of external credible commitment.

2. Conclusion

What did we learn from the Brookings research of relevance to the Australian debate on monetary regimes? The first lesson is that money targeting is dominated by other regimes. Both the nominal-income target and the inflation plus output deviation from potential targets (what I call the BHM rule) dominate the other money and interest-rate targeting rules. The attractiveness of the preferred policy rules, whether in the form of the BHM rule (or various forms of this rule called the Taylor Rule or the Henderson-McKibbin Rule), is dependent on the type of shocks hitting the economy. Where productivity shocks or supply-side shocks are dominant, the nominal-income rule has a number of drawbacks relative to the BHM rule. First, if real output returns to trend there is a tendency for policy to have to drag the price level back to baseline which can have additional output losses along a transition path. This has already been widely discussed in the literature on price-level drift or base drift in the early money-stock targeting debates (Hansen 1996). It is unlikely for most objective functions that the gains to returning the price level to the desired level can justify the loss in real output during the transition. The second advantage of the BHM class of rules over nominal-income targeting is that when there is significant wage persistence, the fall in output may induce a lowering of interest rates to offset the employment loss before prices begin to rise. As output recovers and prices rise, interest rates rise appropriately thus giving a better employment and output performance than a nominal-income rule. This result depends crucially on the nature of the wage dynamics in the economy as well as the size of the weight on inflation in the output inflation feedback rule (0.5 appears optimal in Taylor-type models, whereas unity is better in MSG2 type models). Nonetheless, these theoretical results and results from the MSG2 model suggest that indeed there is such a gain from this type of rule relative to the pure nominal-income rule.

What does all this mean for the evaluation of current Reserve Bank policy? It would appear that the current policy of ‘targeting inflation over the cycle’ is close to a rule from the class of BHM rules that in many cases in the Brookings project were found to dominate the alternative simple rules. What the exact weights are on this rule currently in Australia is unclear (probably just as much to Reserve Bank officials as to outside observers). A case could be made that to maximise the credibility gain from moving to a simple rule, as the Bank has clearly done since the early 1990s, it would be helpful for the Reserve Bank to be more specific on what the parameters are. In addition, a case can be made that there should be less uncertainty surrounding the timing of changes in interest rates in response to changes in these variables (or at least in response to changes in the expected outcomes of the targets depending on the way the rule is actually implemented). In the words of the above summarised literature, there should be a more explicit statement of the size of the feedback coefficient or the degree of instrument adjustment.

A final issue that should be considered is the extent to which a simple policy rule will be, or should be, sustained if and when the next big shock hits the Australian economy. Whether it is optimal to stick to a simple rule under all circumstances is open to debate. We know that time-consistent discretionary policy may dominate simple rules, but credibility arguments rule out discretion in most moderate circumstances. However, in the face of a large shock, it is possible that sticking to a simple rule at all costs will probably be suboptimal and most likely will not be credible anyway (given that exogenous commitment is all that holds the rule in place). Thus, rather than sit back and feel comfortable about where the monetary-policy regime has settled in Australia, it is crucial to continue to improve our understanding of the Australian economy and its place in the global economy, through continued investment in theoretical and empirical research. When the time comes to deviate from the simple monetary-policy rule onto which we have currently converged in relatively calm times, the deviation in monetary policy will need to be done appropriately and swiftly. The more we understand about the economy, the more likely the policy adjustment will work in the right direction to lower the costs of large economic shocks rather than exacerbate these costs, as unfortunately has been the case in many previous episodes of significant monetary-policy adjustment in Australia.

References

Ball, L. (1997), 'Efficient Rules for Monetary Policy', NBER Working Paper No. 5952.

Barro, R. and D. Gordon (1983), 'Rules, Discretion and Reputation in a Model of Monetary Policy', *Journal of Monetary Economics*, 12(1), pp. 101–121.

Bean, C. (1983), 'Targeting Nominal Income: An Appraisal', *Economic Journal*, 93, pp. 806–819.

Bryant, R., P. Hooper and C. Mann (eds) (1993), *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*, Brookings Institution, Washington, D.C.

Bryant, R., P. Hooper and C. Mann (1993), 'Stochastic Simulations With Simple Policy Regimes', in R. Bryant, P. Hooper and C. Mann (eds), *Evaluating Policy Regimes: New Research in Empirical Macroeconomcs*, Brookings Institution, Washington, D.C., pp. 373–415.

Corden, M. (1981), 'Comments: On Monetary Targets', in B. Griffiths and G. Wood (eds), *Monetary Targets*, Macmillan, London, pp. 86–94.

de Brouwer, G. and J. O'Regan (1997), 'Evaluating Simple Monetary-policy Rules for Australia', paper presented at this conference.

Edey, M.L. (1989), 'Monetary Policy Instruments: A Theoretical Analysis', Reserve Bank of Australia Research Discussion Paper No. 8905.

Edey, M.L. (1990), 'Operating Objectives for Monetary Policy', Reserve Bank of Australia Research Discussion Paper No. 9007.

Edey, M.L. (1997), 'The Debate on Alternatives for Monetary Policy in Australia', paper presented at this conference.

Gagnon, J. and D. Henderson (1990), 'Nominal Interest Rate Pegging under Alternative Expectations Hypotheses', in P. Hooper, K. Johnson, D. Kohn, D. Lindsey, R. Porter and R. Tryon (eds), *Financial Sectors in Open Economies: Empirical Analysis and Policy Issues*, Board of Governors of the Federal Reserve System, Washington, D.C., pp. 437–473.

Grenville, S.A. (1995), 'The Monetary Policy Transmission Process: What Do We Know? (And What Don't We Know?)', Reserve Bank of Australia *Bulletin*, September, pp. 19–33.

Hansen, E. (1996), Price Level versus Inflation Rate Targets in an Open Economy with Overlapping Wage Contracts, paper presented at the Reserve Bank of New Zealand Workshop on Monetary Policy, Wellington, 20–21 May.

Henderson, D.W. and W.J. McKibbin (1993a), 'A Comparison of Some Basic Monetary Policy Regimes for Open Economies: Implications of Different Degrees of Instrument Adjustment and Wage Persistence', *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 221–317.

Henderson, D.W. and W.J. McKibbin (1993b), 'An Assessment of Some Basic Monetary Policy Regime Pairs: Analytical and Simulation Results from Simple Multi-Region Macroeconomic Models', in R. Bryant, P. Hooper, and C. Mann (eds), *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*, Brookings Institution, Washington, D.C., pp. 45–218.

Jonson, P.D. and R.W. Rankin (1986), 'Some Recent Developments in Monetary Economics', *Economic Record*, 62(178), pp. 257–267.

Kydland, F. and E. Prescott (1977), 'Rules Rather than Discretion: The Inconsistency of Optimal Plans', *Journal of Political Economy*, 85(3), pp. 473–491.

Masson, P.R. and S.A. Symansky (1993), 'Evaluating Policy Regimes under Imperfect Credibility', in R. Bryant, P. Hooper, and C. Mann (eds), *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*, Brookings Institution, Washington, D.C., pp. 461–474.

McKibbin, W.J. (1989), 'Time Consistent Policy: A Survey of the Issues', *Australian Economic Papers*, 28(53), pp. 167–180.

McKibbin, W.J. (1993), 'Stochastic Simulations of Alternative Monetary Regimes in the MSG2 Model', in R. Bryant, P. Hooper, and C. Mann (eds), *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*, Brookings Institution, Washington, D.C., pp. 519–534.

McKibbin, W.J. (1996), 'Disinflation, Fiscal Consolidation and the Role of Monetary and Fiscal Regimes', ANU Centre for Economic Policy Research Discussion Paper No. 348.

McKibbin, W.J. and J. Sachs (1988), 'Comparing the Global Performance of Alternative Exchange Arrangements', *Journal of International Money and Finance*, 7(4), pp. 387–410.

McKibbin, W.J. and J. Sachs (1989), 'Implications of Policy Rules for the World Economy' in R. Bryant, D. Currie, J. Frenkel, P. Masson and R. Portes (eds), *Macroeconomic Policies in an Interdependent World*, The Brookings Institution, Centre for Economic Policy Research and International Monetary Fund, Washington D.C., pp. 151–194.

McKibbin, W.J. and J. Sachs (1991), *Global Linkages: Macroeconomic Interdependence and Cooperation in the World Economy*, Brookings Institution, Washington, D.C.

McTaggart, D. and C. Rogers (1990), 'Monetary Policy and the Terms of Trade: A Case for Monetary Base Control in Australia?', *Australian Economic Review*, 90, pp. 38–49.

Meade, J.E. (1978), 'The Meaning of "Internal Balance"', *Economic Journal*, 88, pp. 423–435.

Poole, W. (1970), 'Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model', *Quarterly Journal of Economics*, 84(2), pp. 197–216.

Reinhart, V. (1990), 'Targeting Nominal Income in a Dynamic Model', *Journal of Money, Credit and Banking*, 22(4), pp. 427–443.

Roper, D.E. and S.J. Turnovsky (1980), 'Optimal Exchange Market Intervention in a Simple Stochastic Macro Model', *Canadian Journal of Economics*, 13(2), pp. 296–309.

Stemp, P. and S. Turnovsky (1989), 'Optimal Monetary Policy in an Open Economy', *European Economic Review*, 31(5), pp. 1113–1135.

Tobin, J. (1980), 'Stabilization Policy Ten Years After', *Brookings Papers on Economic Activity*, 1, pp. 19–72.

The Welfare Effects of Alternative Choices of Instruments and Targets for Macroeconomic Stabilisation Policy

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1. Introduction

Many debates in macroeconomic policy involve arguments about the appropriate choice of instruments and targets for stabilisation. Keynesian aggregate-demand-management policy was centred on the use of fiscal instruments to stabilise the level of employment or real activity in the short term. The monetarists of the late 1970s favoured the use of monetary instruments to stabilise the growth rate of money supply and therefore, it was assumed, the medium-term growth rate of nominal output. More recently, the use of interest rates and other monetary instruments to stabilise inflation rates has been advocated.

In these debates, macroeconomic stabilisation is commonly treated as an end in itself. Arguments concerning the choice of targets and instruments have therefore been based on considerations such as political feasibility, the ease with which instruments can be adjusted, and the lag between policy changes and impacts on the level of economic activity.

In debates over the choice of policy instruments and targets, direct impacts on individual welfare are rarely considered. Yet the nature and incidence of the effects of, say, an increase in interest rates are quite different from those of an increase in income taxes, even though, in macroeconomic terms, the two may be regarded as substitutes. Similarly, the welfare effects of policies that successfully stabilise real interest rates will differ from the effects of policies that stabilise the price level or the inflation rate.

Many of the critical issues in evaluating the relative merits of monetary and fiscal stabilisation arise when individuals are, at least *ex post*, heterogeneous. Such issues are particularly important in the evaluation of monetary policy. The net effect on consumption arises through changes in the relative price of current and future consumption. Hence, individuals may gain or lose depending on their pattern of borrowing and lending. By contrast, the effects of a contractionary fiscal policy, such as an increase in taxation, are more evenly spread. Within the period in which such a policy is applied, most individuals have their disposable income reduced and none have their income increased, at least by direct government action.[1]

In this paper, the welfare effects of alternative targets and instruments for stabilisation are examined in the context of a life-cycle model. The central idea is to model the effects

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1. If fiscal restraint is applied on the expenditure side, the effects may be more concentrated. For example, the cuts in the 1996/97 Budget affected Canberra more than other communities.

of alternative policy instruments on the *ex ante* riskiness of individual consumption. Policies have a direct effect on individual consumption, through the changes in relative prices and post-tax incomes which they induce, and an indirect effect arising from stabilisation of the target variables. A policy is regarded as successful to the extent that it reduces the riskiness of individual consumption, and therefore yields an increase in welfare. It is argued that the direct effects of countercyclical fiscal policy tend to reduce individual consumption risk, while the direct effects of countercyclical interest-rate policy tend to increase individual consumption risk. Hence, if stabilisation of aggregate output is desired, fiscal policy is the appropriate instrument.

The paper is organised as follows. Section 2 deals with the recent evolution of macroeconomic policy and the emergence of a policy framework based on the use of countercyclical monetary policy as the principal method of stabilisation. It is argued that the appropriate aggregate goals are minimisation of unemployment and stabilisation of real interest rates. Section 3 deals with the choice of targets for stabilisation and the desirability, from a microeconomic viewpoint, of stabilising output, consumption, prices, interest rates and unemployment. In Section 4, a life-cycle model in which these issues may be addressed more formally is presented. In Section 5, the model is used to analyse the microeconomic impact of fiscal and monetary stabilisation policies. It is argued that fiscal policy is the appropriate instrument for macroeconomic stabilisation. Section 6 deals with policy implications and particularly with the proposition that political constraints prevent the use of active fiscal policy. Section 7 deals with the choice of a long-term real interest-rate target for stabilisation policy.

2. The Emergence of Countercyclical Monetary Policy

In the history of postwar Australian macroeconomic policy, three main phases may be distinguished. During the Keynesian period, roughly from 1945 to 1975, monetary policy played a subordinate role. Fiscal policy was seen as the primary instrument for domestic macroeconomic stabilisation. In the Keynesian framework, achievement of internal balance was supposed to imply both full employment and price stability, while external balance could be dealt with by exchange-rate adjustments. Monetary policy could therefore be used either to stabilise interest rates or as a backup to fiscal policy.

The next phase was that of monetarism, in which the money stock became the key instrument and the rate of inflation the key target of policy. In Australia, as in most OECD countries, this phase ran from the mid 1970s to the mid 1980s and was followed by a period of some confusion, during which it was difficult to discern any coherent macroeconomic policy framework. Financial deregulation contributed to this confusion and was even more extensively used as an excuse for the lack of a framework.[2] More fundamentally, however, the problem was a lack of faith in traditional stabilisation policies combined with unwillingness to accept radical new classical arguments rejecting stabilisation in principle.

2. For example, few central banks explicitly rejected monetarism. Instead, most announced that financial deregulation had invalidated previous relationships between monetary stocks and activity, therefore necessitating a temporary suspension of monetary-stock targeting. In nearly all cases, the temporary suspension turned out to be permanent.

The new-classical arguments against stabilisation policy introduced, for the first time in the modern debate, explicit consideration of individual welfare effects. Two main streams of criticisms may be considered. First, in a model where the representative agent is an infinitely lived individual or dynasty, the Ricardian-equivalence proposition of Barro (1974) supports the new-classical view that stabilisation policy must be ineffective in the long run. Second, the real-business-cycle literature began as a development of the idea that observed business cycles may represent optimal individual responses to real shocks, such as fluctuations in the rate of technological change.

In response, the 'new Keynesians' used models of individual optimisation to justify stabilisation policy. Many of the criticisms of the Ricardian-equivalence model imply that macroeconomic stabilisation policy may not only be effective but may raise the welfare of the representative agent. For example, if individuals are risk averse and have a finite time-horizon, stabilisation policy may be justified on the basis of considerations of risk aversion as a form of intergenerational insurance. The potential benefits of stabilisation policy are reinforced by non-neoclassical features of the economy such as liquidity constraints.

A new phase in the evolution of macroeconomic policy began in the early 1990s and involved renewed attempts to stabilise aggregate economic activity, this time using interest rates rather than fiscal adjustments as the key instrument of policy. A similar policy framework emerged at the same time in the United States. Unlike the shift to monetarism, this change in approach was not officially announced and did not arise from theoretical debates within the economics profession. The new policy framework reflects a general belief in the necessity of some form of stabilisation, combined with a view, at least in Australia and the United States, that political constraints prevent the effective use of fiscal policy. The fact that income taxes can no longer be increased rapidly through bracket creep, and that successive prime ministers have made a fetish of not increasing income tax rates gives substance to this view.

An alternative approach, adopted in New Zealand and advocated in Australia, has been to target the inflation rate, rather than the level of economic activity. In practice, to the extent that short-run macroeconomic fluctuations are primarily movements up and down a short-run Phillips curve, the two approaches may imply similar policies. The main difference has been that, by tightly targeting a single indicator of economic activity, the New Zealand approach implies more active use of interest-rate variations than the Australian approach based on a range of indicators each with an implicit band of tolerance.

2.1 Macroeconomic policy in the 1980s and 1990s

Except where macroeconomic policy is rigidly based on a fixed rule, such as a monetary-growth rule, it is necessary to consider the discretionary choices made by policy-makers as well as the framework within which they operate. Two features of macroeconomic policy in the 1980s and 1990s stand out. The first is the persistently contractionist bias of policy. This bias may be viewed in a number of ways.

Particularly since 1989, official forecasts of economic growth rates and unemployment rates have been consistently over-optimistic, leading to the formation of policies based on the need to avoid unsustainably rapid growth. Forecasting of growth rates has improved since the recession, but forecasting of unemployment rates has not.

Also, if it is assumed that the non-accelerating inflation rate of unemployment (NAIRU) is between 7 and 8 per cent, unemployment has been in excess of the NAIRU for all but three of the past fifteen years. The decline of unemployment to a rate of 5.9 per cent, perhaps 1 per cent below the NAIRU, in 1989 brought forth one of the most contractionary combinations of fiscal and monetary policy in Australia's history. By contrast, there was a three-year lag between the onset of recession in mid 1989 and a shift in fiscal and monetary policy to a stance that could reasonably be described as stimulatory.

The restrictive bias of macroeconomic policy over the 1980s has been retrospectively justified as the price of the reductions in inflation that took place over that period. However, despite the fact that inflation has been low throughout the 1990s, the stance of policy and the statements of policy-makers appear to indicate that the risks of excessive expansion are still viewed as more important than the costs of sustained high unemployment.

A second and related feature of the policy scene is the way in which macroeconomic policy has repeatedly been derailed by policies of microeconomic reform. The collapse of monetary targeting following financial deregulation was the first such incident. The exceptional over-optimism of macroeconomic policy-makers in 1989 reflected the false belief that microeconomic reform had produced an economy so flexible that it would rapidly bounce back from the effects of fiscal and monetary contraction (Higgins 1989). Much of the resistance to stimulatory policies in the first years of the recession was due to a desire not to disrupt programs of microeconomic reform, such as tariff cuts, and to the generally anti-government ideology associated with microeconomic reform. Finally, the restrictionist bias of macroeconomic policy in the 1990s has been due, in large measure, to uncertainty about the aggregate impact of labour-market reforms. These reforms were based on an explicit rejection of concern about aggregate wage levels in favour of a decentralised approach to wage determination.

3. The Choice of Targets for Stabilisation Policy

From a microeconomic perspective, there is no reason to seek to stabilise aggregates such as gross domestic product (GDP) or the GDP deflator *per se*. The ultimate concern should be to stabilise individual consumption and relative prices, at least to the extent that fluctuations in these variables are generated by macroeconomic disturbances. The implications for major economic variables are considered below

3.1 Stabilisation of output and consumption

A microeconomic basis for the stabilisation objective implies that macroeconomic policy should stabilise the output of each sector in the economy, except insofar as output fluctuations reflect underlying microeconomic shocks. Policy should not induce excess contraction in one sector to offset expansion in another, since this will introduce additional noise into relative prices.

To illustrate this point, consider a country made up of two regions, east and west that do not engage in trade (say, Pakistan prior to the secession of Bangladesh). Suppose that the eastern region is characterised by a business cycle and the western region by a stable trend in output and consumption. It would be possible to stabilise aggregate output and consumption for the country as a whole by inducing cyclical fluctuations in the western region that are out of phase with those in the eastern region. It is obvious, however, that such a policy would reduce welfare in the western region, while having no effect in the eastern region. The use of the aggregate economy as a unit of analysis in this case simply obscures the issue. Problems of this kind can arise whenever macroeconomic policy affects different sectors of the economy differently. The ultimate basis for welfare analysis must be individual consumption, and this is most naturally analysed in the context of a life-cycle consumption model.

3.2 Unemployment

The variable contributing most directly to variation in individual consumption is the unemployment rate, along with closely related variables such as the rate of bankruptcies. High levels of unemployment imply high variability of consumption. Hence the main object of stabilisation policy should be to reduce the average unemployment rate. This will normally imply reducing the variability of the unemployment rate, but it should be recognised that stability in the unemployment rate is desirable primarily because stability is conducive to the achievement of lower average rates of unemployment.

Policies for reducing the average rate of unemployment have been the subject of some discussion. Three major classes of policy have been proposed. First, classical policy responses have been based on recommendations that minimum wages and social welfare benefits should be reduced. The underlying assumption is that high levels of unemployment are the result of policies that prevent the labour market from clearing. International evidence suggests that such policies have some impact on unemployment rates, part of which arises through increased employment. However, since they reduce the welfare of both the unemployed and low-wage employed workers, the impact of classical policies on consumption risk is unambiguous.

Active labour-market policies, such as those implemented in the Working Nation Job Compact, are designed to shift the short-run Phillips curve, which relates unemployment to nominal wage growth, and the Beveridge curve, which relates unemployment to vacancy rates, so that a lower level of unemployment is consistent with a given level of excess capacity in the economy as a whole. Evidence on the effectiveness of active labour-market policies remains limited.

Expenditure-switching policies, such as those proposed by Langmore and Quiggin (1994), are designed to increase the demand for labour associated with a given level of aggregate demand and, in particular, a given level of demand for imports. The underlying assumption is that high levels of unemployment reflect an underlying decline in the demand for labour, and that this decline has been exacerbated by government policies that have constrained the growth of labour-intensive areas of the economy such as the community-service sector. There has, as yet, been little discussion of the potential benefits and costs of an expenditure-switching policy.

Although reduction in the average level of unemployment must be a central objective of public policy, it may be regarded as logically distinct from the problem of macroeconomic stabilisation over the business cycle. The present paper is concerned with the latter issue.

3.3 Prices and interest rates

Price fluctuations reduce welfare when there are unpredictable variations in relative prices not derived from shocks to demand for, or supply of, particular commodities.[3] In particular, unanticipated general inflation reduces welfare since it implies unpredictable variations in the relative prices of consumption at different dates. However, this effect arises not through inflation *per se*, but through the resulting fluctuation in real interest rates. The need to stabilise relative prices rather than price indexes *per se* implies that the appropriate aggregate price targets are real interest rates, that is, relative prices of present and future consumption.

The welfare-relevant measure of stability of prices over time is the relative prices of consumption at different dates, that is, real interest rates. A policy that stabilises some measure of the inflation rate but destabilises real interest rates must reduce welfare. To the extent that there is a welfare-relevant case for an inflation target as opposed to a real-interest-rate target, it must be as a proxy for stabilisation of medium-term and long-term real interest rates at the expense of greater variability in short-term rates. Such a case needs to be made explicitly in any given situation rather than resting on appeal to some inchoate notion about the desirability of low and stable inflation rates.

As well as affecting intertemporal price ratios, monetary policy based on an inflation target may alter relative prices within a given period. There is a large literature devoted to the analysis of the proposition that inflation is associated with increased variability in relative prices. Golob's (1993) summary finds a preponderance of evidence in favour of the proposition, though this evidence has been criticised (Bomberger and Makinen 1993). Assuming that anticipated inflation is associated with increased relative-price variability, welfare benefits may be obtained from reductions in inflation, provided the instrument used to reduce inflation does not itself generate relative-price variability.

Stabilisation of indexes such as the GDP deflator *per se* is of no interest. Stabilisation of the general price level is desirable only as a proxy for stabilisation of relative prices of the large set of commodities that make up GDP. Hence, a policy aimed at stabilising the aggregate price level should not induce large fluctuations in relative prices, for example through differential impacts on different sectors of the economy. There is a danger that an activist monetary policy will have the effect of destabilising demand for the output of sectors such as housing, and therefore of destabilising relative prices. The success of a price-stabilisation policy should be measured by the variability of relative prices, not by variability of aggregate measures such as the GDP deflator.

If real interest rates are constant, variations in the inflation rate translate directly into variations in the nominal interest rate, and only the return to cash is affected. If the

3. If low-cost stockholding is feasible, price shocks due to temporary fluctuations in demand or supply may be smoothed by private speculation or through buffer-stock stabilisation schemes, and welfare will be increased as a result.

equilibrium real interest rate is constant, constancy of real interest rates, is equivalent to perfect anticipation of inflation. Hence, we derive the conclusion that the objective of stabilising real interest rates is equivalent to the objective of eliminating unanticipated inflation. It follows, for example, that to the extent that economic cycles are characterised by predictable procyclical movements in inflation rates, no attempt should be made to eliminate these cycles.

4. The Life-cycle Consumption Model

In the standard form of the life-cycle model, an individual i with wage income $w_i(t)$ seeks to maximise lifetime utility $V = \int_{t_0}^{t_1} e^{-\delta t} u(c_i(t))\,dt$ where δ is the rate of time-preference, $[t_0, t_1]$ is the individual's lifetime with $t_1 = t_0 + T$, $c_i(t)$ is consumption at time t, and u is an instantaneous utility function, subject to a budget constraint

$$\int_0^T c_i(t)\rho(t)dt = \int_0^T w_i(t)\rho(t)dt \tag{1}$$

or

$$\int_0^T (c_i(t) - w_i(t))\rho(t)dt = 0 \tag{2}$$

where $\rho(t)$ is the price of consumption claims at time t. To simplify, we will ignore the discount factor δ and begin by considering the case when $\rho(t)$ is identically equal to 1, that is, the real interest rate is constant and equal to zero.[4] Thus, the optimal policy under perfect foresight is to consume at a constant level w^*, where $w^* = \int_0^T w_i(t)dt/T$ is the annualised present value of wages over the lifetime. This yields $V = Tu(w^*)$.

We may think of the individual's wage profile $w_i(t)$ over the interval $[t_0, t_1]$ as a sample from a stochastic process w with long-run mean value $\overline{w}$. Given the assumption of costless borrowing and saving, the only relevant parameter of the wage profile $w_i(t)$ is the present value w^* which is a random variable. We define the *ex ante* expectation of w^* as the expected value of w^* over a large number of draws from the stochastic process and observe that this *ex ante* expectation is equal to $\overline{w}$. The higher moments of the distribution of w^* will depend on the properties of the stochastic process w.

If u is a constant relative-risk-aversion utility function with coefficient of relative risk aversion α, we have the standard approximation

$$E[V] = T(1-\theta)u(\overline{w}) \tag{3}$$

where

$$\theta = \tfrac{1}{2}\alpha\,\mathrm{var}(w^*)/\overline{w}^2. \tag{4}$$

With this setup it is natural to think of macroeconomic instability as a factor that increases the variance of w^* for a representative individual. A simple representation arises if wage income for all workers, expressed as a deviation from mean lifetime

4. The analysis is essentially unchanged if the simplifying assumption that $\delta = \rho = 0$ is relaxed by allowing $\delta(t)$ to be a positive constant, and setting $\rho(t) = e^{-rt}$ for some constant interest rate r and arbitrary numeraire date 0.

income $\overline{w}$ may be represented as the sum of two orthogonal processes, an idiosyncratic process $z_i(t)$, and a common process $x(t)$, which represents exposure to systematic fluctuations in aggregate income. We may assume, without loss of generality, that $E[z_i(t)]=0$ for all t and i.

If each individual has an equal share in the aggregate process, we may write

$$x(t) = \overline{w} + \varepsilon(t) \tag{5}$$

$$w_i(t) = \overline{w} + z_i(t) + \varepsilon(t). \tag{6}$$

When the number of individuals is large, $\sum_{i=1}^{n} z_i(t)/n$ will be close to zero for almost all t and we have the approximation $\overline{w}+\varepsilon(t)\approx W(t)/n$.

Observe that in this case, we can derive the beta coefficient

$$\beta = n\,cov(w,W)/var(W). \tag{7}$$

Hence we can generalise by setting

$$w_i(t) = \overline{w} + z_i(t) + \beta_i\varepsilon(t) \tag{8}$$

where the average value of β_i, taken over all individuals i, is equal to 1. With this formulation, some individuals are more exposed to systematic risk than others.

A particularly interesting case is that examined by Mankiw (1986) as a possible explanation for the equity-premium puzzle (Mehra and Prescott 1985). Suppose that *ex ante*, the expected value of β is one for all individuals, but that *ex post*, β takes the value β/p with probability $p>0$, and zero with probability $1-p$. That is, *ex post*, the losses associated with systematic economic fluctuations are concentrated on a subset of the population, for example, those who lose their jobs or go bankrupt. The risk premium in this case may be approximated by

$$\theta = \tfrac{1}{2}(1/p)\alpha\,\mathrm{var}(W^*)/\overline{W}^2 \tag{9}$$

with the term $(1/p)$ reflecting the increased cost of risk when it is concentrated *ex post*.

As long as preferences display risk aversion, welfare will be reduced by unpredictable variation in wage income. The welfare loss will be increased if losses are concentrated *ex post* on a small subset of the population. The welfare loss from wage variability will also be increased if individuals are credit constrained or face costs in borrowing and lending. Hence, there are potential gains to be obtained from an appropriately designed stabilisation policy.

5. Policy Options

In the presence of random shocks to aggregate income, a stabilisation policy is potentially welfare improving. The impact of fiscal and monetary policy may be examined in the context of a life-cycle model.

5.1 Fiscal policy

Now consider a stationary economy made up, at any point in time, of n individuals indexed by i and a fiscal policy operating solely through a lump-sum tax transfer instrument involving payment by each individual of individual $\tau(t)$, where τ is positive when, in the absence of stabilisation policy, aggregate income $W(t) = \sum_{i=1}^{n} w_i(t)$ exceeds its long-run expected value $\overline{W} = n\overline{w}$, and negative when $W \leq \overline{W}$. For simplicity, assume $\tau(t) = \kappa(W - \overline{W})/n$. Then $E[\tau(t)] = 0$.

Even in the absence of a stabilising effect on $W(t)$, such a fiscal policy will be beneficial. Consider the case when $W(t)$ is unchanged by fiscal policy, so that the only effects arise through changes in post-tax income. The individual's budget constraint now becomes

$$\int_0^T (c_i(t) + \tau(t) - w_i(t))dt = 0 \tag{10}$$

and the optimal policy is to set consumption equal to w_i-$\tau(0,T)$, where

$$\tau(0,T) = \int_0^T \tau(t)dt / T = \kappa \int_0^T W(t)dt / nT. \tag{11}$$

The variance of w_i-$\tau(0,T)$ will be less than that of w_i if and only if w is positively correlated with τ, that is, if and only if w is positively correlated with W.

Result 1: In the absence of stabilising effects on aggregate income, fiscal policy improves *ex ante* economic welfare for individual i if and only if the stochastic process w_i is positively correlated with the stochastic process W.

The question of whether fiscal policy systematically stabilises aggregate income and, if so, how, remains controversial.[5] For the purpose of the present argument, it is sufficient to require that the stabilising effect of countercyclical fiscal policy be modelled as a reduction in the variance of $w^*(t)$. If this condition is satisfied, we may derive:

Result 2: If wage income for all individuals follows a process of the form (6), countercyclical policy will yield an *ex ante* Pareto-improvement.

Result 2 will not apply to individuals for whom the idiosyncratic component of income is negatively correlated with aggregate income, such as specialists in bankruptcy law or services to the unemployed.

More importantly, Result 2 is valid only *ex ante*. An individual who happens to live through a period in which $w^*(t)$ is consistently positive will be worse off as a result of the application of countercyclical fiscal policy. *Ex ante*, though, countercyclical fiscal policy has a twofold beneficial effect. In addition to the beneficial effects of reducing the variability of $W(t)$, and hence, *ex ante*, of all $w_i(t)$, fiscal policy acts as an intergenerational insurance mechanism, levying taxes on 'lucky' generations and paying them out to 'unlucky' generations.

5. Suppose, for example, that individuals are credit constrained in periods of recession. A countercyclical fiscal policy will permit them to increase consumption in those periods, thereby increasing the demand for goods and services and therefore aggregate income. Credit constraints are not modelled here. If credit constraints are present, the welfare loss associated with any given level of variance in wage income will be greater than the cost derived above. This will only amplify the results derived here.

The intergenerational insurance benefit will be greater, the greater the variance of experience across generations. If individuals do not optimise over the life-cycle but over a series of shorter time horizons, or if they follow suboptimal rules of thumb, insurance benefits will arise within, as well as across, generations. The insurance benefit will disappear only in the case of infinitely lived individuals or dynasties. This is precisely the case of full Ricardian equivalence (Barro 1974).

5.2 Monetary policy

The analysis of countercyclical monetary policy is more difficult. In a life-cycle perspective, countercyclical monetary policy may be seen as raising the price of consumption in boom periods (those when $W(t)$ is high in the absence of active policy) and lowering the price of consumption in recessions. By destabilising intertemporal consumption prices in this fashion, monetary policy tends to stabilise aggregate demand and therefore W.

The problem of analysing the welfare effects of such a policy raises issues analogous to those of the debate over price stabilisation. Samuelson (1972) and Massell (1969) showed that feasible price stabilisation through the introduction of a buffer stock (assumed to be costless) must increase welfare. Conversely, feasible price destabilisation must reduce welfare.

As Samuelson observed, the fact that consumers' utility functions are convex in prices implies either that price destabilisation must reduce the mean price or that the operators of the destabilisation scheme must lose money. In the analysis of countercyclical monetary policy, the mean price may be assumed to be determined by an exogenous long-term real interest rate r, here assumed equal to zero. The requirement that no arbitrage profits be available implies that $\lim_{k\to\infty}\int_s^{s+\kappa}\dot{\rho}\,dt = 0$. Integrating by parts, this implies:

$$\lim_{k\to\infty}\int_s^{s+\kappa} \log(\rho(t))\, dt = 0\,. \qquad (12)$$

If $\rho(t)$ is not constant, $\int_s^{s+\kappa}\log(\rho(t))dt = 0$ implies that $\int_s^{s+\kappa}\rho(t)dt > 1$. Since, under a countercyclical policy $\rho(t)$ and $W(t)$ will be correlated, the effect of the policy will be to raise the present value of a representative individual's income stream. This gain must be matched by a loss incurred by the monetary authorities, and taxes must be imposed to eliminate these losses. The scheme will be revenue neutral when the present value of aggregate consumption is equal to the present value of aggregate income at the prices prevailing in the absence of intervention.

Consider the case where, in the absence of countercyclical monetary policy, $\rho(t)=0$ for all t, and consider first a population of infinitely lived individuals all of whose income is exactly proportional to $W(t)$. In the absence of countercyclical monetary policy, such an individual will consume a constant amount equal to expected long-run income. Under a revenue-neutral countercyclical policy, the optimal solution for a representative individual will involve a variable stream of consumption with an average value equal to expected long-run income. By the convexity of preferences, this must involve a reduction in welfare.

Now consider a heterogeneous population where individuals differ in their intertemporal elasticity of substitution. Individuals with a sufficiently high elasticity of substitution will benefit from the opportunity of increasing their consumption in periods when $\rho(t)$ is set low by policy. On the other hand, individuals with a low elasticity of consumption will suffer a greater than average loss. Nevertheless, there must be a net welfare loss.

Countercyclical monetary policy also gives rise to redistribution between individuals with different profiles of income and consumption. The direct welfare impact of countercyclical policy is given by

$$\int (\rho(t) - \rho^0(t))(w_i(t) - c_i(t))dt \tag{13}$$

where $\rho^0(t)$ is the price of consumption claims in the absence of policy.

Other things being equal, individuals will benefit from countercyclical policy if they have positive net saving in periods when policy increases the price of consumption claims and negative net savings in periods when policy reduces the price of consumption claims. That is, individuals will benefit when $(w_i(t) - c_i(t))$ is positively correlated[6] with $(\rho(t) - \rho^0(t))$, and will lose if $(w_i(t) - c_i(t))$ is negatively correlated with $(\rho(t) - \rho^0(t))$. The correlation between $(\rho(t) - \rho^0(t))$ and $(w_i(t) - c_i(t))$ will be determined partly by the behaviour of the idiosyncratic component of income and partly by life-cycle considerations. Individuals who borrow to buy a house or start a business at the beginning of a period of policy-induced high interest rates will suffer losses as a result. If we suppose that, on average, net borrowers have debt equal to one year's income, a 3 per cent increase in real interest rates implies a loss equal to 3 per cent of income for this group. This is comparable to the aggregate income reduction associated with a recession. Hence, it seems reasonable to suggest that for this group, even if countercyclical policy were successful in stabilising aggregate income, the cure would be as bad as the disease.

By contrast with the case of fiscal policy, the main direct intergenerational effects of countercyclical monetary policy are random. Generations will be made worse off by countercyclical policy if they experience tight monetary policy during their periods of high indebtedness and loose monetary policy during periods of positive financial wealth. Conversely, generations with the opposite experience will be made better off.

6. Policy Implications

The analysis presented above leads to a straightforward conclusion. Fiscal policy, and, more specifically, tax-welfare policy, should be used to stabilise aggregate output, while monetary policy should be used to stabilise real interest rates. Stability of the inflation rate or the aggregate price level should not be a target, although policy should be consistent with the maintenance of a suitably low medium-term average inflation rate.

These policy conclusions are derived from consideration of the microeconomic impacts of aggregate stabilisation policy. Surprisingly, although orthodox Keynesianism is the brand of aggregate macroeconomics least concerned with microfoundations, the

6. More precisely, individuals will benefit if the correlation between their own net savings and the change in policy is greater than the correlation between aggregate saving and the change in policy.

policy prescription derived from a microeconomic analysis is quite similar to the policy program that prevailed during the long postwar boom. This policy program combined reliance on fiscal policy as the main instrument of aggregate stabilisation with a commitment to low and stable interest rates.

The desirability of using fiscal rather than monetary policy was a central Keynesian claim in the early stages of the Keynesian/monetarist debates which took place in the late 1960s and early 1970s. However, at least at a formal level, the Keynesian critique of monetary policy rested on fairly dubious theoretical constructs such as the liquidity trap, and the debate was cast in terms of the question 'does money matter?'. Although concerns about the effects of high interest rates were clearly a factor in the Keynesian rejection of monetary policy, these concerns were never clearly articulated.

To confuse matters further, the monetarist position combined a defence of the proposition that money does matter, at least in the short run, with opposition to any kind of active countercyclical policy. Thus, the policy of countercyclical monetary policy that has emerged by default in Australia and the United States has never been properly defended or criticised.

The use of fiscal policy as an active instrument of stabilisation will be feasible only if the current political obstacles to increases in tax rates are removed. However, it would not be desirable to use tax rates as a finetuning instrument, since frequent changes in tax rates are costly. A reasonable strategy would be to allow taxes to be reduced once during the contractionary phase of an economic cycle, preferably as early as possible in the cycle, with the remainder of the fiscal stimulus being given through more frequent increases in public expenditure. Conversely, an increase in taxes should be imposed early in the recovery phase of the cycle with cyclical expenditure programs being wound back more gradually.

It is useful to consider whether, if fiscal policy is not available, it is preferable to use monetary policy as an active instrument of stabilisation or to do nothing. The analysis presented above suggests that policy-makers should be very cautious in adopting countercyclical monetary policies as a substitute, particularly where they involve sustained periods of high interest rates. The destabilising effects on individual incomes may more than outweigh the benefits of stabilising aggregate income.

7. Where Should Real Interest Rates be Stabilised?

In the long term, Australia's real interest rate will be determined by the world real interest rate. If securities in different countries are not perfect substitutes, the long-term equilibrium rate may be higher for small capital-importing countries like Australia than for the world as a whole, but, in view of the potential for arbitrage profits, it is unlikely that any premium will be large.

There are a number of reasons for believing that the appropriate range for real interest rates is between 2 and 5 per cent, with a preferred target between 3 and 4 per cent. During periods of price stability and political stability in the nineteenth century, real interest rates of around 3 per cent prevailed for long periods. The average real rate over the twentieth century in the United States has been around 1 per cent, but the twentieth century has been characterised by repeated episodes of unanticipated inflation.

Another way of approaching the real interest rate is from considerations of intergenerational equity. Technological progress appears to contribute on average around 1.5 per cent per year to growth. Following the Ramsey rule of saving, and assuming a coefficient of relative risk aversion between 1 and 2, the real interest rate must lie between 1.5 and 3 per cent. The Ramsey rule of saving is based on the assumption that future utility is not discounted. If a pure discount factor of 1 per cent, approximately equal to the annual mortality rate, is admitted, the real interest rate will be between 2.5 per cent and 4 per cent. These arguments are addressed further in Quiggin (1996).

When inflation is low, a normal yield curve, with long rates above short rates represents an allowance for the fact that inflation is more likely to rise than to fall over the life of, say, a 10-year bond. Assuming an underlying equilibrium real interest rate of between 3 and 4 per cent, the current 10-year bond rate of 8 per cent implies an expected average inflation rate of between 4 and 5 per cent over the next decade.

7.1 The rate of inflation

The difficulty of determining the equilibrium real interest rate is exacerbated by the difficulty of forecasting future inflation rates. Since the principal instrument of monetary policy is the nominal interest rate, an estimate of the future rate of inflation is an essential element of a policy of stabilising the real interest rate. One estimate of the long-term future rate of inflation is given by the long-term bond rate, which is determined on world markets rather than by domestic monetary policy. Thus, a practical method of implementing a target of stable real interest rates when the future inflation rate is expected to be stable is the maintenance of a standard yield curve. Short-term inflationary shocks – those that had no significant effect on the long-term bond rate – would be reflected in corresponding adjustments in nominal interest rates.

Exact stabilisation of real interest rates may not be a feasible guide to practise in the short term. Nevertheless, acceptance of the desirability of such an objective would imply significant changes in the practice of monetary policy. In particular, large swings in interest rates over the course of the economic cycle would be avoided.

8. Conclusion

In this paper, attention has been focused on the microeconomic implications of stabilisation policy in a world of heterogeneous individuals and overlapping generations. It has been shown that countercyclical fiscal policy will, on average, stabilise individual as well as aggregate income and consumption. By contrast, any aggregate stabilising effects of countercyclical monetary policy are achieved at the cost of considerable random destabilisation of individual consumption. For individuals who are more vulnerable to fluctuations in real interest rates than to fluctuations in aggregate income, the cure may be worse than the disease.

References

Barro, R. (1974), 'Are Government Bonds Net Wealth?', *Journal of Political Economy*, 82(6), pp. 1095–1117.

Bomberger, W.A. and G.E. Makinen (1993), 'Inflation and Relative Price Variability: Parks' Study Reexamined', *Journal of Money, Credit and Banking,* 25(4), pp. 854–861.

Golob, J.E. (1993), 'Inflation, Inflation Uncertainty, and Relative Price Variability: A Survey', Federal Reserve Bank of Kansas City Research Working Paper No. 93-15.

Higgins, C.I. (1989), 'The Australian Economy Entering the 1990s', Opening Address at the Consult Australia Annual Forum, 16 November.

Langmore, J.V. and J. Quiggin (1994), *Work for All, Full Employment in the 1990s*, Melbourne University Press, Melbourne.

Mankiw, N.G. (1986), 'The Equity Premium and the Concentration of Aggregate Shocks', *Journal of Financial Economics*, 17(1), pp. 211–219.

Massell, B. (1969), 'Price Stabilization and Welfare', *Quarterly Journal of Economics*, 83(2), pp. 284–298.

Mehra, R. and E.C. Prescott (1985), 'The Equity Premium: a Puzzle', *Journal of Monetary Economics*, 15(2), pp. 145–161.

Quiggin, J. (1996), 'Discount Rates and Sustainability', *International Journal of Social Economics,* (forthcoming).

Samuelson, P. (1972), 'The Consumer does Benefit from Price Stability', *Quarterly Journal of Economics*, 86(3), pp. 476–493.

The Australian Government's Current Approach to Monetary Policy: An Evaluation

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1. Introduction

The responsibilities of the Reserve Bank of Australia are defined in the *Reserve Bank Act 1959*, which sets out very broad objectives for monetary policy. While this Act remains the defining piece of legislation for the Bank's activities, the weight that the Reserve Bank gives to different objectives has changed with time and circumstance.

Consistent with the conservative approach that characterises the behaviour of central banks worldwide, recent changes in the Reserve Bank's approach to monetary policy have been instituted gradually. A typical change might begin with small changes of wording in statements emanating from the Bank, before being reinforced in informal public utterances and then finally acquiring the mantle of 'Bank Policy' in a major speech by the Governor or one of the Bank's Deputy Governors. As a consequence, it is often difficult to define the precise point in time when a particular change was instituted.

The current emphasis on inflation targeting as the primary role of monetary policy really had its genesis as early as the second half of the 1980s, with the adoption of operating procedures that focused on the cash rate as the primary operating instrument of monetary policy and the adoption of the so-called 'check-list' or 'indicators' approach.

Under the check-list approach, adopted following the abandonment of M3 targeting in January 1995, monetary policy emphasised the attainment of short-run stabilisation objectives. At different times, using this approach, monetary policy was directed towards a range of objectives including achieving reasonable growth in activity, reducing the current account deficit and stabilising the exchange rate. The medium-term objective of reducing inflation was relegated to secondary importance.

By the end of 1989, there had been signals both from the Reserve Bank and the Treasury of a move away from the check-list towards an approach which gave greater emphasis to reduction in inflation (Morgan 1990). In subsequent years, the Reserve Bank emphasised that monetary policy had developed a more medium-term anti-inflationary focus than formerly. Considerable emphasis was still given to output and employment objectives and, on occasions, to reducing the current account deficit.

Monetary policy also became more transparent. Changes in short-term interest rates since January 1990 have been announced the moment that they are made. Interest-rate

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changes are less volatile than was the case in the past. In addition, the Bank upgraded its public commentary on the economic outlook and issues bearing on monetary-policy settings, through speeches by senior Bank officers and through quarterly reports on the economy contained in the Reserve Bank *Bulletin*.

By the mid 1990s, the Reserve Bank's approach to monetary policy aimed to achieve dual objectives. The first objective was to keep underlying inflation to an average of 2 to 3 per cent over the course of the cycle. The second objective gave emphasis to achieving desirable output and employment outcomes (Grenville 1996).

With the appointment of Ian Macfarlane as Governor in August 1996 came the further development of a formal Statement by the Treasurer on the Conduct of Monetary Policy (Treasurer, Costello 1996). This Statement gave greater emphasis to 'the importance of low inflation and low-inflation expectations' and also emphasised 'the need for effective transparency and accountability arrangements'. It also reaffirmed the Reserve Bank's medium-term price stability objective of keeping underlying inflation between 2 and 3 per cent, on average, over the cycle.

The Statement also promised enhanced transparency arrangements. The new Governor made a commitment to release, at six-monthly intervals, statements on monetary policy and the role it is playing in achieving the Bank's objectives; these statements would include specific information on the outlook for inflation. The Governor also indicated plans to be available twice a year to report on the conduct of monetary policy to the House of Representatives Standing Committee on Financial Institutions and Public Administration.

As chronicled above, since 1985 there has been an evolution in the focus of monetary policy. From an emphasis on a range of short-term objectives (including output, the exchange rate and the current account deficit) in the second half of the 1980s, to a greater emphasis on reducing inflation in the early 1990s, to a dual-objective (inflation and output) approach, to the current approach which is tightly focused on achieving an inflation target. Over the course of the past decade, Australian monetary policy has not always moved monotonically towards its current state but has tended to meander through a range of policy regimes. Consistent with past performance, the current inflation objective is sufficiently loosely defined that, if circumstances subsequently dictate, there is nothing to stop reversion in the focus of monetary policy to one giving renewed emphasis to unemployment and output or, even, for that matter, to the exchange rate or current account deficit.

The remainder of this paper proceeds by first detailing five issues that are central to the debate about the appropriate settings for monetary policy. Next, an index of independence and accountability is constructed. This index is used to evaluate the Australian performance on monetary policy over time and also to compare the current performance of the Reserve Bank of Australia with that of the Reserve Bank of New Zealand and the Bank of England. The concluding sections draw together earlier material to provide a series of recommendations for changes to the Australian approach as well as presenting an overall evaluation.

2. Central Issues

In recent years, a selection of central banks has chosen to adopt an explicit target for inflation as a basis for determining monetary policy. King (1996) lists eight countries which have recently adopted an explicit inflation target.[1] Apart from countries with an explicit inflation target, there are other major countries, such as the G3 countries (Germany, the United States and Japan), which have also achieved consistently low inflation rates over the past decade.

This section examines certain central issues that lead to the adoption of an inflation target and describes questions that must be addressed in determining the precise institutional arrangements under which such a target is implemented.

2.1 'Finetuning'

There is now a substantial body of literature demonstrating that it is inappropriate to use monetary policy to 'finetune' the economy. This argument is contained in two strands of argument – the first strand based on the effectiveness of such a policy and the second strand based on credibility arguments.[2]

A cogent argument against the use of monetary policy for finetuning the economy is that the effects of changes in monetary policy are transmitted to the real economy only with long and variable lags. The length of these lags is substantial; Lowe (1992) estimates lags of the order of 12 to 24 months. This, alone, is a powerful argument against intervention. Argument is further enhanced when coupled with evidence that the length of these lags can change significantly over the course of the cycle and under changing expectations scenarios (Oster 1988; Grenville 1995).

A further reason why finetuning is not appropriate is the difficulty of forecasting what the state of the economy is likely to be one to two years ahead. Examination of revisions to National Accounts data provided by the Australian Bureau of Statistics demonstrates that there is even inordinate difficulty in defining history with any degree of certainty. These uncertainties are further highlighted when one observes the deficiencies of past forecasts. Examination of the accuracy of past forecasts shows that turning points are particularly difficult to predict.

In order to achieve efficacious outcomes from monetary intervention, monetary authorities must first predict the timing and amplitude of economic turning points and then adjust monetary policy so that it has the desirable outcome at the appropriate point in time. This is virtually impossible in an environment where it is hard to provide accurate forecasts and where the transmission lags of monetary policy are not constant from one cycle to the next.

The arguments against finetuning are enhanced by recent literature emphasising the role of expectations and the importance of credibility and reputation in achieving

1. These countries are: Australia, Canada, Finland, Israel, New Zealand, Spain, Sweden and the United Kingdom.
2. For an in-depth discussion of these arguments, see Stemp (1996b). A briefer discussion is contained in Stemp (1996a).

desirable monetary-policy outcomes. For example, it will be possible to reduce inflation more easily if private agents believe that the monetary authority is committed to reducing inflation (Stemp and Murphy 1991).

There is also another important incentive facing the monetary authority. A need to maintain credibility and reputation means that the monetary authority will face pressure to justify as appropriate all its past approaches to monetary policy. When a central bank is faced with incentives that make it difficult to acknowledge past failings, this means that all assessments of monetary contributions to past outcomes emanating from the central bank must be viewed with some scepticism. In such an environment, it is important that the central bank's approach to monetary policy is, at all times, transparent, so that private agents can evaluate the success of the central bank in meeting its objectives. This ideal of transparency is unlikely to be present when the adopted regime involves finetuning.

The problems highlighted with regard to finetuning suggest that monetary policy can be asked to deliver too much with consequential undesirable effects. In practice, monetary policy can be most effective when it is confined to achieving at most one objective. It is argued below that an inflation target is an appropriate single objective.

2.2 Why target inflation?

There is a substantial literature on the economic costs of inflation. These costs are largely associated with real resources expended by private agents in responding to inflation and the uncertainty it creates. Wealth and income-redistribution effects are also important, including the expenditure of real resources as agents attempt to rearrange their personal affairs so as to be well placed to benefit financially in an inflationary environment. Costs include so-called 'shoe leather' costs, menu costs, the costs associated with the interaction between the taxation system and inflation, as well as effects on the cost of labour and the level of the capital stock. In a non-inflationary environment, resources would be employed more efficiently, increasing the level of present and future output.

In practice, there is ambiguous evidence as to whether or not the costs associated with an increase of inflation from, say, 0 per cent per annum to 5 per cent per annum, warrant concern. While levels of inflation of 100 per cent per annum are likely to introduce substantial distortions into consumption and investment decisions, there is conflicting evidence as to whether or not inflation levels of 5 per cent per annum introduce significant distortions to economic decision-making. Pagan and Trivedi (1983) argue that the welfare costs associated with an increase in inflation are small. Recent work by Feldstein (1996) provides evidence that such costs can be substantial.

Even if the costs of moderate inflation are relatively insignificant, an alternative argument for keeping inflation low is associated with the costs of disinflation. If inflation has a tendency to slowly creep upward, then at some stage inflation levels will reach a point at which it is necessary for inflation to be reduced. But reducing inflation involves corresponding temporary reductions in output levels as well as temporary increases in unemployment. Empirical estimates for Australia show that a 1 per cent reduction in the three-year average inflation rate can lead, in the short run, to as much as a 2 per cent reduction in real output (Stevens 1992, Table 3, p. 218).

If the costs of disinflation have already been met so that inflation is already low, then, in order to avoid future costs of disinflation, it is desirable to maintain low inflation levels. However, whether or not it is appropriate to set a low inflation target in a high-inflation environment will depend on the relative costs of inflation and disinflation. In setting its inflation target, the Reserve Bank of Australia has avoided this last question. King (1996, p. 54) notes that, of those countries which have in recent years adopted an explicit inflation target, only Australia set an inflation target that had already been achieved.

Another reason for focusing on inflation rather than, say, activity, is the long-run neutrality of money; this is the proposition that monetary policy can have an impact only on prices and not on activity in the long run. This establishes inflation as the most suitable medium-term target for monetary policy.

Long and variable lags in the transmission of monetary policy, coupled with the difficulty of providing accurate forecasts of economic outcomes, make it inappropriate to focus monetary policy on achieving more than one objective. The above arguments suggest that a suitable objective for monetary policy would be one that aimed to achieve an appropriate inflation target.

2.3 Distribution of output and employment

One of the costs of inflation is that it leads to transfers between those who are better placed to take advantage of inflation (such as home-owners) and those who are not so well placed (for example, renters). Over time, inflationary pressures can lead to significant real resources being expended by individuals as they rearrange their affairs so as to benefit from inflation. Elimination or reduction of inflation means that these resources are more likely to be utilised more efficiently.

The long-run neutrality of money means that price stabilisation is an appropriate primary objective for monetary policy. Of course, there are some agents in the economy who receive little benefit from reduced inflation – notably the unemployed. And when reductions in inflation are accompanied by higher levels of unemployment, output is distributed away from any newly unemployed individuals. These issues lead well-meaning commentators to suggest that it is inappropriate to focus monetary policy exclusively on an inflation target, and that some weight should be given to output stabilisation objectives in determining the stance of monetary policy. The problem with such an argument is that it fails to acknowledge the difficulties of achieving multiple objectives using monetary policy.

Arguments against finetuning the economy are also arguments against attempting to achieve multiple monetary-policy objectives. Forecasting difficulties and the long and variable lags in the transmission of monetary policy may mean that the timing of monetary policy is inappropriate. In such a situation, well-intentioned attempts to use monetary policy to stabilise output may actually increase the amplitude of the business cycle – thus, making matters worse rather than better.

Furthermore, unemployment often has strong regional components; and it is impossible to run different monetary policies in different regions of Australia. As a consequence, at least part of the unemployment problem, that is, high unemployment in country areas and differing unemployment levels across State capitals, cannot be addressed by monetary policy.

Is there anything that can be done to change the distribution of output or, at least, improve the prospects and circumstances of the unemployed? Fiscal policy is an obvious candidate. The Mundell-Fleming model of the open economy suggests that, under perfect capital mobility and a flexible exchange rate, fiscal policy will have no impact on national output and can therefore only be used to redistribute output within the national economy.[3] To the extent that this paradigm provides an accurate representation of the Australian economy, it suggests that redistribution of fiscal expenditure should be used to provide a welfare net and job-creation programs for the truly needy rather than in any attempt to increase overall aggregate demand. In addition, the stance of fiscal policy (in particular, the fiscal deficit and levels of public indebtedness) should be chosen so as not to place any unnecessary upward pressure on prices, which would then have to be offset by monetary policy.

It must be emphasised that, in arguing that monetary policy should be focused on achieving an inflation target, it is not being suggested that unemployment and the effects of the business cycle are not important issues. But the fact that unemployment is undesirable does not mean that monetary policy can be used directly to address this problem. Proponents of inflation targeting typically argue for such an approach on the basis that the most effective way that unemployment can be reduced is by creating a suitable environment for long-term growth; low inflation is an important pre-condition for such an environment.

2.4 Upside and downside risks

In its current approach, the Reserve Bank of Australia does set an inflation target, specifically requiring that underlying inflation should achieve an average of '2-point-something' over the course of the cycle. Unfortunately, the success or failure of such an approach cannot be properly evaluated until a full cycle has passed. As detailed in the first section of this paper, Australian monetary policy has not always moved monotonically towards its current state but has tended to meander through a range of policy regimes. Consistent with past performance, there is nothing to stop a substantial change to the focus of monetary policy. Accordingly, there is no strong guarantee that the current approach to monetary policy will be sustained for a long enough period to allow a proper evaluation of the Reserve Bank's success in achieving its stated objective.

Future uncertainty must be allowed for in any evaluation of current institutional arrangements. Accordingly, in any assessment of the current approach, it is appropriate to specify both upside and downside risks. In particular, short- to medium-term outcomes are likely to be major determining factors in whether inflation targeting is allowed to continue into the long term as the sole monetary-policy objective.

3. As a model of the Australian economy, the Mundell-Fleming model has several deficiencies that should be noted. First, Australian international capital flows do not satisfy perfect capital mobility. Second, expectations are not modelled in this paradigm. Third, the exchange rate is a crucial means of transmission in this model; however, the exchange rate does not always act as predicted.

In the event of a favourable supply shock, inflation is likely to be further reduced, accompanied by strong employment growth. Under this scenario, which encompasses the most likely upside risk, the inflation-targeting approach would almost certainly be seen as highly successful and the likelihood of an inflation-targeting approach being allowed to continue would be greatly enhanced.

The most likely downside risk arises as the business cycle moves into its next trough. Depending on the magnitude of the next recession, there could be considerable pressures on the Reserve Bank to adopt a stance for monetary policy which emphasises employment and output outcomes as well as inflation. This would come at precisely that stage in the cycle, a turning point, when activist monetary intervention is likely to be least effective; indeed, when there is a high probability that attempting to finetune the economy will do more harm than good. This would likely be followed by a substantial change to the focus of monetary policy, most probably associated with a resurgence in inflation. Indeed, if agents in the economy see that such an outcome could easily eventuate, inflationary expectations now will be higher than otherwise, leading also to higher actual inflation.

One way that such an undesirable outcome can be avoided is by enshrining the inflation target in a legislated central bank contract between the government and senior officers of the Reserve Bank.

2.5 Optimal central bank contracts

Following from the seminal work on time inconsistency by Kydland and Prescott (1977), a substantial literature on incentives facing central bankers and desirable properties for associated central bank contracts has recently developed.

Barro and Gordon (1983) demonstrated that an unconstrained central bank may adopt a stance for monetary policy that is biased towards achieving a level of inflation which is too high.[4] Extending Barro and Gordon's framework, Rogoff (1985) showed that society will be better off by appointing a central banker who places too large a weight on inflation-rate stabilisation relative to employment stabilisation. In subsequent work, Lohmann (1992) showed that a better outcome is achieved if the government retains the right to override an otherwise independent central banker in times of extreme supply-side shocks. In normal times, the central banker sets the inflation rate independently at his discretion. In extreme situations, he implements a flexible escape clause: the larger the output shock, the more the central banker accommodates the government's *ex post* demands in order to avoid being overridden.

Rogoff and Lohmann focus on the government's choice of central banker, viewing the government as choosing from a population of potential bankers with differing preferences over inflation and output fluctuations. The government picks the banker whose preferences are such that the resulting conduct of monetary policy maximises the government's

4. This literature assumes that the central bank has a target level of output which exceeds the full-employment level of output. Such an assumption can be justified on two separate grounds. First, distortions (such as those arising through taxation) can mean that the full-employment level of output is socially suboptimal. Second, the true full-employment level of output is not observable and agents in the economy may mistakenly believe that full-employment output is higher than is really the case.

expected utility. In a further development of this approach, Walsh (1995a,b) examines how the behaviour of central bankers can be modified by appropriate incentive structures. In particular, he investigates whether there is an optimal contract the government should offer to the central banker. That is, if central banks respond to the incentives they face, then what form should those incentives take? In Walsh's framework, suitable incentives can take the form of a state-contingent wage contract for the central banker but, in some cases, may also resemble an inflation-targeting rule or even a dismissal rule. The precise structure of any optimal contract depends on the availability and timing of information to government and central banker.

Assuming that the central banker cares about holding office and has the same objective as the government, Walsh (1995a) derives an optimal contract that involves dismissal of the central banker under specific circumstances. This dismissal rule works as follows: the government must establish a critical inflation rate and dismiss the central banker whenever actual inflation exceeds this value. In Walsh's framework, the critical inflation rate would need to be adjusted in the face of significant aggregate-supply shocks, but cannot be adjusted in light of aggregate-demand disturbances. Walsh observes that the structure of this optimal contract looks similar to the approach currently adopted under the *Reserve Bank of New Zealand Act 1989.*

There are certain aspects with respect to this literature on optimal central bank contracts that need to be emphasised. First, even when output and employment outcomes are very important considerations for all agents in the economy, an optimal central bank contract should focus exclusively on achieving an inflation target. Second, the optimal central bank contract should involve the threat of some significant sanction against the person(s) responsible for implementing monetary policy if the designated inflation target is not achieved. Third, there should be an appropriate adjustment to the inflation target if significant supply-side shocks hit the economy.[5]

2.6 Summary

The inherent difficulties associated with finetuning an economy suggest that trying to achieve too much with monetary policy can lead to undesirable outcomes. Because of these difficulties, efficacious outcomes from monetary policy are best achieved by focusing monetary policy on achieving a single objective. The long-run neutrality of money coupled with evidence on the costs of inflation suggest that, if a single objective is to be chosen for monetary policy, then an inflation target is appropriate.

A decision to target inflation does not imply any assessment that unemployment or troughs in the business cycle are unimportant, but, rather, that monetary policy is not the appropriate instrument with which to address these problems in the short run. Adjustments

5. It is important to make the distinction between objective criteria (or loss functions) and operating rules. In the optimal central bank contract literature, the inflation target is a way of evaluating or synthesing the community loss function. It is possible to have an inflation target that focuses solely on achieving an outcome for inflation that lies in a specified range, and yet have an operating rule that responds to both output and inflation. The reason for this is that, as long as all agents in the economy care about both inflation and output outcomes, then by specifying an acceptable range for inflation there is also an implicit acceptable range for output. By broadening the acceptable range for inflation, the corresponding implicit range for output is narrowed.

in fiscal expenditure, so as to provide an appropriate welfare net and job-creation programs, are the best way to achieve appropriate distributional outcomes. In the long run, low inflation is a precondition for output growth and the creation of more jobs.

Also, even in a world where all agents are concerned about outcomes for output as well as inflation, the best result can be achieved by requiring the central bank to focus solely on achieving an inflation target. This is because there can be a temptation to try to achieve an output and employment outcome which is too high and this can lead to undesirable inflationary pressures with no compensating increase in output.[6] Recent literature suggests that an inflation target, subject to an override provision in the case of major supply shocks, and with appropriate sanctions on responsible individuals if the inflation target is not met, provides an appropriate structure for an optimal central bank contract.

The easiest way that undesirable outcomes can be avoided is through enshrining the Reserve Bank's inflation objective in appropriate legislation. Consistent with the literature on optimal central bank contracts, this legislation should clearly set out the inflation objective, the person(s) responsible for achieving the inflation objective, and appropriate sanctions if the inflation objective is not met.

3. Constructing an Index of Independence and Accountability

Having argued above that a legislative approach to the implementation of monetary policy should be adopted, this section sets out certain desirable criteria that can be found in the legislative approaches adopted in other countries. Subsequently, these criteria will be used to calculate indices of independence and accountability at different points in time and for different central banks.

The desirable criteria are as follows:

- *Specification of objectives*: measures the extent to which the ultimate objectives of monetary policy are clearly specified.
- *Inflation target*: measures the extent to which specified objectives for monetary policy are focused on a clear, well-defined inflation target.
- *Operational responsibility*: measures the extent to which the central bank has operational responsibility for achieving its specified objectives without direction or interference from the relevant government.
- *Ultimate responsibility*: measures the extent to which there is a clearly defined and ultimate responsibility for meeting the specified objectives. This ultimate responsibility can rest either with an individual or group of individuals.
- *Transparency*: measures the extent to which information and forecasts used in determining the stance of monetary policy are clearly available.
- *Accountability*: measures the extent to which the consequences, for those ultimately responsible, of not meeting the specified objectives are clearly set out. Accountability may involve the dismissal, reduction in salary, or other form of sanction of those ultimately responsible if specified objectives are not met. Given that it has been shown that an optimal central bank contract would also include an override

6. Misguided pressure for the central bank to achieve output and employment outcomes that are too high may come from politicians concerned about their own re-election rather than from within the central bank.

provision in the case of significant supply shocks, any measure of accountability should also include appropriate override provisions.

3.1 Evaluating the Reserve Bank's current approach

Under current arrangements, the Reserve Bank of Australia has a clearly specified inflation target. As a consequence, it ranks highly on the specified objectives criterion. On the inflation-target criterion, its ranking would improve marginally if a specific range for inflation were specified rather than just an average 'over the course of the cycle'. The Bank also ranks highly against the transparency criterion; its performance in this regard could be improved however, if it were to provide regular minutes of meetings of the Bank Board.

An important consideration that has a bearing on the assessment of the Bank's success in meeting the other criteria is the composition, operation and legislative position of the Reserve Bank Board.

The Board is composed of the Governor, two Deputy Governors, the Secretary to the Treasury, an academic economist, and five business representatives. The Governor and Deputy Governors are appointed for terms of up to seven years, the Secretary to the Treasury is appointed *ex officio*, the academic economist and five business representatives are appointed for five-year terms. During the life of the previous Labor Government, there was also a Trade Union representative on the Bank Board. Presumably to avoid potential conflicts of interest, there is a requirement that Board members cannot be directors, officers or employees of businesses whose main activity is banking – this means that many individuals who might be particularly well-suited for determining the stance of monetary policy are precluded from Board membership. Little is known about the precise method of operation of the Board. There are no minutes of meetings. It is not even known whether votes are taken on specific issues or the Board operates under a consensus arrangement.

Under the Reserve Bank Act, the Board has ultimate responsibility for the setting of monetary policy. But, in the past, Treasurers have been known to claim full responsibility for interest-rate changes. Also, the lack of financial-market and monetary expertise of business representatives on the Board means that the Bank and Treasury arguments may not be viewed sufficiently critically. This lack of technical expertise by some Board members, the close association of other Board members (notably, the Secretary to the Treasury) with the implementation of other aspects of government policy, and the absence of detailed minutes of Board meetings means that, in practice, it is not possible to evaluate the extent of government influence on Board decisions. Also, the definition of the inflation target is sufficiently loose that it is going to be extremely difficult to determine when the inflation target has, or has not, been achieved. There is no override provision in the case of major supply shocks; perhaps because the specification of the inflation target is so loose that an override provision is not considered necessary. The position of the Board, coupled with the possibility for government to intervene surreptitiously in the implementation of monetary policy gives the Bank a mediocre ranking against the operational-responsibility criterion and very low rankings against ultimate-responsibility and accountability criteria.

In the spirit of previous studies, this paper next employs the six criteria to create an index of independence and accountability. While it must be recognised that the compilation of such an index is somewhat subjective, an index does provide a useful way of evaluating a range of issues and providing an overall perspective.

Table 1 compares the current approach of the Reserve Bank of Australia with the approaches adopted in June 1996 (prior to the Treasurer's August Statement on the Conduct of Monetary Policy) and in June 1987 (when the monetary stance was determined using the check-list approach). A ranking of 1 indicates that no attempt has been made to satisfy the relevant criterion. A ranking of 5 means that the Reserve Bank has been highly successful in meeting the criterion.

Table 1: Independence and Accountability of the Reserve Bank of Australia at Different Points in Time

Graded on a scale of 1 to 5

Criteria	June 1987	June 1996	June 1997
Specification of objectives	1	5	5
Inflation target	1	3	4
Operational responsibility	3	3	3
Ultimate responsibility	1	1	1
Transparency	1	3	4
Accountability	1	1	1
Raw mean	**1.33**	**2.67**	**3.00**

Table 1 demonstrates a substantial improvement in independence and accountability from June 1987 until June 1996, coupled with even further improvement between June 1996 and June 1997.[7] Those areas in which significant improvement has been achieved are: in the clear specification of objectives, in the setting of an inflation target, and in improved transparency. For some criteria, no progress has been achieved since June 1987. Throughout the past decade, the measure for operational responsibility has remained in the midrange of success. Virtually nothing has been done over the past decade to improve unsatisfactory levels on the definition of an individual or group of individuals who are ultimately responsible for the implementation of monetary policy and in the accountability criterion which measures the implementation of review procedures in the event that monetary objectives are not met.

7. Different individuals might choose to give different weights to alternative criteria. For that reason the raw mean should be considered as an ordinal measure rather than a cardinal measure of independence and accountability. However, the statement that there has been a substantial improvement between June 1987 and June 1996 can be justified because the change over that period has involved an improvement in so many components of the index.

3.2 Comparison with approaches adopted in New Zealand and the United Kingdom

Two countries that have chosen to adopt a legislated inflation target are New Zealand and the United Kingdom.[8] It is informative to examine how the central banks in these countries perform against the six criteria as well as on the overall index. By constructing a comparable index for these countries, it is possible to provide a benchmark for an overall evaluation of the performance of the Reserve Bank of Australia.

Generally speaking, both the Reserve Bank of New Zealand and the Bank of England show a high average on the overall index, with the New Zealand approach ranking slightly ahead of the approach soon to be adopted in the United Kingdom. By clearly specifying an inflation target, both institutions rank highly on the specified-objectives criterion as well as the inflation-target criterion. Also, both central banks have full operational responsibility. In both cases, while the government determines the objective of monetary policy, the central bank has operational responsibility for achieving the specified objective without direction or interference from the relevant government. Also, for both central banks there is clear ultimate responsibility for inflation outcomes. In the case of the Reserve Bank of New Zealand, the Governor has ultimate responsibility; for the Bank of England, ultimate responsibility lies with the Monetary Policy Committee.

Both central banks have suitably transparent reporting arrangements. The Reserve Bank of New Zealand's Policy Targets Agreement (PTA) is a public document; the New Zealand Bank is required to release a six-monthly Monetary Policy Statement. The monthly meetings of the Bank of England's Monetary Policy Committee will be minuted, and released no later than six weeks after the meeting. There will also be enhanced requirements for reports to the Parliament.

The Reserve Bank of New Zealand seems also to be more accountable with the Governor being subject to possible dismissal if the Minister of Finance or the Bank's Board of Directors believe that his performance in meeting the inflation objective has been inadequate. Appropriate override provisions have also been specified. While the performance of the Monetary Policy Committee of the Bank of England will be monitored at monthly meetings of a reformed Court of the Bank, there is no indication of any override provisions for the inflation target or of what is expected to happen if performance is considered unsatisfactory.[9]

Table 2 compares the current approach by the Reserve Bank of Australia with the current approaches of the Reserve Bank of New Zealand and the Bank of England. This

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8. The approach of the Reserve Bank of New Zealand is defined in the Reserve Bank of New Zealand Act. A changed framework for British monetary policy was announced by the Chancellor following the election of the Labour Government in May 1997 (Chancellor of the Exchequer, Brown 1997). The Reserve Bank of New Zealand and the Bank of England provide detailed information about their current approaches on the World Wide Web.

9. Under the *Bank of England Act 1946*, the Court of Directors of the Bank of England has overall responsibility for all affairs of the Bank. The Chancellor has proposed that the Court be reconstituted to comprise no more than 19 members consisting of the Governor, his two Deputies, and 16 non-Executive Members. The Court will be representative of the whole of the United Kingdom. The non-Executive Members will be appointed for their expertise and will be drawn widely from industry, commerce and finance.

table shows that the Reserve Bank of Australia still has substantial area for improvement particularly in the definition of ultimate responsibility and accountability but also in the delegation of clear operational responsibility to the Bank.

Table 2: Independence and Accountability of the Reserve Bank of Australia Current Approach Compared with other Central Banks

Graded on a scale of 1 to 5

Criteria	Reserve Bank of New Zealand	Bank of England	Reserve Bank of Australia
Specification of objectives	5	5	5
Inflation target	5	5	4
Operational responsibility	5	5	3
Ultimate responsibility	5	5	1
Transparency	5	5	4
Accountability	5	3	1
Raw mean	**5.00**	**4.67**	**3.00**

3.3 Summary

In summary, Tables 1 and 2 demonstrate that, in recent years, the Reserve Bank of Australia has gone a substantial way toward adopting an inflation-targeting approach which ranks highly against some of the six criteria. However, comparison with other central banks shows that further significant improvements can still be made.

4. Recommendations

How can the Reserve Bank of Australia achieve further independence and accountability? The preceding analysis has described the deficiencies in the current approach. This analysis can now be extended to suggest ways in which the current approach can be improved. On the basis of previous arguments, the following proposals would seem appropriate:

- The current focus on an inflation target as the sole objective of monetary policy should be continued.
- A clearer inflation objective should be defined. This should include precise indications of success or failure in meeting the specified objective including an appropriate override clause in the case of significant supply shocks.
- Ultimate responsibility for success or failure in meeting the specified objective should be delegated to a suitably qualified individual or group of individuals. This individual or group of individuals should be clearly independent of government

influence. On face value, at least, it would appear that some members of the current Bank Board may not be suitably qualified for this role. This does not mean that the current Bank Board could not have a supervisory and review role, similar to that of the Board of the Reserve Bank of New Zealand or of the proposed reformed Court at the Bank of England.

- There should be a clearly defined set of review procedures if the specified objective is not met.
- Current transparency arrangements should be continued. These should be extended to provide full minutes of meetings of the Reserve Bank Board. Also, if ultimate responsibility for the stance of monetary policy rests with a group of individuals rather than with a single individual, minutes of meetings of that group should also be publicly available.

5. Conclusion

When considering the introduction of innovative approaches to monetary policy, it is important to remember that a government's approach to the setting of monetary policy is an important factor in determining national welfare outcomes. For this reason it is appropriate that central bankers should adopt a conservative approach to the revision of policy objectives. Even if it is now acknowledged that inflation targeting is appropriate as a monetary-policy objective, this does not necessarily mean that it would have been a good idea for the Reserve Bank of Australia to have been a pacesetter in pioneering new approaches to monetary policy.

However, the legislative experiment conducted by the Reserve Bank of New Zealand has now run since 1990 with a considerable degree of success. Also, a significant number of OECD countries now have an approach to monetary policy which is focused towards the achievement and sustainability of low inflation outcomes. In a world of flexible exchange rates and limited impediments to international capital flows, the decision by other central banks that they should pursue an inflation target actually creates a bandwagon effect, building pressure on other central banks to follow suit. Given significant agreement amongst central bankers on the appropriateness of an inflation target, it is important to set up institutional arrangements so as to ensure the best possible outcome.

This paper has argued that the Reserve Bank of Australia should have a single objective for monetary policy focused on a legislated inflation target. Analysis of the evolution of the current approach suggests that Australia's approach is evolving in the right direction. But comparison with the approach adopted by other central banks suggests that there is still room for significant improvement. The paper has made five specific suggestions for future development.

In conclusion, I would like to focus on the title of this paper. An earlier working draft was entitled: 'The Reserve Bank of Australia's Current Approach to Monetary Policy: An Evaluation'. Subsequent revisions saw a change to the current title, which recognises the pivotal role of government in setting in place a legislative framework. Many of the suggested changes can only be instituted by an incumbent government. On the one hand, governments may be tempted to reject any approach which restricts their use of monetary policy as an instrument for stabilisation. This paper has argued that, in practice, it is not possible to use monetary policy to achieve desirable stabilisation objectives. Attempting to use monetary policy for this purpose may actually do more harm than good. On the other hand, by handing over operational responsibility and making hard decisions about interest rates the responsibility of an independent individual or group of individuals, a government may also be able to distance itself from some of the more unpalatable economic decisions. Recent changes at the Bank of England are evidence that, increasingly, governments are beginning to acknowledge the benefits of a legislative approach.

References

Bank of England Act 1946, HMSO, London.

Barro, R.J. and D.B. Gordon (1983), 'A Positive Theory of Monetary Policy in a Natural Rate Model', *Journal of Political Economy*, 91(4), pp. 589–610.

Chancellor of the Exchequer, Gordon Brown, MP (1997), 'Statement from the Chancellor', 6 May.

Feldstein, M. (1996), 'The Costs and Benefits of Going from Low Inflation to Price Stability', NBER Working Paper No. 5469.

Grenville, S.A. (1995), 'The Monetary Policy Transmission Process: What Do We Know? (And What Don't We Know?)', Reserve Bank of Australia *Bulletin*, September, pp. 19–33.

Grenville, S.A. (1996), 'Recent Developments in Monetary Policy: Australia and Abroad', *Australian Economic Review*, 113(1), pp. 29–39.

King, M. (1996), 'How Should Central Banks Reduce Inflation? – Conceptual Issues', in *Achieving Price Stability,* Federal Reserve Bank of Kansas City, Kansas City, Missouri, pp. 53–92.

Kydland, F.E. and E.C. Prescott (1977), 'Rules Rather than Discretion: The Inconsistency of Optimal Plans', *Journal of Political Economy*, 85(3), pp. 473–492.

Lohmann, S. (1992), 'Optimal Commitment in Monetary Policy: Credibility versus Flexibility', *American Economic Review*, 82(1), pp. 273–288.

Lowe, P. (1992), 'The Term Structure of Interest Rates, Real Activity and Inflation', Reserve Bank of Australia Research Discussion Paper No. 9204.

Morgan, D. (1990), 'Evolution of Monetary Policy Since Financial Deregulation', *Economic Papers*, 9(4), pp. 1–18.

Oster, A. (1988), 'Lags and Monetary Policy', *Economic Papers*, 7(1), pp. 41–50.

Pagan, A.R. and P.K. Trivedi (1983), 'The Effects of Inflation: A Review with Special Reference to Australia', in A.R. Pagan and P.K. Trivedi (eds), *The Effects of Inflation: Theoretical Issues and Australian Evidence*, Centre for Economic Policy Research, Australian National University, Canberra, pp. 10–100.

Reserve Bank Act 1959, AGPS, Canberra, reprinted March 1989.

Reserve Bank of New Zealand Act 1989, Government Printer, Wellington.

Rogoff, K. (1985), 'The Optimal Degree of Commitment to an Intermediate Monetary Target', *Quarterly Journal of Economics,* 100(4), pp. 1169–1189.

Stemp, P.J. (1996a), 'Legislating an Inflation Target', *Policy*, 11(4), pp. 28–33.

Stemp, P.J. (1996b), 'The Role of Monetary Policy in Australia: A Minimalist Approach', *Australian Economic Review*, 113, pp. 10–28.

Stemp, P.J. and C.W. Murphy (1991), 'Monetary Policy in Australia: The Conflict Between Short-term and Medium-term Objectives', *Australian Economic Review*, 94, pp. 20–31.

Stevens, G. (1992), 'Inflation and Disinflation in Australia: 1950–91', in A. Blundell-Wignall (ed.), *Inflation, Disinflation and Monetary Policy,* Reserve Bank of Australia, Sydney, pp. 182–244.

Treasurer, The Rt. Hon. P. Costello (1996), 'Statement on the Conduct of Monetary Policy', 14 August, reprinted in Reserve Bank of Australia *Bulletin*, September, pp. 1–3.

Walsh, C.E. (1995a), 'Is New Zealand's Reserve Bank Act of 1989 an Optimal Central Bank Contract?', *Journal of Money, Credit and Banking*, 27(4), pp. 1179–1191.

Walsh, C.E. (1995b), 'Optimal Contracts for Central Bankers', *American Economic Review*, 85(1), pp. 150–167.

Discussion on Papers by Warwick McKibbin, John Quiggin and Peter Stemp

1. Glenn Stevens

These are three quite different papers, from very different perspectives. John Quiggin adopts a micro approach; Warwick McKibbin's views are informed by research on optimal policy regimes in large-scale macro models, while Peter Stemp's comments are mainly based on the literature which deals with institutional structure and incentives for monetary policy. I want to respond to a couple of points raised by each author, and then end by suggesting three questions – one from each of the papers – on which discussion might focus. I am going to talk about the three papers in the order in which I read them, which is not the order in which you have heard them today.

John Quiggin's paper has a micro framework. He starts with a representative agent maximising a lifetime utility function subject to the usual constraints. If I understand this analysis correctly, John makes two points:

- People care about volatility in consumption streams. If you give them two streams of income and consumption which have identical discounted present value, but one is much more volatile from period to period than the other, they will prefer the less volatile one, if they are risk averse. This is a standard implication of concave preferences: people prefer a certain amount equal to the expected value of a gamble to the gamble itself.
- Macroeconomic stabilisation policies may diminish welfare at the individual level even if they stabilise aggregates, if there are sectoral or distributional elements to the effects of policy applications (which, of course, there clearly are with monetary policy).

The implications drawn from this are that monetary policy should stabilise real interest rates; output stabilisation should be achieved by a particular kind of fiscal policy, namely lump-sum taxes which are positive under conditions of strong growth and negative under conditions of weak growth or recession. Inflation *per se* should not be a target of monetary policy – or any policy. This seems to be based on the idea that stabilising interest rates will be consistent with stabilising inflation, rather than the idea that inflation is costless, but more fundamentally there is no money or prices in this model, so it cannot really answer questions about inflation.

This view of monetary policy has, in some ways, a parallel to the older monetarist idea that activist monetary policy can be destabilising, but at the same time it turns that idea on its head. The Friedman money *k*-per cent growth rule was designed to avoid instability emanating from long and variable lags. The idea was that interest rates should not be smoothed, but allowed to vary as the market determined to keep demand for money on line with the smoothly growing supply. Central banking practitioners, on the other hand, have always smoothed short-term interest rates. They can justify this by the claim that shocks to money come from the demand side; I suspect they also think that lessening volatility in interest rates is, under most circumstances, probably 'a good thing'. Among the reasons for this may be perceived costs of reversals, a topic covered in the paper by Philip Lowe and Luci Ellis. To a point, I think central bankers would find some agreement with Quiggin that the idea that a high degree of instability in interest rates is not good.

But only to a point. I think central bankers would have to take issue with a proposal to try to stabilise real interest rates completely. For one thing, they will always worry about the response of price expectations to a price shock. Suppose inflation rises unexpectedly because of a temporary demand disturbance. If inflation expectations do not change, then the actual inflation shock will die out, inflation will go back to where it was; no nominal interest rates need change, and no policy-induced effects on the economy are necessary. Real interest rates in an expected sense do not move (though real *ex post* interest rates temporarily fall). This is well and good; but suppose expectations *do* move when actual inflation rises. Then something has to happen to bring them and actual inflation back down again, unless we accept that higher inflation is costless (an argument Quiggin does not make). In the standard framework that is a rise, temporarily, in real interest rates. This is just an application of the literature covered in detail in Malcolm Edey's paper about needing to tie down the price level by having real interest rates respond to a nominal target. This literature would say that John's real-interest-rate-stability rule would not achieve this. Furthermore, unless markets have some confidence that action would be taken to contain inflation, they are likely to build an inflation risk premium into market rates, which means that real interest rates are higher than they would otherwise be.

An additional point is that the 'equilibrium' real interest rate may itself be subject to shocks. Economists often assume this away, but I do not see why we should. Trying to stabilise the real interest rate on financial assets in the face of such shocks would be inherently inflationary or deflationary – just as Wicksell pointed out. So while John assumes (in the structure of his model) that stability in the intertemporal price of consumption is good, surely relative prices are supposed to change when underlying fundamentals shift. It may be appropriate to assume that the fundamentals determining equilibrium real interest rates do not shift – then again it may not.

One response to these concerns is to look for a more active role for fiscal policy in stabilising output and inflation. John is not the first person to say that we should not eschew the use of taxes for countercyclical stabilisation. (Bernie Fraser, former Governor of this Bank, said so too.) The question is to what extent this is a practical option. It is not necessarily that easy, and one can I think detect in the concluding part of John's paper a recognition that this sort of use of tax policy is not politically straightforward – it will be easier to cut taxes in recessions, for example, than to raise them in booms (a bit like interest rates, actually). Does this lead to arguments for an independent fiscal authority, immune from the political process, setting lump-sum taxes according to its forecast of the state of aggregate demand? The paper does not take this issue up – but it seems a logical implication of the argument.

A more general comment perhaps is that the paper does not consider explicitly the institutional framework. This is in contrast to Peter Stemp's paper, which does draw attention to the institutional framework for monetary policy.

Peter also eschews any active role in output stabilisation for monetary policy, but for a different reason to John. While John thinks that even if it succeeds in stabilising aggregate output, monetary policy can still be welfare reducing, and it should not worry unduly about responding to inflation *per se*, Peter thinks that policy cannot hope to stabilise output because of lags *etc*. and it should concentrate *only* on prices. Commenting on the evolution of the policy framework over the past decade, Peter says Australia has 'meandered through a range of policy regimes'. Whether that course was a meandering one or a purposeful evolution is discussed in detail in Stephen Grenville's paper. John's concern is that even though we have a reasonably sensible target regime at present, there is 'nothing to stop reversion' to some other less defensible regime. Hence his call for further institutional development.

In reflecting on the lags issue, one is, I think, bound to observe that the lags between monetary-policy changes and inflation are in all probability longer than those from policy to activity. The available empirical evidence in Australia suggests so anyway. The obvious reason is that changing the economy's short-run output trajectory relative to potential – opening or closing output gaps – is an important part of the short-run dynamics of inflation. If long and variable lags are a reason not to try to stabilise output, why do these same arguments not apply to trying to stabilise prices?

The answer is that they do apply, but that despite these difficulties, targeting inflation is still the best policy approach available, unless we have the unfailing intermediate target (a very stable money-demand function or sustainable exchange-rate peg with the perfectly compatible larger neighbour). The way we target inflation is by making the best forecast we can and adjusting the instrument accordingly.

A policy so carried out should, incidentally, do something to help stabilise the business cycle in instances where the cycle is driven by demand-side disturbances: policies to manage the cyclical swings in inflation and policies to dampen cyclical swings in output should be much the same thing. In other words, even if one accepts that inflation should be the sole *long-run* objective of policy, that does not rule out a role for policy in doing what it can to counter cyclical swings in output. In this sense, at least, policy can have dual objectives (Fischer 1996). One can, I hope, say this without it implying one thinks that monetary policy can reduce unemployment below the NAIRU sustainably or things of that nature.

The main idea which supports the focus on institutional structure is the time-inconsistency one: policy-makers are continually tempted to spring some surprise inflation to get some growth beyond potential. But since everyone knows this, and expects the higher inflation, the equilibrium is that we get the higher inflation without the growth; if only policy could credibly pre-commit to price stability, we could get an equilibrium with a lower inflation rate (and still the same growth). The way we achieve this is to appoint a 'conservative central banker', or work hard at designing an optimal contract.

Peter proceeds by examining the evolution of the structure in Australia and elsewhere, developing a ranking of three central banks in terms of independence and accountability on various criteria. He finds Australia has improved absolutely over time, but is last (by a fair distance) in this particular group. The basis for this conclusion is that, in his view at least, the RBA has insufficient operational independence, and there is not enough accountability (i.e. it is not clear enough who, if anyone, loses their job if the target is missed).

I think there is little point in getting into a discussion about rankings. While the three central banks are obviously ones of interest – they are all represented here today – it is a small sample. On the more comprehensive rankings – such as those of Grilli *et al.* (1991) and Cukierman (1992) – the RBA comes out around the middle, which seems about right to us. The RBNZ and the Bank of England will have moved up in these rankings with the reforms of recent years.

On the specific issue of whether the RBA has full operational independence, Peter's comments are, to say the least, puzzling. The Bank has for some time had operational independence for interest-rate moves. The Board decides the changes and makes them. The Statement on the Conduct of Monetary Policy issued by the Treasurer and the Governor in August 1996 makes this even clearer than it was. It says the Bank is independent, and that it will pursue the target.

Evidently this is not clear enough for Peter, who says that because some Board members 'lack technical expertise', because one member is head of the Treasury (an institution not usually known for its preference for higher inflation), and because there are no published minutes of the Board's meetings, 'it is not possible to evaluate the extent of government influence on Board decisions'. This strikes me as trying a little hard to establish lack of independence. Supposed lack of technical expertise would have little bearing on independence; and *if* there were improper political pressure, it does not seem likely to me that minutes – especially published ones – would reveal it. While Peter seems to imply the Bank should be more independent, he is not very specific about exactly what should be done to bring this about.

It is an old record, but it must be put on again: the Bank is, and has been, independent of government and has not tailored interest-rate decisions to political needs. The ultimate test of this is the outcomes: inflation has averaged about $2^1/_2$ per cent since 1991. (Incidentally, when Peter says the target is not quite clear enough for us to be able to evaluate success, the answer is that we have had six years of inflation at an average of $2^1/_2$ per cent. When we say we want to average two-point-something over time, this is exactly what we mean.)

But rather than extend that (rather sterile) debate, what might be more useful is to talk about Stemp's more important recommendations. I think the main one of interest is the idea that there should be a review process in the event of the target being revised.

The Statement on Monetary Policy says the Bank will report to Parliament periodically. This was already provided for in the Act in the form of the Annual Report, but there will now be two Semi-Annual Reports on Monetary Policy each year, with the Governor appearing before the relevant Committee. We had the first one in May this year. If the Bank loses the plot on inflation, or tries to fudge the target, or avoid responsibility for inflation outcomes – things which Peter seems to worry about – then the Parliament can and should call it to account.

True, there is no threat (or power) to dismiss the Governor if he or she misses the target. The formal review processes in the event of the target being missed in some other countries are of interest. But this is an area of inflation targeting where there is little to go on in the way of actual experience. For the most part, reviews have not been triggered in countries which have formal mechanisms – which of course is good insofar as it means inflation is being controlled. So far, we have only one example to my knowledge of the target technically being missed, and the review processes operating; that was in New Zealand in 1996. Dr Brash was obviously not fired – since he is here today! – we assume because the RBNZ by any standard has done a very good job in controlling inflation.

This episode does remind us, however, that the way in which the reviewing body (surely a parliamentary one) chooses to conduct its review will be important. Personally, I think the idea that pre-determined sanctions for failure to control inflation, meted out by elected representatives, will be an important deterrent on central banks otherwise disposed to spring an inflation surprise is a bit naive. McCallum (1995) has argued that the time-consistency problem is not solved by having Governments review central bank performance, only relocated. (Have we given enough thought to whether the incentives are correctly structured to make sure that, if inflation exceeds a target, parliamentarians demand to know why the Governor did not raise interest rates sooner or by more?)

I think there is ample scope for our system, characterised by very open public and parliamentary debate on monetary policy, to keep people's minds concentrated. There are arguments for some sort of mechanical review process in the event of failure to hit the target, but it could also be argued that the review processes which occur before such an event – and so might head it off – are more important. The parliamentary group has a fairly wide mandate to query the Governor on any issue twice a year. It might be worth seeing how this works for a while before concluding, as Peter does, no effort has been made in the area of improving accountability.

As a modeller from way back – indeed as one who has a model of the whole world – Warwick McKibbin is not as daunted by the problems of model uncertainty as Peter Stemp. Unlike both Peter and John Quiggin, Warwick believes in a certain amount – an optimal amount – of monetary-policy activism, aimed at a degree of stabilisation of output and inflation in the face of various shocks.

Warwick has given us a distillation of a very large program of research aimed at establishing the set of circumstances in which various rules are optimal or close to optimal. This seems to be in the same general line of research as that of, for example, Gordon de Brouwer and James O'Regan at this conference. Noting that a fully optimal rule may well be so complex as to approximate discretion – that is, not really a rule at all in the usual sense of that word – Warwick goes on to talk about various classes of fairly simple, and transparent, rules and their robustness across different circumstances.

One of the basic findings of this research seems to be that rules which respond to both output and inflation deviations – let me call them BHM-HMcK-Taylor rules – are not too bad in a variety of circumstances, and dominate alternatives in many important cases. There will be a detailed discussion of these sorts of rules later in the conference so I will not go into them now.

Warwick characterises the current approach to policy in Australia as close to such a rule, though the weights in our particular rule are unclear to him, and he comments that it may be credibility enhancing if we were to spell them out. Perhaps there is something to be gained by telling people our reaction-function weights – how much we think we have to adjust our instrument in response to deviations of forecast inflation from target. I think, however, that what has been more important for us over the past five or six years is to clarify the weights in our *objective* function. By the setting of our instrument, we have been proving to people that the weight on inflation in our objective function is high, by being prepared to tighten policy quickly when inflation pressures begin to mount. As it has become clearer that we have succeeded in containing inflation at the rates we said we would, credibility – on several measures – has gradually increased (though there is further work to do here yet).

Warwick's conclusion returns to the idea of robustness, and challenges us to keep probing the limits of our present rule, and contemplating the possibility of a major shock which might require a different reaction function (I do not think he is talking about a different *objective*). It might be worth spending a few minutes in our discussion speculating on what these shocks might be.

One can think of several possibilities. I think one of the hardest ones to face might be asset-price fluctuations – where it may be difficult for policy to respond in a timely enough fashion to prevent instability in the financial system which flows over to the real economy. (Question: Would a BHM-HMcK-Taylor rule have worked well in Japan in recent years? Would it have avoided the bubble economy, and subsequent problems?)

Let me try to finish up my discussion of these three quite different perspectives on Australian monetary policy, by suggesting a few topics around which we might organise discussion:

- First, interest-rate volatility: are there costs in interest-rate fluctuations, even movements which the macro models suggest are optimal from an aggregate point of view, arising at the micro level? If so, how may they be minimised while still achieving a degree of aggregate stabilisation, particularly inflation stabilisation? What role might reasonably be expected of fiscal policy in stabilisation?
- Second, the institutional framework for monetary policy in Australia: what further changes, if any, might be useful? Is there anything we can learn from the experience of other countries about how to structure review mechanisms?
- Third, how do we balance the need for *credibility*, which may require, if not a rule, perhaps fairly predictable responses to observed information – 'rule-like behaviour' – with the need for *adaptability* – the capacity to learn quickly about changes in the economy's structure, and to assess big shocks accurately, and to respond quickly?

References

Cukierman, A. (1992), *Central Bank Strategy, Credibility and Independence: Theory and Evidence,* MIT Press, Cambridge, Massachusetts.

Fischer, S. (1996), 'Why are Central Banks Pursuing Long Run Price Stability?', in *Achieving Price Stability,* Federal Reserve Bank of Kansas City, Kansas City, Missouri, pp. 7–34.

Grilli, V., D. Masciandaro and G. Tabellini (1991), 'Political and Monetary Institutions and Public Financial Policies in the Industrial Countries', *Economic Policy*: *A European Forum,* 13, pp. 342–392.

McCallum, B. (1995), 'Two Fallacies Concerning Central Bank Independence', *American Economic Review,* 85(2), pp. 207–211.

2. General Discussion

There was considerable discussion concerning John Quiggin's proposal for greater stability of real interest rates. There was little support for the extreme version of this proposal which sees the central bank keeping the real interest rate constant. It was generally felt that such a policy would fail to tie down the inflation rate, as it would see policy accommodate inflation shocks. Moreover, since the real interest rate is the outcome of preferences and opportunities, a constant real rate would fail to respond to evolving 'fundamentals'. Notwithstanding these comments, some participants argued that real interest rates should be more stable than they have been over recent decades.

Most speakers saw some merit, in principle, of an increased role for fiscal policy in the management of the cycle. But most wondered whether or not this was practical. While changes in monetary policy alter the distribution of income and affect different sectors of the economy in different ways, some participants questioned the proposition that fiscal policy could avoid these distributional effects. Lump-sum taxes might reduce the size of any effects, but would probably not eliminate them and, in any case, such taxes are extremely difficult to implement.

There was also a discussion about the political economy of fiscal policy, with several speakers noting that it was much more difficult to increase taxes than to reduce them. In the end this difficulty served to limit the flexibility of fiscal policy to actively assist in the management of the business cycle. In this regard, some noted the commitment of several European countries to satisfy certain fiscal criteria as a precondition for monetary union as an example of governments being prepared to tie their hands on fiscal policy.

There was also a discussion on whether an inflation-targeting system is more effective if there is a review mechanism (with the possibility of penalties) which is invoked when inflation breaches a certain band. There was no general agreement on this issue. Some argued that if there is to be a review process, the inflation target needs to be specified so that it is clear when the target is being met and when it is not being met; they see the Australian specification of 'two-to-three per cent over the cycle' as not meeting this criterion. The alternative view is that the Reserve Bank of Australia is subject to systematic periodic scrutiny by a parliamentary committee, and that the public is able to assess the Bank's expected path of inflation over the next few years.

Some thought a triggered review mechanism was necessary to focus the minds of central bankers on the need to achieve low inflation. It was also argued that review procedures are an important part of the process of public accountability. Others saw little benefit in triggered review processes, arguing that the process of review should be ongoing. They wondered whether governments would be prepared to penalise central banks for not having had higher interest rates. Also, the possibility of a triggered review with some form of penalty could distort the incentives of the central bank, leading it to induce extra volatility in output to avoid a review. Others noted that when policy is decided by a committee, as opposed to an individual, it is difficult to design appropriate penalties. Despite these potential problems, some participants argued that the New Zealand system had worked well; the review procedures had helped underline the commitment of the central bank and the government to low inflation.

Finally, there was a brief discussion on the appropriate size of reaction coefficients in simple interest-rate rules. (This issue was also discussed following the paper by de Brouwer and O'Regan.) It was noted that that the optimal coefficients depend upon the type of shock. If policy-makers can observe shocks, then optimal monetary policy does not require that interest rates always respond by the same degree to deviations of inflation and output from their targets; that is, there is not one simple rule that policy-makers can use. Despite this, some participants wondered whether a simple rule would perform better than unconstrained discretion, believing that discretion could be abused.

Financial-asset Prices and Monetary Policy: Theory and Evidence

Frank Smets*

1. Introduction

The monetary-policy environment over the past decade in industrial countries has been increasingly characterised by low and stable inflation and often large movements in the prices of equities, bonds and foreign exchange, or financial assets more broadly. While volatility in part reflects the nature of asset prices, driven primarily by revisions in expectations of future returns, large movements raise questions about the appropriate response of monetary policy. In the past year, for instance, several central banks have expressed concern about such changes. In the United States, Chairman Greenspan raised questions about the large gains in stock prices and whether they had extended beyond levels that are justifiable on the basis of economic fundamentals. In many formerly high-yielding bond markets such as in Italy and Spain, yields fell by several percentage points, often putting pressure on the respective central banks to relax policy rates. In the United Kingdom, the pound sterling appreciated by more than 15 per cent in effective terms from August 1996 to the beginning of 1997, giving rise to a lively debate between market observers and the central bank about the appropriate policy response.

The first part of this paper (Section 2) attempts to put these concerns in perspective by putting forward a common framework in which the optimal policy response to financial-asset prices can be analysed. Within the context of the central bank's objective of price stability, the basic answer to the question raised is simple: the central bank's response to unexpected changes in asset prices should depend on how these changes affect the inflation outlook; if they imply a rise in the inflation forecast, policy should tighten and *vice versa*.[1]

The harder task is to determine how the inflation forecast is affected, as this requires a structural model of the economy. Although the model developed in Section 2.1 following Gerlach and Smets (1996) is simple, it does highlight two reasons why unexpected asset-price movements may affect the inflation forecast. First, changes in asset prices may affect aggregate demand directly. For example, changes in asset prices affect household wealth and consumption expenditure, affect the ability of enterprises to raise funds and thereby influence investment spending, and raise the value of collateral which affects the willingness of banks to lend. Similarly, sharp changes in exchange rates affect the demand for net exports. To the extent that there is no other information to suggest that the movement in asset prices is warranted by the underlying fundamentals

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1. The central role of the inflation forecast in inflation-targeting countries has been emphasised by Svensson (1997).

of the economy, the central bank may wish to offset such changes in order to avoid unnecessary output and price variability.

Second, asset prices are strongly influenced by expectations of future returns, which in turn are related to expectations of future economic activity, inflation and monetary policy. Thus, even if their impact on aggregate demand is limited, they may contain useful information about current and future economic conditions. This information may be used to improve the inflation forecast on which the direction of monetary policy is based. The optimal policy response to asset prices for this reason will depend on the information contained in these prices. A number of authors have recently warned against the incorporation of asset prices in monetary-policy feedback rules (Fuhrer and Moore 1992; Woodford 1994). In the concluding part of Section 2.2, this criticism is briefly discussed.

Since the early 1990s, a number of central banks have incorporated the exchange rate in their inflation-targeting framework by using a monetary conditions index (MCI) – that is, a weighted average of a short-term interest rate and the exchange rate – as an operating target. The analysis in Section 2 suggests that this idea could be extended to other asset prices that affect aggregate demand. In Section 3, I therefore discuss the advantages and pitfalls of setting monetary policy in terms of an MCI. Using an MCI is beneficial in terms of practicality and because it contributes to transparency about how the central bank intends to achieve its announced inflation target. There are, however, two potentially serious limitations which in part follow from the simplicity of the MCI concept. First, the policy focus on interest rates or exchange rates may need to vary over time, for example, depending on which sectors are the cause of inflationary pressures. Second, the MCI concept ignores the potentially useful informational role of asset-price movements mentioned above.

In Section 4, I analyse the monetary-policy response to financial-asset prices and, in particular, the exchange rate in Australia and Canada. While the central banks of both countries have announced explicit inflation targets since the early 1990s, their views on how to respond to unexplained exchange-rate movements differ. In contrast to the Bank of Canada which uses an MCI, the Reserve Bank of Australia has resisted systematically responding to unexplained exchange-rate movements. In Section 4.1, I estimate a policy reaction function for both central banks over the period 1989–96 using a methodology proposed by Clarida, Galí and Gertler (1997). The estimated parameters confirm that while both central banks strongly respond to deviations of inflation from the announced target, their short-term response to the exchange rate is indeed different. I also examine whether the two central banks attach any weight to the long-term interest rate or the stock-market index in their short-run policy settings.

Finally, in Section 4.2, I examine whether, in accordance with the theoretical results of Section 2, differences in the sources of exchange-rate innovations can explain the different policy response to unexpected exchange-rate movements in the two countries. If most of the exchange-rate innovations are related to changes in the real economy, it may be optimal not to respond. In contrast, offsetting the effects of unexplained exchange-rate changes on aggregate demand is optimal, if most of the shocks to the exchange rate are financial. Using a set of structural VAR models, I find some evidence that terms-of-trade shocks are more important in Australia than in Canada, while the reverse is true for nominal shocks, in particular during the most recent period. Section 5 concludes and suggests two other reasons why asset prices may play a role in monetary-policy formulation.

2. Financial Prices and Optimal Monetary Policy

2.1 A simple model

I start the analysis of the interaction between financial prices and monetary policy by developing a stylised model of the economy. The model is an extension of that used by Gerlach and Smets (1996) to analyse the optimal policy response to the exchange rate. In this paper I focus on a general asset price and demonstrate that the same principles govern the optimal response to any asset price whether it is an exchange rate, equity prices or bond prices. Although the model is very simple, it does capture the two most important reasons why monetary authorities may want to respond to financial prices in their pursuit of price stability. First, shocks to financial prices that are not driven by fundamentals may destabilise the economy through their effects on aggregate demand, in which case the central bank may want to offset them. Second, asset prices are determined by arbitrage equations in which expectations of future returns play an important role. As a result, these prices may contain additional information about current and future economic conditions that may be useful to the monetary authorities in their stabilisation policy.

Equations (1) to (6) describe the economy:

$$p_t = E_{t-1}p_t + \gamma(y_t - \varepsilon_t^s) \tag{1}$$

$$y_t = -\alpha r_t + \beta f_t + \varepsilon_t^d \tag{2}$$

$$f_t = \rho E_t^+ f_{t+1} + (1-\rho)E_t^+ d_{t+1} - r_t + \varepsilon_t^f \tag{3}$$

$$d_{t+1} = y_t \tag{4}$$

$$r_t = R_t - E_t(p_{t+1} - p_t) \tag{5}$$

$$f_t = F_t - p_t \tag{6}$$

where all variables, except the interest rates, are in logarithms, and the constants have been normalised to zero.

Equation (1) is a simple Phillips curve which states that prices (p_t) are determined by last period's expectations of the current price level and the output gap ($y_t - \varepsilon_t^s$). Such a relationship can be derived in an economy where prices are determined as a mark-up over wages and wages are set one period in advance (Canzoneri and Henderson 1991).

According to Equation (2), aggregate demand depends negatively on the expected real interest rate (r_t) and positively on a real asset price (f_t). Different interpretations of f_t are possible. In what follows I will mainly think of f_t as a real stock price. Equation (3) is then a log-linear approximation of the arbitrage equation which requires the real return on equities, which can be decomposed into the expected dividend yield and the expected capital gain, to equal the real riskless rate plus a time-varying risk premium (ε_t^f). $E_t x_{t+i}$ denotes the expectation of variable x at time $t + i$, based on information available at time t. As discussed below, I allow for the fact that the information set of the asset-market participants may be larger than that of the other agents in the economy. Expectations based on this larger information set are denoted by E_t^+. According to Equation (4) the expected real dividend on equities is proportional to output. Since stocks are claims on output, note that, for $\beta = 1$, Equation (2) then simply says that the share of demand in total wealth is a function of the real interest rate.

Gerlach and Smets (1996) interpret f_t as a real exchange rate. The parameter β then captures the effect of the real exchange rate on aggregate demand, which will depend on, for example, the size of the traded-goods sector. For $\rho = 1$, the arbitrage Equation (3) becomes

$$r_t = E_t^+(\Delta f_{t+1}) + \varepsilon_t^f . \qquad (3')$$

This can then be interpreted as an uncovered interest-rate parity condition, provided the foreign interest rate and prices are normalised to be constant at zero. Finally, if dividends are constant (i.e. $d_t = 0$), then the real asset price can also be viewed as a real bond price.

Equations (5) and (6) define the expected real interest rate as the difference between the nominal interest rate and the expected inflation rate over the period and the real asset price as the difference between the nominal asset price (F_t) and the current price level.

The central bank sets the nominal interest rate to minimise the following intertemporal loss function,

$$E_t \sum_{i=0}^{\infty} \rho^i L_{t+i} \quad \text{where} \quad L_t = \gamma(y_t - \varepsilon_t^s)^2 + \chi(p_t - \overline{p})^2 . \qquad (7)$$

The central bank cares about both deviations of output from potential and deviations of prices from target. Two aspects of this loss function deserve to be highlighted. First, the central bank has no incentive to push output beyond its natural level (given by ε_t^s) and, as a result, is not subject to an inflation bias as in Barro and Gordon (1983). Second, the loss function implies that the central bank tries to stabilise the price level rather than the inflation rate. This is done for convenience, as targeting the inflation rate complicates the derivation of the optimal reaction function under asymmetric information without affecting the main results. Moreover, I assume that the price target is constant over time.

Next, I discuss the assumptions regarding the information set available to the different agents in the economy. First, all agents (the central bank, wage setters and financial-market participants) know the parameters and the distribution of the disturbances of the model. Second, all agents observe last period's realisation of the price level and output, and the current nominal interest rate and asset price. This assumption can be rationalised in two ways. First, while asset prices are continually quoted in auction-like markets, the collection of data on output and prices is more cumbersome and takes some time. Alternatively, in a dynamic model which would incorporate lags in the transmission mechanism, it is future output and prices – by definition currently unobservable – rather than current output and prices that would enter the objective function.

More controversially, I allow for the possibility that asset-market participants do have some information on current output and prices. One justification is that asset-market participants have financial incentives to acquire this information as their profits depend on how good their forecast of current and future returns is. For example, stock-market analysts have an incentive to gather detailed firm-level information to forecast corporate earnings. Such an argument is often made in favour of using asset prices rather than survey measures as indicators of private-sector expectations.

Finally, in order to derive the reaction function, I need to make assumptions about the stochastic processes driving the shocks to the economy. For simplicity, I assume that the supply shock follows a random walk, the demand shock a first-order autoregressive process and the financial shock a white-noise process, that is, $\varepsilon_t^s = \varepsilon_{t-1}^s + \xi_t^s$, $\varepsilon_t^d = \delta\varepsilon_{t-1}^d + \xi_t^d$ and $\varepsilon_t^f = \xi_t^f$, and that the shocks are mutually uncorrelated.

2.2 Optimal monetary policy

As shown in the Appendix, optimal monetary policy in this model results in setting the perceived (or forecast) price level equal to its target. However, the actual equilibrium output and price level will differ from their targets to the extent that there are unexpected excess-demand shocks which the central bank fails to stabilise. This control problem arises from a lack of information concerning the current shocks affecting the output gap and consequently the price level.[2]

In the following two subsections, I discuss the central bank's interest-rate reaction function which results in the achievement of the optimal price level.[3] In the first subsection, it is assumed that the information set of the central bank and the asset-market participants is the same. This allows me to focus on the implications of the role of the asset price in the monetary transmission mechanism for the optimal policy response to asset prices. In the second subsection, I investigate the implications of the informational role of asset prices by assuming that asset-market participants observe the current demand and supply shocks.

2.2.1 Asset prices and their role in the monetary transmission mechanism

When asset markets do not contain additional information concerning current demand and supply shocks, the optimal reaction function is given by

$$R_t = \frac{\beta}{\alpha} F_t + \frac{1}{\alpha} E_t(\varepsilon_t^d - \varepsilon_t^s) = \frac{\beta}{\alpha} F_t + \frac{1}{\alpha}(\delta\varepsilon_{t-1}^d - \varepsilon_{t-1}^s)\,. \tag{8}$$

2. These results are very similar to the results in Svensson (1996) who studies a (more realistic) dynamic model in which there is a one-period lag in both the Phillips curve and the aggregate-demand function. In that model actual output and inflation will deviate from their target levels because of shocks that occur during the control lag.

3. The optimal reaction function is derived in the Appendix. In deriving Equations (8) to (15) a zero price target is assumed.

In order to achieve the optimal price level, the central bank tightens policy rates in response to a rise in the asset price and perceived excess-demand shocks to the output gap. In this case the perceived output gap is just a function of past supply and demand shocks. To understand the rationale behind this reaction function, note from Equations (1) and (2) that for given price expectations and holding the interest-rate and exchange-rate path unchanged, excess-demand shocks will directly feed through into prices. As monetary policy affects prices through the effect of interest rates and asset prices on aggregate demand, it is optimal to change interest rates in such a way that the combined effect of the interest-rate and asset-price movements offsets the effect of the shocks to the output gap.

The equilibrium asset price and interest rate are then given by

$$F_t^* = \frac{\alpha(1-\rho)+1}{\alpha(1-\rho)+\beta}\varepsilon_{t-1}^s - \frac{\delta}{\alpha(1-\rho\delta)+\beta}\varepsilon_{t-1}^d + \frac{\alpha}{\alpha+\beta}\varepsilon_t^f \tag{9}$$

and

$$R_t^* = -\frac{(1-\beta)(1-\rho)\theta}{\alpha(1-\rho)+\beta}\varepsilon_{t-1}^s + \frac{\delta(1-\rho\delta)}{\alpha(1-\rho\delta)+\beta}\varepsilon_{t-1}^d + \frac{\beta}{\alpha+\beta}\varepsilon_t^f\,. \tag{10}$$

On the basis of Equations (8) to (10) two observations can be made. First, Equation (8) highlights the asset price's role in the transmission mechanism. If $\beta = 0$, i.e. the asset price does not affect aggregate demand, then it drops out of the reaction function. Moreover, by rewriting Equation (8), the optimal reaction function can be interpreted as the central bank setting a weighted average of the interest rate and the asset price – a monetary conditions index (MCI) – in response to perceived changes in the output gap:

$$\alpha R_t - \beta F_t = MCI_t^* = \delta\varepsilon_{t-1}^d - \varepsilon_{t-1}^s\,. \tag{11}$$

If the asset price is the exchange rate, Equation (11) shows that the practice of setting monetary policy in terms of a weighted average of the interest rate and the exchange rate, with the weights determined by their respective effects on aggregate demand, is optimal in this particular model (Gerlach and Smets 1996). More generally, an MCI should also include other asset prices such as long-term interest rates and stock prices that affect aggregate demand.

Second, Equations (10) and (11) are equivalent policy rules. This serves to highlight two misconceptions that sometimes arise in discussions about the usefulness of MCIs. First, using an MCI as the operating target does not imply an automatic reaction to *all* asset-price changes, as the response depends on the perceived output gap. In fact, if $\beta = 1$, the correlation between asset-price movements and the short-term interest rate will be zero in the case of supply shocks, negative in the case of demand shocks and positive in the case of financial shocks. Second, by the same token, it is clear that using an MCI as the operating target does not obviate the need to determine the source of the asset-price shocks. Freedman (1994) emphasised that policy-makers who use an MCI as the operating target need to make a distinction between shocks that affect the desired MCI (i.e. the left-hand side of Equation (11)), such as demand and supply shocks, and shocks that do not, such as financial shocks.

2.2.2 The informational role of asset prices

In this section, I investigate the implications of the informational role of asset prices for the optimal policy response. I therefore assume that asset-market participants have information about current supply and demand shocks.[4] In this case financial prices may affect policy rates through their effect on the perceived output gap.

In the Appendix I show how to solve for the optimal response to the asset price in two steps. First, I postulate a particular form of the optimal interest-rate reaction function to the asset price and calculate the equilibrium asset price that would be consistent with such a reaction function. Given the expression of the asset price, I can then solve for the signal-extraction problem of the central bank and calculate the optimal response to the asset price. As an illustration, I analyse here the special case when there are only two fundamental shocks to the economy: a permanent supply shock and a temporary financial shock.

Consider first the case of $\beta = 1$. As can be seen from Equation (10), in this case it is optimal for the central bank not to respond to supply shocks in the symmetric information case. The reason for this is that the rise in stock prices, in response to the improved supply side of the economy, increases demand enough to close the output gap. Stock prices play an equilibrating role in response to supply shocks. In contrast, policy rates need to move strongly in response to financial shocks.

Under asymmetric information, the optimal interest-rate reaction function is

$$R_t = \frac{1-\lambda}{\alpha} F_t - \frac{1-\lambda}{\alpha} \varepsilon^s_{t-1} \quad \text{with} \quad \lambda = \frac{(1+\alpha)(\gamma+\rho)\sigma_s^2}{(1+\alpha)(\gamma+\rho)\sigma_s^2 + \alpha(1+\gamma)\sigma_f^2}. \quad (12)$$

As $0 \le \lambda \le 1$, it is clear from comparing Equations (8) and (12) that, when stock prices contain information about the current supply shock, the optimal policy response to them will be reduced. In determining how much lower the response will be, the most important factor is the ratio of the variance of supply shocks (σ_s^2) relative to the variance of financial shocks (σ_f^2). This signal-to-noise ratio can be interpreted as an indicator of the information content of changes in stock prices. As financial shocks become increasingly important, this ratio tends to zero and the informational role of the asset price is lost and the optimal policy reaction function reverts to Equation (8). In contrast, if financial shocks to stock prices are rare, the central bank concludes that most unexpected changes in stock prices are due to supply shocks. Since such movements in the stock market are equilibrating the goods market, the central bank wants to accommodate them. As $\lambda \to 1$, the central bank no longer responds to changes in the stock market, which is the optimal response in the face of supply shocks.[5] Thus, this example shows that the informational role of asset prices may change the optimal response to asset prices from firm leaning against the wind to complete *laissez-faire*.

4. I assume asset-market participants observe the current supply and demand shocks. This assumption is made for convenience. Alternatively, one could assume that they only observe a noisy signal of these shocks.

5. The basic insight is, of course, not new. For example, Boyer (1978) extends the classical Poole (1970) analysis to the question of optimal foreign-exchange market intervention.

Take now the case in which stock prices have no effect on aggregate demand ($\beta = 0$), so that it is never optimal to respond to stock prices in the symmetric information case. When current stock prices contain information about current supply shocks, the optimal reaction function becomes

$$R_t = -\frac{\lambda}{\alpha} F_t - \frac{1-\lambda}{\alpha} \varepsilon^s_{t-1} \quad \text{with} \quad \lambda = \frac{\rho \sigma_s^2}{\dfrac{\rho(\alpha(1-\rho)+1)}{\alpha(1-\rho)} \sigma_s^2 + \dfrac{\alpha(1-\rho)}{(\alpha(1-\rho)+1)} \sigma_f^2}. \tag{13}$$

Because rising equity prices signal positive supply shocks, which in turn lower the inflation forecast, it now becomes optimal to lower policy rates in response to a booming stock market.

2.2.3 Conclusions

In this section, I have shown that the optimal monetary-policy response to changes in asset prices depends on their role in the monetary transmission mechanism and the sources of the shocks affecting them. Recently, a number of authors have criticised the use of asset prices in feedback rules of monetary policy. This criticism has basically taken two forms. The first set of arguments are a manifestation of the well-known Lucas critique. Fuhrer and Moore (1992), for example, analyse the implications of the use of simple feedback rules for monetary policy to various asset prices in an overlapping-contracts model and show that including the asset prices themselves in the reaction function can change the direction of the indicator properties. Woodford (1994) observes that econometric evaluations on whether an asset price has good forecasting power may not be relevant. On the one hand, it may not be desirable to base policy on an indicator which has been found useful in forecasting inflation, because the forecasting ability may be impaired by the very fact that the monetary authority responds to it. A specific example of this phenomenon is analysed by Estrella (1996), who shows within a simple model that the ability of the slope of the term structure to forecast economic activity and inflation may disappear under a strict inflation-targeting rule. On the other hand, low forecasting power may not justify ignoring an indicator if the absence of it simply means that the variable is already used by central banks in the conduct of policy.

The second form of criticism concerns the existence and uniqueness of equilibria when the central bank, in setting its policy rule, uses private-sector forecasts which themselves are based on expected monetary policy (Bernanke and Woodford 1996). For example, Fuhrer and Moore (1992) find that placing too much weight on asset prices in the reaction function, may lead to instability as policy loses control of inflation. Similarly, Woodford (1994) and Bernanke and Woodford (1996) show that automatic monetary-policy feedback from such indicators can create instability due to self-fulfilling expectations.

The analysis in these papers shows that automatic policy feedback from changes in financial-asset prices and private-sector inflation forecasts may be dangerous. However, the use of a structural model to interpret observed changes in asset prices reduces the two potential problems. First, the Lucas critique is not valid because the new information is evaluated within the context of the central bank's structural model and not just on the basis of forecasting ability. Second, the potential for instability or non-existence of equilibria is reduced because the response to asset prices is conditioned by the information asset prices contain concerning the structural shocks to the economy and their implications for the achievement of the central bank's inflation objective. In particular, the use of a structural model allows the central bank to filter out how much of the movement in asset prices is due to the expected monetary-policy response so that the problem of 'circularity' disappears (Bernanke and Woodford 1996, p. 3).

3. Advantages and Pitfalls of an MCI as an Operating Target

Recently, the Bank of Canada has formalised the role of the exchange rate in its inflation-targeting framework by using a weighted average of a short-term interest rate and the exchange rate – an MCI – as an operating target.[6] In the Canadian context, the inclusion of a short-term interest rate and an exchange rate in the MCI was motivated by research findings that inflationary pressures were largely determined by the output gap and that monetary policy affected the output gap mainly through the effects of the exchange rate and short-term interest rates on aggregate demand (Duguay 1994; Longworth and Poloz 1995). It was therefore natural to monitor a weighted average of the two, with the weights determined by their relative importance in affecting demand.

The analysis in Section 2.2 suggests that, more generally, the MCI could be extended to include other asset prices that affect aggregate demand. Indeed, in research at the European Monetary Institute a long-term interest rate was included on the grounds that these rates matter more for aggregate demand in many continental European countries (Banque de France 1996). Similarly, it could be argued that in Japan, where the effects of equity prices on economic activity are shown to be stronger than in many other countries, the MCI should include a stock-price index. In this section, I therefore discuss some of the advantages and pitfalls of setting monetary policy using an MCI. Most of the arguments that relate to an MCI which only includes the short-term interest rate and the exchange rate, also carry over to a broader MCI.

3.1 Advantages

One advantage of using an MCI as the operating target is that it is practical to formulate monetary policy in terms of the financial-asset prices that matter in the transmission process, because it is in general difficult to predict the response of asset markets to changes in policy rates (Freedman 1994). Having a target for the MCI automatically achieves the desired monetary-policy stance in the presence of uncertainty about how financial markets will respond.

6. See Freedman (1994). Following the Bank of Canada, central banks in a number of countries – among them Sweden, Finland, Iceland and Norway – have adopted MCIs. In contrast to Canada, however, the Nordic countries use the MCI primarily as an *ex post* indicator of the stance of policy. Since October 1996, the Reserve Bank of New Zealand also uses an MCI as the operating target. While the Bank of Canada only indicates the direction of its desired path, the Reserve Bank of New Zealand quantifies its desired path for both components.

A second advantage is that it clarifies the central bank's view of the monetary transmission mechanism. This increased transparency may be more important in a monetary-policy strategy which does not rely on intermediate targets to communicate policy decisions. Moreover, announcing the desired path of monetary conditions improves the transparency of the intentions of the monetary authorities and by reducing financial-market volatility may make policy more effective.[7]

3.2 Pitfalls

Two sets of problems may reduce the desirability of using an MCI as the operating target (Gerlach and Smets 1996). First, the concept of an MCI depends on a simple view of the transmission mechanism which may only be a poor approximation of the actual working of the economy. Second, its use presumes that most unexplained movements in asset prices are not related to the fundamentals of the underlying economy and therefore need to be stabilised. It therefore potentially underestimates the informational and equilibrating role of asset-price innovations. I discuss each of these arguments in turn.

The model on which the MCI concept is based may be deficient in a number of ways. First, monetary policy may affect inflation through transmission channels other than through the output gap, for instance through the direct effect of exchange rates on import prices. Until recently, the Reserve Bank of New Zealand focused on this more direct transmission channel to control inflation (Grimes and Wong 1994). While such direct price effects are important, Freedman (1994) argues that they are best interpreted as only affecting the price level and can hence be accommodated without necessarily triggering ongoing inflation. Stochastic simulations by Black, Macklem and Rose (1997) suggest that controlling inflation through the output gap rather than through import prices may lead to higher inflation variability, but appears more appealing in terms of output, interest-rate and exchange-rate volatility.

A second problem arises from the assumed constancy of the demand elasticities. The effects of interest rates and exchange rates on aggregate demand may depend on the structure of indebtedness of the economy. For example, in a country with a large foreign debt, exchange-rate changes may have important wealth effects potentially offsetting the direct effects on aggregate demand. Possibly even more important is the fact that exchange-rate movements primarily affect the tradable-goods sector, while changes in interest rates have a potentially stronger impact on non-tradable-goods sectors such as the housing market. The model underlying a fixed-weight MCI assumes that resources can be shifted relatively easily from one sector to the other so that only the economy-wide output gap matters. In practice, inflationary pressures may arise from bottlenecks in different sectors at different times. In such a situation the weight on the relevant asset price should shift (King 1997).

Finally, the lags with which the exchange rate and the interest rate affect aggregate demand may be different. Indeed, simulations with macroeconometric models suggest that exchange-rate changes have more immediate effects on real economic activity than

7. Similar arguments are used in favour of other instrument rules that quantify the link between the central bank's policy instrument and economic conditions; see Taylor (1996).

changes in interest rates (Smets 1995). If so, changes in interest and exchange rates that leave the MCI unaffected will change aggregate demand.

The second set of problems with the concept of an MCI relates to its neglect of the potential informational and equilibrating role of asset-price innovations. As discussed in Section 2 and Gerlach and Smets (1996), the optimal weight on the exchange rate in the MCI will depend on its information content. When unexplained exchange-rate innovations are primarily driven by underlying terms-of-trade shocks, then, depending on the parameters of the model, it may actually be optimal to respond to an appreciation by raising interest rates as the exchange rate signals a rise in the demand for home goods which may lead to inflationary pressures. On the other hand, if most innovations in the exchange rate are considered to be financial and related to changes in risk premia or the credibility of monetary and fiscal policy, then the MCI weights as usually determined are optimal. The central bank's view on what drives unexpected changes in the exchange rate is thus important in deriving the optimal response and the implicit weight in an MCI. In Section 4.2 this is further explored to explain the different response to the exchange rate in Canada and Australia.[8]

This point also raises the general issue whether central banks know enough about asset-price determination to usefully target them in an MCI. Using an MCI presupposes that the central bank knows what the equilibrium asset price should be. If this is not the case, targeting a desired path for the MCI may hinder the equilibrating role of asset prices. For example, in the simple example of Section 2.2 with $\beta = 1$ and asymmetric information, if the central bank acts according to Equation (8), then the equilibrating role of the response of equity prices to supply shocks would be undone by the monetary-policy response and output and price variability would be larger than under *laissez-faire*.

In practice, there appears to be a trade-off between avoiding letting financial shocks destabilise the economy and the possibility that a policy response hinders the equilibrating role of asset prices. When there is genuine uncertainty concerning what drives financial prices, the potential for asset-price misalignments to destabilise the economy will be a determining factor. Thus, if the demand effects of changes in a particular asset price are limited, the central bank's bias will be not to interfere with the market. On the other hand, if unwarranted movements in the asset price can have strong and lasting effects on output and prices, a policy of leaning against such changes may be cautious.

4. Financial-asset Prices and Monetary Policy in Australia and Canada

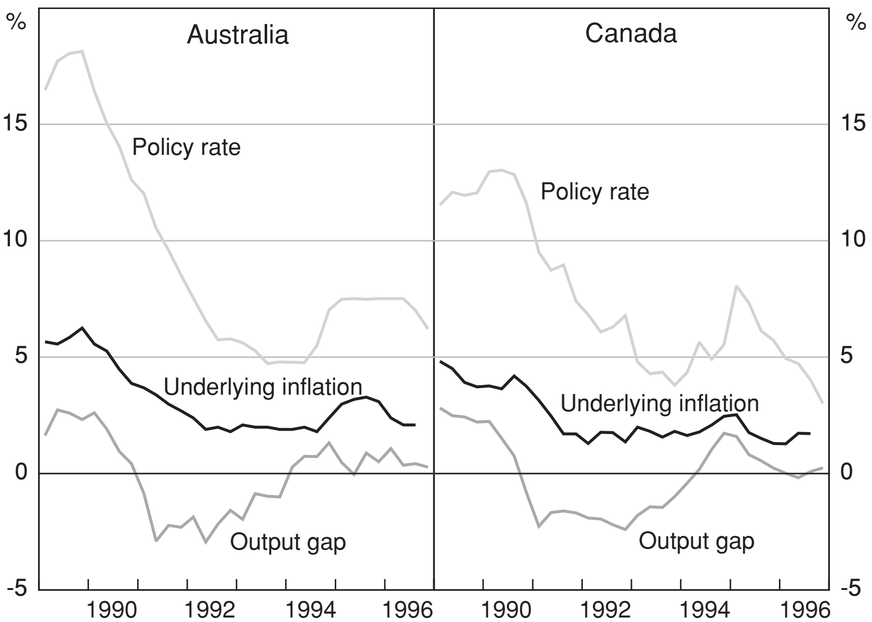
4.1 Estimating a policy reaction function

Since the early 1990s both the Bank of Canada and the Reserve Bank of Australia have had publicly announced explicit targets for inflation. The Bank of Canada announced inflation-reduction bands in February 1991 and has, since 1995, been targeting the

8. For example, the view consistent with the analysis in Astley and Garrat (1996), that most exchange-rate innovations are driven by real shocks, may partly explain why the Bank of England has rejected the usefulness of an MCI; see also King (1997).

inflation rate within a band of ±1 per cent around a midpoint target of 2 per cent. The Reserve Bank of Australia started publicly quantifying its inflation objective in 1993, announcing a target of 2–3 per cent on average over the course of the business cycle. However, while the Bank of Canada has incorporated the exchange rate in the inflation-targeting framework by using an MCI as the operating target, the Reserve Bank of Australia has resisted systematically responding to unexpected exchange-rate movements.[9]

Figure 1: The Policy Rate, Inflation and the Output Gap



In this Section I attempt to quantify the commitment to low inflation and test the different attitude towards the exchange rate by estimating a policy reaction function for the Bank of Canada and Reserve Bank of Australia over the period 1989–96, using the methodology proposed by Clarida, Galí and Gertler (1997).[10] They assume that within each operating period the central bank has a target for the nominal policy-controlled interest rate, R_t^*, which is based on the state of the economy. In particular, the target depends on perceived inflation and output,

9. Opinions about the usefulness of an MCI as an operating target also differ among other inflation-targeting countries. While the Reserve Bank of New Zealand started using an MCI as the operating target at the end of 1996, the Bank of England firmly rejects it (King 1997).

10. Although the announcement of the inflation targets occurred in the early 1990s, in both countries the commitment to low and stable inflation became gradually clear in the late 1980s when interest rates rose strongly to undo the upward trend in inflation (Figure 1). In Canada, the appointment of John Crow to Governor of the Bank of Canada in February 1987 marked a shift towards more emphasis on the goal of price stability. This shift was more gradual and less transparent in Australia (Debelle 1996).

$$R_t^* = \bar{R} + \beta(E[\pi_t \mid \Omega_t] - \bar{\pi}) + \gamma E[y_t - \bar{y}_t \mid \Omega_t] \tag{14}$$

where $\bar{R}$ is the equilibrium nominal interest rate, π_t the trend inflation rate, $\bar{\pi}$ the inflation target and $y_t - \bar{y}_t$ the current output gap.

This target rule is a generalisation of the type of simple interest-rate rules proposed by Taylor (1993).[11] It can be derived as the optimal rule for a central bank that has a quadratic loss function over inflation and output in a model similar to that in Section 2 (Svensson 1997). For this target rule to lead to an effective stabilisation of the inflation rate, β needs to be greater than one and γ positive, so that the real policy rate rises whenever trend inflation is above target and/or output is above potential.

In order to derive the equation estimated in Table 1, three more steps are necessary. First, as discussed extensively in Lowe and Ellis at this conference, central banks tend to smooth changes in interest rates. This interest-rate smoothing is captured by assuming that the actual rate partially adjusts to the target as follows:

$$R_t = (1-\rho)R_t^* + \rho R_{t-1} + v_t \tag{15}$$

where the parameter ρ captures the degree of interest-rate smoothing and v_t reflects a white-noise control error. Letting $\alpha \equiv \bar{R} - \beta\bar{\pi}$ and $gap_t = y_t - \bar{y}_t$, and combining Equations (14) and (15), the policy reaction becomes

$$\Delta R_t = (1-\rho)\left\{ \alpha + \beta E[\pi_t \mid \Omega_t] + \gamma E[gap_t \mid \Omega_t] - R_{t-1} \right\} + v_t \,. \tag{16}$$

Second, in analogy with Equations (8) and (12) of the model in Section 2, I allow the policy rate to respond to contemporaneous changes in asset prices. Financial prices may affect current policy rates either because they have an independent impact on future inflation or because they contain information about current trend inflation and the output gap not captured in the instrument set.[12] Adding asset prices to the reaction function yields

$$\Delta R_t = (1-\rho)\left\{ \alpha + \beta E[\pi_t \mid \Omega_t] + \gamma E[gap_t \mid \Omega_t] - R_{t-1} \right\} + \sum_{i=1}^{n} \omega_i \Delta x_{it} + v_t \tag{17}$$

where ω_i is the response to the change in the ith financial variable. In Table 1, I consider three such variables: a nominal trade-weighted exchange rate, a 10-year nominal bond yield and a broad stock-market index.

Finally, I eliminate the unobserved variables by rewriting the policy rule in terms of realised variables as follows:

$$\Delta R_t = (1-\rho)\left\{ \alpha + \beta\pi_t + \gamma gap_t - R_{t-1} \right\} + \sum_{i=1}^{n} \omega_i \Delta x_{it} + \varepsilon_t \tag{18}$$

where the error term $\varepsilon_t \equiv -(1-\rho)\left\{ \beta(\pi_t - E[\pi_t|\Omega_t]) + \gamma(gap_t - E[gap_t|\Omega_t]\right\} + v_t$.

11. In contrast to Taylor (1993), Clarida, Gali and Gertler (1997) use expected inflation instead of actual inflation arguing that this makes it easier to disentangle the link between the estimated coefficients and the central bank's objectives. For example, it is not clear from the simple Taylor specification whether the central bank responds to the output gap independently of concerns about future inflation. In this paper, I use a centred annual inflation rate to capture the current trend inflation rate in Equation (14). The two reasons for doing so are that using realised future inflation, first, reduces the already short sample period, and, second, leads to biased estimates because the current interest rate affects future inflation.

12. Clarida, Gali and Gertler (1997) interpret the significance of variables other than expected inflation in the policy reaction function as evidence in favour of other objectives than price stability (e.g. exchange-rate stability).

Table 1: Financial Prices and the Policy Reaction Function in Australia and Canada

Estimates of $\Delta R_t = (1-\rho)\left\{\alpha + \beta\pi_t + \gamma gap_t - R_{t-1}\right\} + \sum_{i=1}^{3}\omega_i \Delta x_{it} + \varepsilon_t$

Country	β	γ	ρ	ω_1	ω_2	ω_3	α	$\bar{\pi}$	$\bar{r}$
Model 1									
Australia	2.83	0.35	0.60	—	—	—	-0.00	2.2	4.5
	(0.37)	(0.31)	(0.11)	—	—	—	(0.00)		
Canada	2.23	1.05	0.77	—	—	—	0.01	1.5	4.1
	(0.69)	(0.72)	(0.07)	—	—	—	(0.01)		
Model 2									
Australia	2.84	0.33	0.60	0.00	—	—	-0.00	2.2	4.5
	(0.36)	(0.30)	(0.11)	(0.01)	—	—	(0.00)		
Canada	2.91	2.01	0.85	-0.22	—	—	-0.01	2.5	2.4
	(0.67)	(0.90)	(0.05)	(0.05)	—	—	(0.02)		
Model 3									
Australia	2.83	0.36	0.61	0.00	0.02	0.00	-0.00	2.2	4.5
	(0.37)	(0.26)	(0.10)	(0.02)	(0.15)	(0.01)	(0.00)		
Canada	2.45	1.14	0.77	-0.14	-0.09	-0.06	0.01	1.6	4.0
	(0.52)	(0.32)	(0.04)	(0.05)	(0.11)	(0.02)	(0.01)		
Model 4									
Australia	3.09	—	0.54	—	—	—	-0.00	2.3	4.4
	(0.25)	—	(0.09)	—	—	—	(0.00)		
Canada	2.50	1.19	0.79	-0.14	—	-0.06	0.00	1.7	3.9
	(0.55)	(0.34)	(0.03)	(0.05)	—	(0.02)	(0.01)		
Model 5									
Australia	2.84	0.26	0.60	—	—	—	0.00	2.0	3.9
	(0.33)	(0.13)	(0.10)	—	—	—	(0.00)		
Canada	0.85	1.00	0.61	-0.15	—	-0.06	0.06	2.2	6.4
	(0.27)	(0.11)	(0.04)	(0.04)	—	(0.01)	(0.00)		

Notes: Estimates are obtained by GMM with correction for MA(3) autocorrelation. The optimal-weighting matrix is obtained from the first-step two-stage non-linear least squares parameter estimates. The sample period is 1989:Q1–1996:Q3. In models 1 to 4, R_t is the day-to-day interest rate, π_t is the centred annual underlying inflation rate, gap_t is the output gap using a HP(1 600) filter to generate the potential-output series. The three asset prices are a nominal trade-weighted exchange rate, a 10-year nominal government bond yield and a broad stock-market index. The instruments used are mentioned in the text. Standard errors are shown in parentheses.

Table 1 reports GMM estimates of Equation (18) using quarterly data over the period 1989:Q1–1996:Q3.[13] The instruments used are two lags of quarterly changes in the underlying inflation rate, the log terms of trade, the policy rate and the three financial variables, two lags in the output gap and the contemporaneous US interest rate, the US/DM exchange rate, the 10-year bond yield and the S&P500 index. In the benchmark model the output gap is calculated as the deviation of actual real GDP from a Hodrick-Prescott (λ = 1 600) generated potential output series (models 1 to 4 of Table 1). In model 5 of Table 1, a quarterly interpolation of the OECD's estimate of the output gap is used.

While the empirical model does not separately identify the inflation target $\bar{\pi}$ and the equilibrium real rate $\bar{r}$, it does provide a relation between the two variables that is conditional upon α and β, which is given by $\bar{\pi} = (\bar{r} - \alpha)/(\beta - 1)$. The second-to-last column of Table 1 gives the implied estimate of the inflation target, using the average real short-term rate over the period 1973–96 as an estimate of the equilibrium real rate. The average real rate over this period is 3.49 per cent in Canada and 4.04 per cent in Australia. The last column reports the implied estimate of the equilibrium real rate using the midpoint of the announced target band as an estimate of the inflation target (2 per cent in Canada and 2.5 per cent in Australia).

In spite of the short sample, the results are quite promising. Model 4 in Table 1 shows the results of the preferred specification. In both countries the parameter on trend inflation is significantly larger than one, indicating the commitment to stable inflation during this period. Moreover, using the average real short rate over the period 1973–96 as an estimate of the equilibrium real rate, the estimated inflation target is close to and not significantly different from the midpoint of the announced inflation bands (2.3 per cent in Australia and 1.7 per cent in Canada). The estimated response to the output gap is strong and significant in Canada: policy rates are increased by more than 1 percentage point for every 1 percentage point increase of the output gap. In Australia, the response is positive (about 0.33) but insignificant (see model 2).

The estimated responses to changes in the three financial variables (model 3), show that, as expected, the Bank of Canada reduces policy rates significantly in response to an appreciation of the trade-weighted exchange rate. The implied estimated weight on the exchange rate (0.12) is about half the size of the announced weight of one-fourth. More surprisingly, changes in the stock-market index are also significant in the policy reaction function of the Bank of Canada. Moreover, the sign of the estimated elasticity suggests that policy rates were eased during the estimation period in response to a rise in the stock market. In light of the theoretical model of Section 2, this can be rationalised if a rise in the stock market reflects positive supply developments which expand output and reduce inflation. An alternative and maybe more plausible explanation is that both the central bank and the stock market respond to news about underlying inflation that is not captured by the instrument set. In contrast, the Reserve Bank of Australia does not respond to changes in any of the asset prices including the exchange rate.

13. Because the trend inflation rate is captured by a centred annual inflation rate, the composite error term has an MA(3) representation with quarterly data. In this case the GMM estimator of the parameter vector is a two-step non-linear two-stage least squares estimator when the model is overidentified. See Hansen (1982) and Cumby, Huizinga and Obstfeld (1983).

The last model of Table 1 shows the effect of using the OECD's estimate of the output gap in the estimation of Equation (18). In the Australian case, the parameter estimates hardly change, but the policy response to the output gap is now significant. The estimate of the parameter γ implies that the Australian cash rate is raised by around 25 basis points for every 1 per cent rise in output above the OECD's estimate of potential. The Canadian results are less robust to the alternative specification of the output gap: the parameter on trend inflation drops to 0.85, not significantly different from 1, while the parameter on the output gap remains strong and is quite precisely estimated. A 1 percentage point rise in output above potential leads to a tightening of the interest rate by 1 percentage point.

4.2 Sources of exchange-rate variation and the policy response

Section 2 demonstrated that the source of unexplained exchange-rate movements and its implications for future inflation determine the optimal reaction coefficient to contemporaneous exchange-rate shocks. If exchange-rate innovations mainly signal relative shifts in the demand and supply of domestically produced goods, then the central bank may want to accommodate or even reinforce such exchange-rate movements. On the other hand, if most exchange-rate innovations are financial, the central bank may wish to lean against them. In this Section I try to identify the sources of exchange-rate innovations in Australia and Canada and analyse whether these can explain the different attitude towards the exchange rate.

To investigate the sources of exchange-rate movements in both countries, I use a set of VAR models, each of which incorporates at a minimum both the nominal bilateral exchange rate against the US dollar and the relative GDP deflator *vis-à-vis* the United States.[14] The structural shocks are identified using triangular long-run zero restrictions (Blanchard and Quah 1989). Long-run restrictions are favoured over short-run restrictions for two reasons. First, because I am interested in uncovering the source of the shocks of the *contemporaneous* innovations in the nominal exchange rate, it is more appealing not to impose any identification restrictions on the contemporaneous correlations. Second, my primary interest is to distinguish between real and nominal shocks for which the long-run restrictions are particularly suited.

Each model is estimated over two subperiods. The first subperiod, which starts after the breakdown of the Bretton Woods system and ends in the last quarter of 1989, has the advantage of excluding the most recent period which was characterised by a shift in monetary-policy regime which may have affected the source of exchange-rate shocks. The second subperiod, which starts in 1980 and ends in 1996, excludes the potentially large effects of the two oil price shocks.[15]

For each of the models, Table 2 reports the percentage of contemporaneous and four-quarter-ahead forecast errors in the nominal exchange rate and of four- and eight-quarter-ahead forecast errors in relative prices that can be explained by the various shocks. This allows me to discuss the relative importance of the different sources of shocks to current exchange-rate innovations and their contribution to the variability in relative prices one to two years ahead.

14. All variables are included as log changes. See Table A1 for the relevant unit-root tests.

15. Because of the limited degrees of freedom, I could not split the total sample period in two.

Table 2: Sources of Nominal Exchange-rate Innovations and Relative-price Developments in Australia and Canada

	1973:Q1–1989:Q4				1980:Q1–1996:Q4			
	Australia		Canada		Australia		Canada	
	Exchange rate	Relative prices	Exchange rate	Relative prices	Exchange rate	Relative prices	Exchange rate	Relative prices
Model 1: Real exchange rate, relative prices								
Real	99 (98)	0 (2)	99 (94)	13 (17)	91 (83)	8 (7)	58 (82)	59 (62)
Nominal	0 (2)	99 (97)	0 (5)	86 (82)	8 (16)	91 (92)	41 (17)	40 (37)
Model 2: Relative output, real exchange rate, relative prices								
Supply	39 (37)	8 (3)	10 (6)	8 (9)	22 (31)	11 (13)	1 (1)	8 (2)
Demand	60 (60)	3 (3)	87 (85)	1 (6)	62 (50)	26 (26)	67 (86)	37 (45)
Nominal	0 (1)	88 (92)	2 (8)	89 (83)	15 (17)	61 (60)	30 (12)	53 (51)
Model 3: Terms of trade, real exchange rate, relative prices								
Terms of trade	65 (70)	1 (3)	20 (17)	10 (9)	65 (62)	13 (11)	32 (43)	11 (8)
Real	33 (26)	1 (1)	78 (80)	11 (15)	24 (15)	0 (0)	33 (44)	45 (54)
Nominal	0 (3)	96 (94)	0 (2)	77 (75)	10 (22)	86 (88)	34 (12)	43 (37)

Notes: Each of the rows shows the percentage of the forecast-error variance explained by a particular shock. The forecast horizon is 0 (4) quarter(s) for the nominal US dollar exchange rate, and 4 (8) quarters for the relative GDP deflator *vis-à-vis* the United States. Each of the VAR models is estimated with six lags of the endogenous variables and the shocks are identified by a long-run triangular Choleski identification scheme.

Model 1 of Table 2 is a bivariate VAR model which only includes the real exchange rate and relative prices.[16] Several authors including Lastrapes (1992) and Enders and Lee (1997) have used this model to decompose the real exchange rate into real and nominal factors. The identifying assumption is that nominal shocks have no permanent effect on the real exchange rate.[17] As can be seen from Table 2, in the period before 1989, real shocks explain 99 per cent of the contemporaneous innovations in the nominal exchange rate, but contribute very little to relative price movements. In contrast, nominal shocks that explain most of the movements in relative prices are not reflected in the nominal exchange rate. For Australia, these results appear quite robust over the whole sample period, suggesting that nominal exchange-rate innovations do not contain much information concerning future inflation. In Canada, however, a remarkable shift can be detected in the second subsample: nominal shocks now explain more than 40 per cent of the contemporaneous exchange-rate innovations.

16. From these two variables the impact on the nominal exchange rate reported in Table 2 can be derived.
17. An alternative, more neutral, view is to interpret the shocks as permanent and temporary innovations to the real exchange rate.

One reason why real shocks are estimated to have only limited effects on relative prices may be that in fact they are a mixture of real supply and real demand shocks. As these shocks have opposite effects on relative prices, the limited price response of the combined shock may be the result of this misspecification. Clarida and Galí (1994) distinguish between supply and demand shocks by adding relative output to the VAR system. The supply shock is then identified by the assumption that only this shock can have an impact on relative output in the long run.[18] Model 2 of Table 2 reports the results from this decomposition for Australia and Canada. The dichotomy between relative prices and exchange rates remains in the earlier period. However, supply shocks are relatively more important than demand shocks in explaining exchange-rate innovations in the Australian dollar. Reviewing the results for the second subsample, it is again clear that nominal shocks are a more important source of exchange-rate innovations in Canada. However, in this period real demand shocks also contribute to the variation in relative prices in Australia.

Following Fisher (1996), I include the terms of trade instead of relative output in model 3 of Table 2 . Since both countries are net exporters of resource-based commodities and net importers of manufactures, it is not surprising that variations in the terms of trade have historically been an important determinant of the real exchange rate in both countries.[19] The identification scheme is the same as in model 2. Since both Australia and Canada are relatively small economies, the assumption that domestic real and nominal shocks cannot affect the terms of trade in the long run is probably reasonable. The results show that terms-of-trade shocks are a much more important driving force behind current exchange-rate innovations in Australia (65 per cent) than in Canada (20 per cent) (Figure 2).[20] The fact that such persistent terms-of-trade movements have only negligible effects on relative prices, may be viewed as evidence that the large exchange-rate response is effective in preventing these shocks from spilling over in domestic inflation.

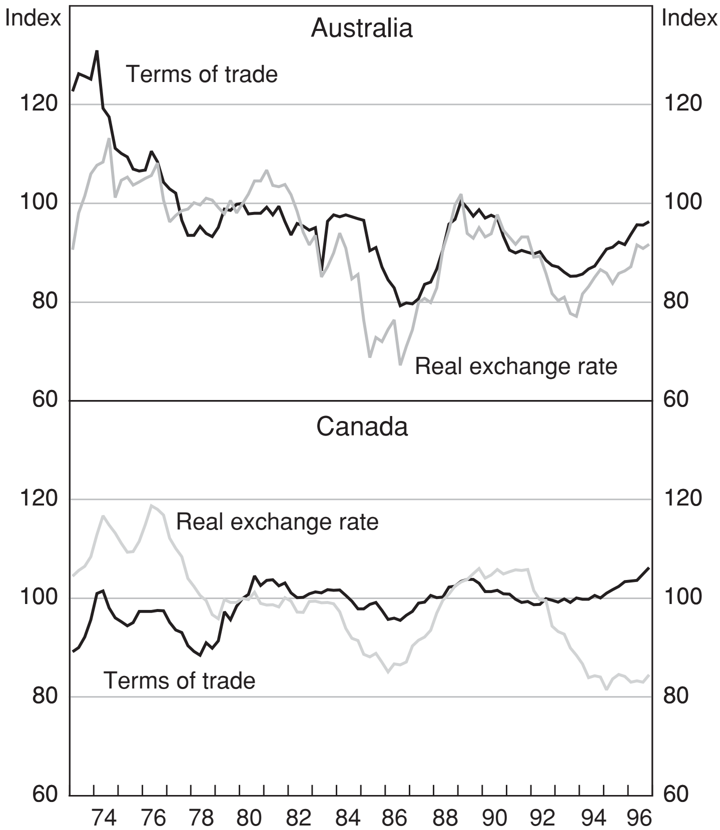
Overall, the results in Table 2 show that terms-of-trade and supply shocks contribute more to exchange-rate innovations in Australia, while in the most recent period nominal shocks contribute more in Canada. Together with more direct evidence that risk-premium shocks due to fiscal sustainability and political problems have been important in Canada during the 1990s (Clinton and Zelmer 1997), this evidence suggests that the source of the exchange-rate shocks can in part explain the different attitude towards the exchange rate of the Reserve Bank of Australia and the Bank of Canada.

18. See Astley and Garrat (1996) and Chadha and Prasad (1996) for two applications of this methodology to the United Kingdom and Japan.

19. See, for example, Gruen and Wilkinson (1994) and Fisher (1996) for Australia, and Amano and van Norden (1995) for Canada.

20. The greater relevance of the terms of trade for the exchange rate in Australia is also confirmed by the cointegration analysis reported in Table A1. While I find a quite robust cointegrating relationship between the nominal exchange rate, relative prices and the terms of trade in Australia, it is much harder to find evidence to that effect in Canada. Amano and van Norden (1996) do find cointegration between the real exchange rate and terms of trade if they split the terms of trade into two components, one capturing energy-related sectors and the other capturing commodities versus manufactures. I was, however, not able to confirm their results using the quarterly data on the terms-of-trade variables at my disposal.

Figure 2: The Real Exchange Rate and the Terms of Trade



5. Conclusions

This paper consists of three sections. First, using a simple model and within the context of the central bank's objective of price stability, I discuss the optimal response of monetary policy to unexpected changes in financial-asset prices. The main conclusion of this analysis is that the optimal response depends on how the asset-price movement affects the central bank's inflation forecast, which in turn depends on two factors: the role of the asset price in the transmission mechanism and the typical information content of innovations in the asset price.

Second, I analysed the advantages and disadvantages of setting monetary policy in terms of an MCI. While using an MCI as the operating target may be useful in terms of practicality and transparency when asset-price innovations are primarily driven by financial shocks, I have highlighted two potentially serious limitations which in part follow from the simplicity of the MCI concept: first, the optimal weights are likely to vary over time, not least because interest rates and exchange rates affect the traded and non-traded goods sector differently; second, the MCI concept ignores the potentially useful informational and equilibrating role of asset-price innovations.

Third, I have estimated a policy reaction function for the Reserve Bank of Australia and the Bank of Canada and found that while both central banks strongly respond to deviations of inflation from their announced target, their short-term response to the exchange rate differs. While the Bank of Canada, consistent with the idea of an MCI, systematically raises interest rates in response to a depreciation of the exchange rate, the Reserve Bank of Australia does not respond. My analysis of the sources of exchange-rate innovations in the two countries suggests that in part this can be explained by the greater importance of terms-of-trade shocks in Australia and, during the more recent period, of nominal shocks in Canada.

In this paper I have focused on the role of asset prices in the central bank's pursuit of price stability. There are at least two other reasons why asset prices may play a role in monetary-policy formulation. First, the information in asset prices may be useful in the tactics of monetary policy. As much of the implementation of monetary policy is about communication and signalling, information from the financial markets about the expected direction of policy may be useful to both assess the appropriateness of a particular timing of policy actions and its effectiveness. Second, it is sometimes suggested that, to the extent that large and persistent asset-price misalignments may give rise to widespread financial instability, asset-price stability by itself should be an important objective of the central bank (Goodhart 1995). Indeed, the experience of the late 1980s, when many countries saw a sharp increase in the prices of real and financial assets which later proved to be unsustainable and led to large-scale losses in the banking sector, shows that the misallocation costs due to such misalignments can be large. Both of these issues deserve further attention in future research.

Appendix: Optimal Monetary Policy in the Model of Section 2.1

Since the central bank does not observe current prices, I follow Canzoneri *et al*. (1983) and Barro and Broadbent (1995) and assume that the central bank optimises the objective function by picking the perceived price level. To implement this approach, I first derive the contemporaneous price perception errors, and then rewrite the objective function (7) in terms of the perceived price level and the price perception errors.

Combining Equations (1) and (2) and rearranging, I express the price level as a function of expectational variables, current observable variables and the excess-demand shock,

$$p_t = \{E_{t-1}p_t + \gamma\alpha E_t(p_{t+1} - p_t) - \gamma\alpha R_t + \gamma\beta F_t + \gamma(\varepsilon_t^d - \varepsilon_t^s)\}/(1+\gamma\beta). \quad \text{(A1)}$$

Agents who use the current interest rate and asset price in making their current price predictions need estimate only the excess-demand disturbance, $\varepsilon_t^{xd} = \varepsilon_t^d - \varepsilon_t^s$, as they either know or can calculate all other terms on the right-hand side of Equation (8). Their current price prediction is therefore

$$E_t p_t = \{E_{t-1}p_t + \gamma\alpha E_t(p_{t+1} - p_t) - \gamma\alpha R_t + \gamma\beta F_t + E_t\varepsilon_t^{xd}\}/(1+\gamma\beta) \quad \text{(A2)}$$

and, combining Equations (A1) and (A2), their price perception error is

$$p_t - E_t p_t = (\varepsilon_t^{xd} - E_t\varepsilon_t^{xd})\gamma/(1+\gamma\beta) = \eta_t\,. \quad \text{(A3)}$$

Note that if agents observed current prices, they would be able to deduce from Equation (A1) the current excess-demand shock, in which case the price perception error would be zero. If central banks do not observe current output and prices, they can still potentially extract information about the current excess-demand shock from the observed asset prices. Indeed, Equation (3) can be rewritten in nominal terms as

$$R_t + F_t = \rho E_t^+ F_{t+1} + (1-\rho)E_t^+ y_t + \varepsilon_t^f\,. \quad \text{(3}''\text{)}$$

As the central bank does observe the left-hand side of Equation (3″), it observes a noisy measure of the asset-market participants' relevant expectations which may include information about current output and prices. Below I discuss how that information can be used to minimise the variance of η_t.

Optimal monetary policy

Equation (A3) can be used to rewrite the loss function in terms of the perceived current price level and a perception error,

$$L_t = (E_t p_t + \eta_t - E_{t-1}p_t)^2 + \chi(E_t p_t + \eta_t - \bar{p})^2\,. \quad \text{(A4)}$$

Differentiating this expression with respect to $E_t p_t$ yields,[21]

21. The underlying assumption is that the price perception errors are independent of monetary-policy behaviour.

$$(1+\chi)E_t p_t = E_{t-1} p_t + \chi \bar{p}\,. \tag{A5}$$

Imposing the rational-expectations condition, the equilibrium solution for the perceived price level is[22]

$$E_t p_t = \bar{p}\,. \tag{A6}$$

The central bank's optimal policy is to equate the perceived price level to its target.

The associated equilibrium price and output level is then[23]

$$p_t = \bar{p} + \eta_t \tag{A7}$$

and

$$y_t = \varepsilon_t^s + \eta_t / \gamma\,. \tag{A8}$$

The equilibrium output and price level differ from their targets to the extent that there are unexpected excess-demand shocks which the central bank cannot stabilise.

The next question is how the central bank should set the interest rate to achieve the optimal price level. Combining Equations (1) and (2), taking the central bank's expectations and substituting for the equilibrium price level, the optimal reaction function in terms of the nominal interest rate is given by[24]

$$R_t = \frac{\beta}{\alpha} F_t + \frac{1}{\alpha} E_t(\varepsilon_t^d - \varepsilon_t^s)\,. \tag{A9}$$

Policy interest rates will tighten in response to a perceived output gap and a rise in the asset price. Note that the size of the response to changes in the asset price depends on its impact on aggregate demand. If $\beta = 0$, i.e. the asset price does not play any role in the transmission mechanism, then policy will not respond to movements in the asset price. However, Equation (A9) tells only part of the story. Since the asset price may contain information about the current output gap, it may affect policy rates through its effect on perceived excess demand. Before turning to this case, I first solve for the equilibrium levels of the interest rate and asset price under symmetric information.

Interest rates and asset prices under symmetric information

Next I derive the equilibrium level of the interest rate and the asset price when the financial market has no additional information on current output and prices. Equation (A9) becomes

$$R_t = \frac{\beta}{\alpha} F_t + \frac{1}{\alpha}(E_t(\varepsilon_t^d - \varepsilon_t^s)) = \frac{\beta}{\alpha} F_t + \frac{1}{\alpha}(\delta \varepsilon_{t-1}^d - \varepsilon_{t-1}^s)\,. \tag{A10}$$

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22. Note that here the assumption that wage setters also do not observe current output and prices is important.

23. In general, this need not be the case. For example, if the central bank targets the inflation rate, the price forecast error will also depend on the past price perception error.

24. From here we assume that the price-level target is zero. Note that since current prices are not observed, neither the real interest rate nor the real stock price are known. In this case the perceived real interest rate and asset price equal the observed nominal interest rate and asset prices because the perceived price level and expected inflation are zero.

Moreover, using Equations (3), (4), (5) and (A7) and (A8) yields

$$F_t = \rho E_t F_{t+1} - R_t + (1-\rho)\varepsilon^s_{t-1} + \varepsilon^f_t . \tag{A11}$$

Combining Equations (A10) and (A11) yields a first-order difference equation in the nominal asset price,

$$F_t = \frac{\alpha\rho}{\alpha+\beta} E_t F_{t+1} - \frac{\delta}{\alpha+\beta}\varepsilon^d_{t-1} + \frac{1+(1-\rho)\alpha}{(\alpha+\beta)}\varepsilon^s_{t-1} + \frac{\alpha}{\alpha+\beta}\varepsilon^f_t . \tag{A12}$$

Solving Equation (A12) forward yields the equilibrium solution given in Equations (9) and (10)

Asymmetric information and the policy response to asset prices

Now I assume that the financial-market participants do have information about current output and prices, i.e. they observe the underlying supply and demand shocks. In this case the optimal response of policy rates is still governed by Equation (A9). However, this time there is a possibility that the asset price contains information about the current excess-demand shock. I solve the optimal response to the asset price in two steps. First, I postulate a particular form of the optimal interest-rate reaction function to the asset price and calculate the equilibrium asset price that would be consistent with such a reaction function. Given the expression of the asset price, I can then solve for the signal-extraction problem of the central bank and calculate the optimal response to the asset price.

In this case I can rewrite the optimal reaction function

$$R_t = \frac{1}{\alpha}F_t + \frac{1}{\alpha}(\delta\varepsilon^d_{t-1} - \varepsilon^s_{t-1}) + \frac{1}{\alpha}E_t(\xi^d_t - \xi^s_t) . \tag{A13}$$

The central bank estimates the current excess-demand shock using its knowledge of the current asset price. I postulate that the signal-extraction function is of the form

$$E_t(\xi^d_t - \xi^s_t) = -\lambda(F_t - E^-_t F_t) = -\lambda(F_t - \frac{\alpha(1-\rho)+1}{\alpha(1-\rho)+\beta}\varepsilon^s_{t-1} + \frac{\delta}{\alpha(1-\rho\delta)+\beta}\varepsilon^d_{t-1}) \tag{A14}$$

where λ is the response parameter that needs to be determined and E^-_t is the expectations operator based on the information set which excludes the current asset price.

Going through the same procedure as before, the solution to a more complicated first-order forward-looking difference equation in F_t becomes

$$\begin{aligned} F_t - E^-_t F_t = & -\frac{\alpha\delta\rho(1+\gamma\beta) - \alpha(1-\rho)(\alpha(1-\rho\delta)+\beta)}{(1+\gamma\beta)(\alpha+\beta) - \lambda(1+\gamma\beta+\alpha(1-\rho))(\alpha(1-\rho\delta)+\beta)}\xi^d_t \\ & + \frac{\alpha(1+\gamma\beta)((\alpha+\beta)(1-\rho)+\rho) - \alpha(1-\rho)(\alpha(1-\rho)+\beta)}{(1+\gamma\beta)(\alpha+\beta) - \lambda(1+\gamma\beta+\alpha(1-\rho))(\alpha(1-\rho)+\beta)}\xi^s_t \\ & + \frac{\alpha(1+\gamma\beta)}{(1+\gamma\beta)(\alpha+\beta) - \lambda(1+\gamma\beta+\alpha(1-\rho))}\xi^f_t \end{aligned} . \tag{A15}$$

Given this solution for the unexpected change in the asset price, I can now solve the signal-extraction problem as follows,

$$-\lambda = \frac{cov(\xi_t^d - \xi_t^s, F_t - E_t^- F_t)}{var(F_t - E_t^- F_t)}. \tag{A16}$$

This yields the following solution for λ,

$$\lambda = \frac{a\sigma_d^2 + b\sigma_s^2}{\frac{a}{\alpha(1-\rho\delta)+\beta}\sigma_d^2 + \frac{b(\alpha(1-\rho\delta)+1)}{\alpha(1-\rho\delta)+\beta}\sigma_s^2 + \frac{\alpha(1+\gamma\beta)}{\alpha+\beta}\sigma_f^2} \tag{A17}$$

with $a = \frac{\delta\rho(1+\gamma\beta)-(1-\rho)(\alpha(1-\delta\rho)+\beta)}{\alpha(1-\delta\rho)+\beta}$

and $b = \frac{((\alpha+\beta)(1-\rho)+\rho)(1+\gamma\beta)-(1-\rho)(\alpha(1-\rho)+\beta)}{\alpha(1-\rho)+\beta}$.

Table A1: Statistics

1973:Q1–1997:Q1

	Phillips-Perron unit root tests		Standard deviation		Correlation
	Australia	Canada	Australia	Canada	
Nominal US$ exchange rate	-1.43	-1.37	3.9	1.6	0.31
Relative GDP deflator	-1.41	-2.27	1.0	0.6	0.35
Terms of trade	-2.45	-2.73	2.4	1.5	0.33

	Johansen cointegration test				
	LR test		Cointegrating equation (CE)		
	No CE	At most one CE	Nominal exchange rate	Relative prices	Terms of trade
Australia	50**	11	1	-1.03 (0.13)	1.86 (0.26)
Canada	23	10	—	—	—

Notes: *(**) denotes rejection at 5(1) per cent significance level. All variables are in logs.

References

Amano, R. and S. van Norden (1995), ‘Terms of Trade and Real Exchange Rates: The Canadian Evidence’, *Journal of International Money and Finance*, 14(1), pp. 83–104.

Astley, M.S. and A. Garrat (1996), ‘Interpreting Sterling Exchange Rate Movements’, *Bank of England Quarterly Bulletin*, 36(4), pp. 394–404.

Banque de France (1996), ‘Les Indicateurs des Conditions Monetaires’, *Bulletin de la Banque de France*, 30, June, pp. 1–15.

Barro, R.J. and D.B. Gordon (1983), ‘Rules, Discretion and Reputation in a Model of Monetary Policy’, *Journal of Monetary Economics,* 12, pp. 101–120.

Bernanke, B. and M. Woodford (1996), ‘Inflation Forecasts and Monetary Policy’, mimeo.

Black, R., T. Macklem and D. Rose (1997), On Policy Rules for Price Stability, paper presented at the Bank of Canada Conference, ‘Price Stability, Inflation Targets and Monetary Policy’, Ottawa, 3–5 May.

Blanchard, O. and D. Quah (1989), ‘The Dynamic Effects of Aggregate Demand and Supply Disturbances’, *American Economic Review*, 79(4), pp. 655–673.

Boyer, R.S. (1978), ‘Optimal Foreign Exchange Market Intervention’, *Journal of Political Economy*, 86(8), pp. 1045–1055.

Broadbent, B. and R.J. Barro (1997), ‘Central Bank Preferences and Macroeconomic Equilibrium’, *Journal of Monetary Economics,* 39(1), pp. 17–43.

Canzoneri, M. and D.W. Henderson (1991), *Monetary Policy in Interdependent Economies*, MIT Press, Cambridge, Massachusetts.

Canzoneri, M., D.W. Henderson and K.S. Rogoff (1983), ‘The Information Content of the Interest Rate and Optimal Monetary Policy’, *Quarterly Journal of Economics*, 98(4), pp. 545–566.

Chadha, B. and E. Prasad (1996), ‘Real Exchange Rate Fluctuations and the Business Cycle: Evidence from Japan’, IMF Working Paper No. 96/132.

Clarida, R. and J. Galí (1994), ‘Sources of Real Exchange Rate Fluctuations: How Important are Nominal Shocks?’, *Carnegie-Rochester Conference Series on Public Policy*, 41, pp. 1–56.

Clarida, R., J. Galí and M. Gertler (1997), ‘Monetary Policy Rules in Practice: Some International Evidence’, mimeo.

Clinton, K. and M. Zelmer (1997), ‘Aspects of Canadian Monetary Policy Conduct in the 1990s: Dealing with Uncertainty’, in BIS, *Implementation and Tactics of Monetary Policy*, Conference Papers Vol. 3, pp. 169–199.

Cumby, R.E., J. Huizinga and M. Obstfeld (1983), ‘Two-Step Two-Stage Least Squares Estimation in Models with Rational Expectations’, *Journal of Econometrics*, 21(3), pp. 333–355.

Debelle, G. (1996), ‘The Ends of Three Small Inflations: Australia, New Zealand and Canada’, *Canadian Public Policy*, 22(1), pp. 56–78.

Duguay, P. (1994), ‘Empirical Evidence on the Strength of the Monetary Transmission Mechanism in Canada – an Aggregate Approach’, *Journal of Monetary Economics*, 33(1), pp. 39–61.

Enders, W. and B.S. Lee (1997), ‘Accounting for Real and Nominal Exchange Rate Movements in the Post-Bretton Woods Period’, *Journal of International Money and Finance*, 16(2), pp. 233–254.

Estrella, A. (1996), ‘Why do Interest Rates Predict Macro Outcomes? A Unified Theory of Inflation, Output, Interest and Policy’, Federal Reserve Bank of New York Research Paper No. 9717.

Fisher, L.A. (1996), 'Sources of Exchange Rate and Price Level Fluctuations in Two Commodity Exporting Countries: Australia and New Zealand', *Economic Record*, 72(219), pp. 345–358.

Freedman, C. (1994), 'The Use of Indicators and the Monetary Conditions Index in Canada', in T.J.T. Balino and C. Cottarelli (eds), *Frameworks for Monetary Stability – Policy Issues and Country Experiences*, IMF, Washington D.C., pp. 458–476.

Fuhrer, J. and G. Moore (1992), 'Monetary Policy Rules and the Indicator Properties of Asset Prices', *Journal of Monetary Economics,* 29(2), pp. 303–336.

Gerlach, S. and F. Smets (1996), 'MCIs and Monetary Policy in Open Economies under Floating Rates', mimeo.

Goodhart, C. (1995), 'Price Stability and Financial Fragility', in K. Sawamoto, Z. Nakajima and H. Taguchi (eds), *Financial Stability in a Changing Environment*, Macmillan, Basingtoke.

Grimes, A. and J. Wong (1994), 'The Role of the Exchange Rate in New Zealand Monetary Policy', in R. Glick and M. Hutchinson (eds), *Exchange Rate Policy and Interdependence*: *Perspectives from the Pacific Basin*, Cambridge University Press, New York.

Gruen, D.W.R. and J. Wilkinson, (1994), 'Australia's Real Exchange Rate: Is it Explained by the Terms of Trade or by Real Interest Differentials?', *Economic Record*, 70(209), pp. 204–219.

Hansen, L. (1982), 'Large Sample Properties of Generalised Method of Moments Estimators', *Econometrica*, 50(4), pp. 1029–1054.

King, M. (1997), 'Monetary Policy and the Exchange Rate', *Bank of England Quarterly Bulletin*, 37(2), pp. 225–227.

Lastrapes, W.D. (1992), 'Sources of Fluctuations in Real and Nominal Exchange Rates', *Review of Economics and Statistics*, 74(3), pp. 530–539.

Longworth, D. and S. Poloz (1995), 'The Monetary Transmission Mechanism and Policy Formulation in Canada: an Overview', in BIS, *Financial Structure and the Monetary Policy Transmission Mechanism*, March, pp. 312–323.

Lowe, P. and L. Ellis (1997), 'The Smoothing of Official Interest Rates', paper presented at this conference.

Poole, W. (1970), 'Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model', *Quarterly Journal of Economics,* 84(2), pp. 197–216.

Smets, F. (1995), 'Central Bank Macroeconometric Models and the Monetary Policy Transmission Mechanism', in BIS, *Financial Structure and the Monetary Policy Transmission Mechanism*, March, pp. 225–266.

Svensson, L.E.O. (1997), 'Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets', *European Economic Review*, 41(6), pp. 1111–1146.

Taylor, J.B. (1993), 'Discretion versus Policy Rules in Practice', *Carnegie-Rochester Conference Series on Public Policy,* 39, pp. 195–214.

Taylor, J.B. (1996), 'Policy Rules as a Means to a more Effective Monetary Policy', Institute for Monetary and Economic Studies, Bank of Japan, Discussion Paper 96-E-12.

Woodford, M. (1994), 'Nonstandard Indicators for Monetary Policy: Can their Usefulness be Judged from Forecasting Regressions?' in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 95–115.

Discussion

1. David Gruen

Frank Smets has written an interesting and thought-provoking paper on the role of asset prices in the formulation of monetary policy. Of particular interest is his comparative analysis of Australia and Canada – two commodity-exporting economies that one might have thought would behave similarly, but which in fact differ in interesting ways. In my comments, I want to talk about some of the things that Smets discusses in his paper, as well as some things that he does not discuss. Let me begin with the things he discusses.

When thinking about asset prices and monetary policy in a small open economy like Australia, perhaps the first asset price that comes to mind is the exchange rate. Policy-induced changes in the exchange rate are an important transmission channel through which monetary policy affects both inflation and activity. The most rapid transmission channel from monetary policy to inflation in an open economy occurs via the exchange rate's effect on import prices. Other transmission channels eventually have a much larger impact on inflation, but they occur more gradually. The effect of changes in the exchange rate on activity arises, of course, because of the exchange rate's effect on the volume of exports and imports and, therefore, on activity in the export and import-competing sectors and the wider economy.

Not all changes in the exchange rate, however, are a reaction to interest-rates changes. When the exchange rate changes for reasons unrelated to monetary policy, these changes have implications for monetary policy. Smets makes the crucial point that, to understand what are the implications, one must take a view on what caused the exchange rate to change. For concreteness, think about an exchange-rate appreciation and assume that the appreciation is expected to last long enough to make a difference to the macroeconomy. For the sake of the argument, we should also assume that the appreciation has not been accompanied by any change in macroeconomic fundamentals; that is, it is purely a financial shock in Smets' terminology. In that case, the exchange-rate appreciation will have a contractionary effect on the economy, at least for some time. It will also put downward pressure on inflation. Other things unchanged, monetary policy should be eased in reaction to such an exchange-rate appreciation.

The alternative case is when the exchange rate is simply responding to a change in macroeconomic fundamentals. In Australia's case, the really important fundamental for the exchange rate seems to be the terms of trade. So let us assume that the terms of trade have risen, and that the exchange rate has risen one-for-one with the terms of trade. (This seems to be roughly the average response of the Australian trade-weighted exchange rate to a terms-of-trade change.) In this case, a back-of-the-envelope calculation suggests that the combined effect of the exchange-rate appreciation and the terms-of-trade rise is mildly expansionary for the domestic economy in the short run.[1] It also appears that the

1. Assume that the terms of trade rise is driven by a rise in the world price of Australia's exports, which is usually the case. If the exchange rate rises proportionately, the $A price of exports is unchanged, while the $A price of imports falls. If the price elasticity of imports was unity, then the fall in their $A price would raise the demand for imports sufficiently to leave nominal expenditure on imports unchanged. In that case,

net effect of the appreciation and the terms-of-trade rise is to reduce inflation in the short run (Gruen and Dwyer 1996).

So in the case of a terms-of-trade rise leading to an exchange-rate appreciation, output expands and inflation falls. For a central bank that cares about both medium-term price stability and output stabilisation, the appropriate monetary-policy reaction is ambiguous. The fall in inflation suggests an easing while the boost to output suggests a tightening. We do not have to resolve this ambiguity here; the important point is the one that Smets highlights. For monetary policy to react appropriately, one must take a stand on what caused the exchange rate to change.

This brings me to some of the interesting empirical results in the paper. Smets finds that terms-of-trade shocks are a much more important driving force for the Australian dollar than they are for the Canadian dollar. We have also noted this empirical regularity. The Australian exchange rate seems to respond more to the terms of trade than any other exchange rate we are aware of. Figure 1 shows how strong the relationship is for Australia, and how much stronger it appears to be than the corresponding relationships for Canada or New Zealand.

We are rather at a loss to understand why the Australian relationship is as strong as it is. We have done some empirical work suggesting that forward-looking participants in the foreign-exchange market ought to be able to profit from the inherent predictability of the terms of trade and their close medium-term relationship with the Australian dollar. Foreign-exchange market participants do not appear to exploit this relationship, at least not in sufficient numbers to weaken it significantly. I have even heard it said that the foreign-exchange market is just responding to all the research the Reserve Bank has published on the strength of the link between the Australian dollar and the terms of trade. If that is true, it seems like a novel example of central bank credibility.

Smets goes on to argue that differences in the source of exchange-rate shocks in Australia and Canada provide a key to understanding the different policy responses in the two countries. This seems to me a sensible conclusion to draw. I do think Smets overstates the argument when he claims that 'the Reserve Bank of Australia does not respond to changes in any of the financial prices including the exchange rate'. There have clearly been times when the behaviour of the exchange rate did lead to policy responses. The 35 per cent fall in the trade-weighted exchange rate over 18 months in the mid 1980s, and the 20 per cent fall in 1992–93 were both episodes which had a bearing on policy interest rates. Steve Grenville discusses these episodes in more detail in his paper for the conference. But the general conclusion that emerges from Smets' econometrics seems the right one. On average, monetary policy in Australia did not respond to changes in the exchange rate because these changes were driven largely by the terms of trade. By contrast, in Canada, the effects on domestic demand of changes in the exchange rate were not, in general, offset by income effects from the terms of trade, and so monetary policy in Canada was used to lean against the wind.

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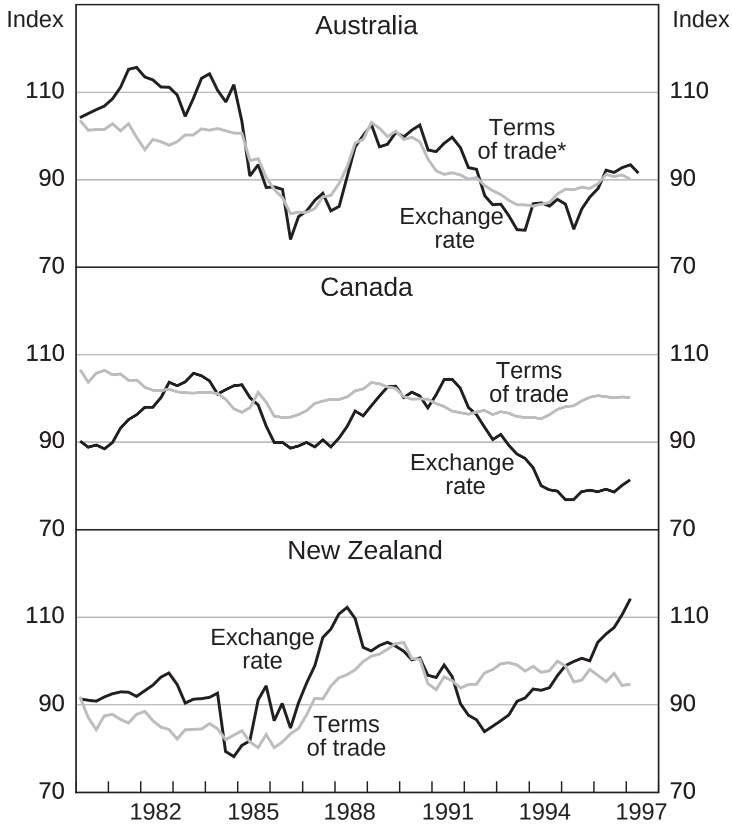
the rise in Australian real income implied by the improvement in the terms of trade would manifest itself solely as a rise in import volumes, at least in the first instance. In fact, the price elasticity of imports seems to be less than one (Dwyer and Kent 1993) implying that the fall in their $A price will result in a fall in expenditure on imports. As a consequence, some of the rise in Australian real income is available to be spent on domestic goods, which should have an expansionary effect on the domestic economy.

Figure 1: Real Effective Exchange Rate and Terms of Trade

Real exchange rate based on relative consumer prices



* Excluding computers.

Such considerations lead naturally to a discussion of the advantages and disadvantages of monetary conditions indices (MCI), and Smets spends some time on this. One of the problems he sees with a fixed-weight MCI is that interest rates and the exchange rate affect different sectors of the economy differently. Much the same could be said about the different sectoral impact of fiscal and monetary policy. Despite this, however, macroeconomists have spent a lot of time debating the trade-off between fiscal and monetary policy, fruitfully in my view. This seems to be the nature of practical macroeconomic analysis. While it would be nice to have a detailed understanding of the evolution of the whole economy on a more microeconomic, disaggregated basis, most practical macroeconomic analysis is done in terms of economy-wide aggregates.

My view on MCIs is that they can be useful in assessing the stance of monetary policy or, if you like, financial conditions, but that they should come with a warning label: ‘use with caution’. For Australia, it will come as no surprise when I say that it makes little sense to construct an MCI which weights together the interest rate and the exchange rate without making some allowance for the terms of trade.

When thinking about asset prices and monetary policy, there is a question which is not directly addressed in Smets' paper, but which I think is important. It has come up on a few occasions in this conference already. Let me conclude with an examination of this question. Does monetary policy have any special role to play when the policy-maker judges that an unsustainable asset-price bubble may be developing? Let us take as given that asset-price bubbles can have high social costs. Japan in the 1990s provides perhaps the most obvious example of this, but Australia in the late 1980s is also an example.

Smets' implicit answer to the question of whether monetary policy should respond is given at the beginning of his paper: 'The central bank's response to unexpected changes in asset prices should depend on how these changes affect the inflation outlook; if they imply a rise in the inflation forecast, policy should tighten and *vice versa*'.[2]

If the policy-maker suspects that an asset-price bubble is forming, it may raise his short-term inflation forecast, but lower his longer-term forecast, as he anticipates that the bursting of the bubble will have a disinflationary impact on the whole economy. But even these conclusions may not be robust. In the late 1980s in Australia, when the price of commercial property was rising rapidly, underlying consumer price inflation was slowly trending down. One might want to argue that the asset-price inflation threatened to spill over into consumer price inflation, and that may well be right. But the point is worth making that it is by no means assured that an asset-price bubble will eventually lead to higher consumer price inflation.

If that is the case, then the question becomes, should monetary policy seek to burst an asset-price bubble, even when developments in the asset market are expected to be consistent with acceptable outcomes for consumer price inflation and economic output over the policy horizon of the next year or two? The grounds for doing so would be that the larger the bubble becomes, the more costly it will be when it eventually breaks.

This seems like a pretty important question, but also a difficult one. Let me give just a few brief thoughts on it:

- How confident can policy-makers be that they can distinguish between an unsustainable asset-price bubble and a realignment of asset prices that is justified by fundamentals? This distinction is usually painfully clear with the benefit of hindsight, but the crucial decisions have to be made in real time.
- Is monetary policy the appropriate policy to deal with a suspected asset-price bubble, or should other (regulatory) instruments be used?
- If monetary policy is used, will the central bank's reputation suffer if it is seen to be the proximate cause of the busting of an asset-price bubble?
- Even if one is confident that a bubble is forming, are there criteria for deciding whether the bursting of the bubble will be costly? Presumably widespread leveraged buying of assets would be a danger sign. If financial institutions have lent money on the basis of asset values that are judged to be unrealistic, then the stability of the financial system is also an issue.
- Are some types of asset-price bubbles, for example property-price bubbles, intrinsically more of a worry than other types of bubbles?

2. Smets does revisit the issue of asset-price bubbles in the final paragraph of his paper, where he argues that the possibility of large and persistent asset-price misalignments is an issue deserving of further attention.

As ever, it is easier to raise these issues than to resolve them. But they are issues on which we need to take a view if monetary policy is to respond appropriately to some of the more troubling developments in asset markets.

References

Dwyer, J. and C. Kent (1993), 'A Re-examination of the Determinants of Australia's Imports', Reserve Bank of Australia Research Discussion Paper No. 9312.

Gruen, D. and J. Dwyer (1996), 'Are Terms of Trade Rises Inflationary?', *Australian Economic Review*, 114, pp. 211–224.

2. General Discussion

Discussion of the paper focused on two issues:

- the response of monetary policy to asset-price movements; and
- the role of a monetary conditions index in an inflation-targeting framework.

The discussion on the link between asset prices and monetary policy followed on from the discussion of Stephen Grenville's paper. At the conceptual level, there was reasonable agreement that there are two reasons why monetary policy might need to respond to asset-price movements. First, a change in asset prices may affect future output and inflation; for example, movements in the exchange rate have a clear impact on prices and the business cycle, and depending upon the circumstances, this may require a change in interest rates. Second, monetary policy may need to respond because of the potential for financial instability in the future if and when an asset-price bubble bursts. By bursting a bubble in its early stages, the costs of the instability might be avoided.

The debate centred on whether there were better instruments than monetary policy for dealing with these problems, and whether it was even practicable to use monetary policy to respond to asset-price bubbles.

Some participants argued that increasing interest rates to burst a bubble could have adverse consequences. When the bubble finally bursts there are likely to be strong contractionary effects: the lagged effect of high interest rates would restrain growth, the fall in asset prices would harm confidence and balance-sheet problems would see investment fall. In this situation, deflationary forces are likely to be strong. There was agreement that this creates a significant problem for monetary policy: should high interest rates be used in an attempt to burst the bubble, or should the authorities simply wait till the bubble bursts of its own accord? The choice was seen to depend upon an assessment of the costs of further asset-price inflation and the costs of high interest rates and falling asset prices.

Some participants suggested that other instruments be used. Clearly, if the asset-price movements are driven by distortions, those distortions should be removed. Some participants thought that the deregulation of the financial system in the 1980s had made the economy more prone to asset-price bubbles, and therefore more vulnerable to the ensuing asset-price deflation. Others noted that asset-price booms and busts had occurred in both the regulated and deregulated financial environment.

One suggested response to asset-price bubbles was to adjust prudential requirements. For example, collateral standards could be tightened when it was perceived that an asset-price bubble was developing. Some participants thought that prudential standards had not kept pace with the speed of financial deregulation and this had contributed to some of the problems in the 1980s, while others suggested that the tax system could be used to influence asset prices. However, some participants suggested caution, arguing that changes in prudential and taxation policy could have unintended side-effects such as encouraging the expansion of institutions which are not subject to prudential regulation.

It was noted that even if one had the right instrument, identifying asset-price bubbles, and their origins, is a difficult task. It was generally agreed that economic models of asset prices are inadequate. One clue to potential problems was seen to be the combination of rapid increases in asset prices and bank credit. There was no agreement on whether the increases in asset prices in Australia in the 1980s were the result of policies in Australia, or were simply part of a wider global phenomenon.

There was a brief discussion of the role of the exchange rate in an inflation-targeting framework. One point of view was that the exchange rate was simply one of the many variables that influences future output and inflation, and should not be accorded a special place in the monetary-policy framework. Others argued that since the influence of the exchange rate is so pervasive in small open economies, the central bank should focus its deliberations on a combination of the exchange rate and short-term interest rate. This argument has led some central banks to publish monetary conditions indices and to use them as a tool for explaining policy decisions, and a rough operational guide for policy in periods between formal monetary-policy meetings.

Evaluating Simple Monetary-policy Rules for Australia

Gordon de Brouwer and James O'Regan*

1. Introduction

Generally, the ultimate objectives of monetary policy are low and stable inflation and maximum sustainable economic growth. Central banks have increasingly sought to achieve these goals through the formulation of formal inflation targets. In pursuing such a target, most central banks use an overnight interest rate as the instrument of policy, but exactly how the instrument should be moved to achieve the objectives of policy is an issue of active debate. A number of simple interest-rate feedback rules have been proposed to assist in setting the overnight interest rate.

The aim of this paper is to analyse these rules in a simple but data-consistent framework of the Australian economy. We do this by trying to answer a number of questions. What sort of simple policy rule – for example, an inflation-only rule, Taylor rule or nominal-income rule – performs best? Given that the economy is subject to a variety of shocks, how much can policy stabilise the economy, and how steep is the trade-off between the variability of inflation and output? How do policy rules vary with changes in inflation expectations induced by the inflation target itself? Do simple rules which also let policy respond to other variables perform better than simple rules based on inflation and output alone? Finally, should policy rules be based on actual or expected values of the target variables?

The structure of the paper follows these questions. Section 2 reviews some terminology about feedback rules, and presents a simple empirical framework of the Australian economy which is used for analysis. Section 3 evaluates several interest-rate rules, and explores the properties of what appears to be the most efficient of these, the Taylor rule. Section 4 addresses how greater credibility can affect price-setting behaviour, and what this may mean for the economy and monetary policy. Section 5 examines whether information in addition to inflation and output improves the rule. Section 6 examines whether forward-looking, rather than backward-looking, rules more successfully stabilise the economy. The findings of the paper are summarised in Section 7.

2. Some Preliminaries

2.1 The use of simple rules

The focus in this paper is on simple interest-rate rules.[1] More generally, monetary-policy rules can focus on a number of financial variables, such as the short-term interest

* We are indebted to our colleagues at the Reserve Bank, particularly David Gruen, Philip Lowe and John Romalis, for helpful comments and discussion.

1. The literature on monetary-policy rules is enormous. Recent summaries are provided in McCallum (1990), Bryant, Hooper and Mann (1993), Hall and Mankiw (1994), Taylor (1996) and Bernanke and Mishkin (1997).

rate, money, credit or the exchange rate. Given that the operating instrument in Australia is the cash rate, however, it is natural to restrict analysis of rules to the overnight nominal interest rate. Moreover, as Edey (1997) argues, other financial variables do not seem to be viable instruments for Australia.

A simple rule is a reaction function, according to which policy is changed in response to the values of a few key variables. While a rule prescribes a certain course of action for policy, it is up to policy-makers whether they follow it or not. There have been proposals at various times for central banks to be bound by such rules – like Friedman's constant money-growth rule – but these are not practical since both the economy and policy are too complex to be summarised in a simple rule. Rather, the prescription provided by a rule can be thought of as a guide for policy-makers in setting the policy instrument.

The simple interest-rate rules examined in this paper are assessed with the aim of finding which rule, and what sort of reaction coefficients in a rule, are most efficient. Since stabilisation policy generally means maintaining low and stable inflation and keeping output at its potential, it is natural to define efficiency in terms of reducing the variability in inflation and the output gap as much as is possible. Accordingly, a policy rule is said to be efficient if the variability of either inflation or the output gap is minimised given the variability of the other. For any given rule, different reaction coefficients can yield different combinations of variability in inflation or output, so there is a frontier of efficient rules.

As explained in Section 3.1, we explore the properties of simple rules by assessing outcomes for a range of values for the reaction coefficients. Since this procedure is not based on the preferences of the monetary authority, the simple rule only reveals the possibilities for the trade-off between inflation and output variability, not which possibility is preferred. Furthermore, since the procedure does not use a maximisation routine, the efficient rules do not necessarily represent the technically best outcomes.[2]

2.2 A stylised representation of the Australian economy

In analysing empirical policy rules it is necessary to have a view on the basic structure of the economy and on how monetary policy affects it. The results depend, of course, on the structure used for analysis. In the simple framework used here, there are five endogenous variables (non-farm output, prices, unit labour costs, the real exchange rate and import prices), five exogenous variables (world output, world prices, the terms of trade, the world interest rate and domestic farm output) and one control variable (the short-term nominal interest rate). While the full set of estimated equations and data are listed in Appendix 1, the equations for the key endogenous variables may be summarised as:

$$y = f_y(\underset{+}{y^*}, \underset{+}{tot}, \underset{-}{rtwi}, \underset{+}{\Delta fy}, \underset{-}{r}) \tag{1}$$

$$p = f_p(\underset{+}{ulc}, \underset{+}{ip}, \underset{+}{gap}) \tag{2}$$

2. Lowe and Ellis (1997) in fact report that the efficient Taylor rules perform well relative to the technically best outcomes.

$$\underset{}{ulc} = f_{ulc}(\underset{+}{p},\underset{+}{gap}) \tag{3}$$

$$rtwi = f_{rtwi}(\underset{+}{tot},\underset{+}{r-r^*}) \tag{4}$$

where *y* is non-farm output, *tot* is the terms of trade, *rtwi* is the real exchange rate in terms of domestic currency (so a rise is an appreciation), *fy* is farm income, *r* is the real interest rate, *p* is the price level, *ulc* is unit labour costs, *ip* is import prices in domestic currency, *gap* is actual output less potential and an asterisk denotes a foreign variable.[3]

In the long run, Australian output is determined by foreign output (through demand and supply effects), the terms of trade and the real exchange rate (Equation 1).[4] To the extent that the real exchange rate is itself determined by the terms of trade (Equation 4), the effect of the latter two variables on output tends to net out, and so Australian output depends on foreign output. Output falls below its long-run path when the real interest rate lies above the so-called policy-neutral rate, which is the real rate when output is at potential and inflation is stable at the desired rate. This implies that in the notional long run, monetary policy does not have real effects. Monetary policy is assumed to affect activity over a period of time. Growth in farm output also has short-run effects on non-farm growth.

Consumer prices are modelled as a mark-up over import prices and unit labour costs, with the mark-up varying over the cycle (Equation 2). Import prices are affected by movements in world prices and the nominal exchange rate, with gradual, but eventually complete, pass-through. World prices are exogenous to a small economy like Australia, but the exchange rate is not. While the nominal exchange rate is unpredictable in the near-term, over longer periods of, say, quarters and years, it is fairly well explained by inflation differences between countries, the terms of trade and the real short-term interest differential (Equation 4). (Since the real exchange rate also enters the output equation, it provides a link between the real cash rate, output and inflation.) The other fundamental determinant of inflation is unit labour costs, or wages adjusted for productivity. Productivity growth is assumed to be constant, so growth in unit labour costs is synonymous with growth in wages. The empirical regularity has been that unit labour costs can be explained by recent past inflation and the recent strength of demand, but not by much else (Equation 3).[5] Both prices and unit labour costs are responsive to lags of the output gap.

3. The equation for import prices in Australian dollar terms is not listed here since it simply estimates the dynamics of pass-through from world prices and the exchange rate.
4. See McTaggart and Hall (1993), Gruen and Shuetrim (1994), de Roos and Russell (1996) and de Brouwer and Romalis (1996).
5. Treasury (1993) finds that unit labour costs rise one-for-one with inflation but fall as the unemployment rate exceeds the NAIRU and as the unemployment rate rises. De Brouwer (1994) finds that wages rise with inflation and increased labour demand (proxied by the difference between output and consumer prices) but fall as inside unemployment rises. An Accord dummy was also significant and lowered wage growth over the 1980s. Cockerell and Russell (1995) present a similar equation for unit labour costs.

Foreign output, foreign prices, farm output, the terms of trade and world real interest rates are exogenous in this system, and are modelled as univariate time series.

This stylised representation of the economy embodies a simple transmission process. The policy instrument is the nominal cash rate. Monetary policy reduces inflation by generating an output gap and an appreciation of the exchange rate. A rise in the nominal interest rate raises the real interest rate which affects output indirectly through the real exchange rate and directly through other mechanisms (Grenville 1995), generating downward pressure on wages and inflation. The appreciation of the nominal exchange rate induced by higher local interest rates also directly lowers inflation by reducing the Australian dollar price of imports. The initial effects of policy on inflation are through the exchange rate, with the output effects taking a relatively long while to feed through.

It is assumed that there is simple feedback between wages and prices. A positive 'shock' to wages is transmitted to prices, fed back into wages and so on. Price and wage inflation rise to a new level unless there is an offsetting negative shock or unless the gap between actual and potential output widens. An offsetting negative shock in this case would be a tightening of wages policy, as occurred, for example, under the Accord. A widening of the gap is effected by a tightening of monetary policy.

3. Which Simple Rule is Best?

There is a menu of rules for policy-makers to chose from, but some perform better than others. This section evaluates the most commonly discussed rules, and then examines the best of these in some detail.

3.1 Evaluating rules

The seven nominal-interest-rate rules evaluated are:

(rule 1) nominal-income-level rule $$i_t = \bar{r} + \pi_{t-1} + \gamma\left(py_{t-1} - py_{t-1}^T\right)$$

(rule 2) nominal-income-growth rule $$i_t = \bar{r} + \pi_{t-1} + \gamma\left(\Delta py_{t-1} - \Delta py_{t-1}^T\right)$$

(rule 3) price-level rule $$i_t = \bar{r} + \pi_{t-1} + \gamma(p_{t-1} - p_{t-1}^T)$$

(rule 4) Taylor rule $$i_t = \bar{r} + \pi_{t-1} + \gamma_1(\pi_{t-1} - \pi^T) + \gamma_2(y_{t-1} - \tilde{y}_{t-1})$$

(rule 5) inflation-only rule $$i_t = \bar{r} + \pi_{t-1} + \gamma_1(\pi_{t-1} - \pi^T)$$

(rule 6) change rule $$i_t = i_{t-1} + \gamma_1(\pi_{t-1} - \pi^T) + \gamma_2(y_{t-1} - \tilde{y}_{t-1})$$

(rule 7) constant-real-interest-rate rule $$i_t = c + \pi_{t-1}$$

where i indicates the nominal interest rate, $\bar{r}$ the neutral real interest rate, π the inflation rate over the past year, py nominal income, superscript T a target, p the price level, y real income, $\tilde{y}$ potential output, c an unspecified constant real interest rate, and γ a reaction parameter.

These rules set the current nominal interest rate on the basis of currently available information. While much of the literature on policy-rule evaluation uses current-dated variables (Bryant, Hooper and Mann 1993; Henderson and McKibbin 1993; Taylor 1993; Levin 1996), the rules in this paper are assessed using variables lagged one quarter since these are the most recent data at hand. This is done in order to evaluate the rules on the same real-time basis as decisions are actually made (Stuart 1996).

The first six of these rules set the nominal cash rate in response to the deviation of a variable, or set of variables, from a target. Rules 1 and 2 respectively tie the interest rate to deviations of nominal income from a target level or target growth rate. These rules both yield the same forecasts for nominal income, but the outcomes can be quite different since a growth rule allows levels-drift, in the sense that past shocks to growth are bygones once growth is back on target. Rule 3 is a variant of Rule 1, by which policy is changed when the price level deviates from the target price level. Rule 4 is a hybrid nominal-income rule by which policy is tightened when inflation is above target and output above potential. In contrast to the nominal-income-growth rule, it is the output gap, rather than output growth, that enters the reaction function. This rule, initially developed by Bryant, Hooper and Mann (1993) but usually called a Taylor rule (Taylor 1993), is widely acknowledged to describe the variables that are of most concern to central banks. Rule 5 is an inflation-only rule, a special case of the Taylor rule when policy responds only to deviations of inflation from target. Both the Taylor rule and the inflation rule are tied to the inflation target, but the Taylor rule also responds to the output gap. Note that 'inflation target' and 'inflation rule' are distinct concepts: the former describes a policy objective, the latter a trigger for changing the policy instrument.

Rules 1 to 5 also include two other variables, the neutral real interest rate and the prevailing inflation rate. This means that if the reaction variables – nominal income, the price level, inflation or output – are at their target value, then the nominal interest rate equals the neutral real interest rate plus the inflation rate. The economy is in equilibrium, and so policy is neutral.[6] Rule 6 is a variant of the Taylor rule, by which the nominal rate is changed when inflation deviates from target and output deviates from potential. It reacts to the same target variables as a Taylor rule, but is not explicitly grounded to the neutral real interest rate.[7]

Rule 7 states that the real interest rate should be kept constant. This rule has been proposed, for example, on the view that fiscal policy should stabilise output, while monetary policy should stabilise the inter-temporal price of consumption – the real interest rate (Quiggin 1997).

Since the Reserve Bank of Australia has a formal inflation target, aimed at keeping average inflation at between 2 to 3 per cent over the course of the business cycle, the inflation target is set at $2^1/_2$ per cent.[8] For comparability, the target price level in Rule 3

6. Including the inflation rate means that the nominal-interest-rate rule is also a real-interest-rate rule, since the real interest rate is just the nominal rate less expected inflation, which is proxied by past inflation.

7. It is, however, implicitly grounded on the real neutral interest rate since the nominal rate will only be constant when inflation is at target and output is at potential. Output is only stable at potential when the real interest rate is at its neutral value.

8. See Debelle and Stevens (1995) and Grenville (1997a) for a discussion of this target.

grows at $2^1/_2$ per cent a year. Potential output grows at its average growth over the past 15 years, which is about 3 per cent a year. Target nominal income growth is about $5^1/_2$ per cent a year, and, again for comparability, the target level for nominal income also grows at about $5^1/_2$ per cent a year. The empirical analysis, trade-offs and discussion in this paper do *not* depend on the specific values of these variables. (Since the constant terms in the equations are calibrated to these values, all they do is 'close' the system without influencing the outcome.)

The properties of the system for different rules are explored using simulation analysis for each rule with different coefficient values in the reaction function. The initial range of values is 0 to 2 with increments of 0.1, but the increments are lowered if the system is unstable at low weights. This range encompasses the figures used in Taylor (1993) and Bryant, Hooper and Mann (1993). There are 10 equations for the five endogenous and five exogenous variables, and these are estimated from September 1980 to September 1996. The simulations for each rule and set of weights are run over 1 000 periods, using random errors for each equation which embody the historical covariance of these 'shocks'.[9] The methodology is explained in more detail in Appendix 2. Each rule is evaluated using the same set of shocks. The shocks to the exogenous variables interact with their data-generating processes to create cycles similar to those of the past 15 years. This paper complements Debelle and Stevens (1995) which explored the trade-offs between variability in inflation and the output gap in a simpler framework.

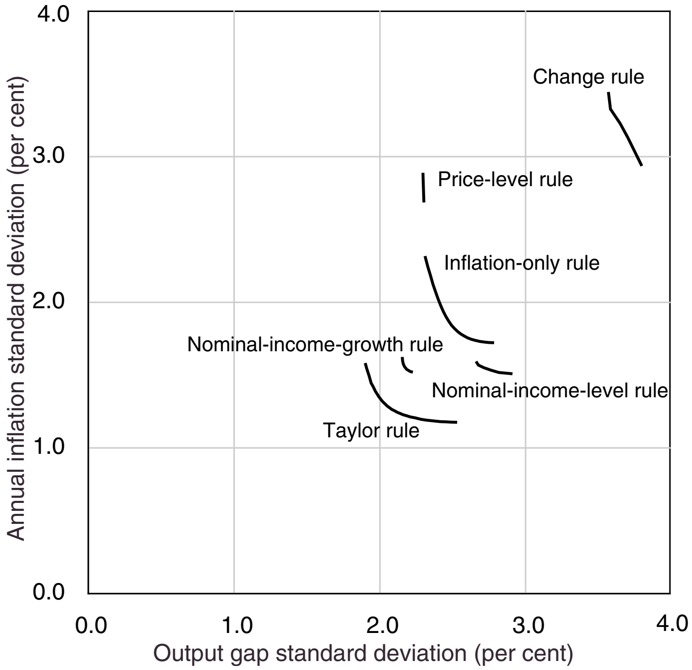
Using the simulated outcomes, we calculate the standard deviations of the output gap and inflation for each of these policy rules. As explained above, a rule specification is efficient if it minimises the variation in the output gap, given the variability in inflation, or *vice versa*.[10] The efficient frontiers for the first six rules are graphed in Figure 1. The length of the efficient frontier can differ between rules. The vertical axis shows the standard deviation of annual inflation; the horizontal axis the standard deviation of the output gap.[11]

9. An alternative way to simulate the system would be to run it for each rule and set of weights over, say, 60 periods (15 years), and repeat the exercise many times with a new set of random errors. The method used is broadly equivalent to running the system over 60 periods with 15 different sets of random errors, but with the economy in equilibrium only at the start of the first run. It may be more realistic to evaluate rules from a point of initial disequilibrium than equilibrium. Moreover, the 1 000-period horizon has the advantage of showing the different long-run properties of particular variables, particularly of the price level and the nominal exchange rate, under different regimes. The trade-offs do not appear to be sensitive to the 1 000 shocks that were randomly drawn: we tried several different seeding values but found no substantive difference in trade-offs. We also ran a simulation using bootstrapping techniques – making a random draw with replacement of the actual residuals – for the Taylor rule and found similar results. In this case, the minimum standard deviations for inflation and the output gap were about 1.5 and 2.0 respectively, with the weights on inflation ranging from 0.5 to 1.7, and those on the output gap ranging from 0.8 to 1.3 (with a mean of 1 and median of 0.9).

10. This criterion for efficiency indicates that the central bank cares about inflation and output separately, rather than their amalgam in the form of nominal income. One way to think about this is that if nominal income growth is $5^1/_2$ per cent, for example, policy-makers *at each and every period* are not indifferent between growth of $5^1/_2$ per cent with zero inflation and zero growth with $5^1/_2$ per cent inflation.

11. Annual, rather than quarterly, inflation is used since it is the focus of the Reserve Bank's inflation target. Moreover, annual inflation is less volatile than quarterly inflation since it averages out some of the noise in the quarterly series. Also, the ranking of the rules does not change if the outcomes are plotted in terms of the standard deviations of annual inflation and output *growth*.

Figure 1: The Efficiency of Different Rules



What is most striking about Figure 1 is that none of the efficient frontiers for any of the rules even gets close to reducing the variability in inflation or output to zero. There is an irreducible variability in inflation and output – policy can help minimise fluctuations in inflation and output, but it cannot get rid of them altogether. In terms of the economic framework used here, the policy rule that unambiguously does this best is the Taylor rule. But even in this case, there is still considerable variability in the economy. For example, an efficient Taylor rule keeps annual inflation within a bound of 0 to 5 per cent, or annual growth within a bound of -1 to 7 per cent, 95 per cent of the time.

The Taylor rule clearly dominates an inflation-only rule since it yields not only lower output variability, as would be expected, but also substantially lower inflation variability. In the analytical framework used in this paper, inflation is largely determined by recent domestic excess demand, either directly or indirectly through wages. As such, current demand is an important predictor of future inflation: reacting to the strength of demand now, as embodied in the output gap, lowers the overall variability of inflation. This is important. Even if a central bank cares only about inflation, it can stabilise inflation more if it responds not just to the deviation of inflation from target but also to the state of demand. This confirms Ball's (1997) analysis and is discussed in more detail in Section 3.2. (For similar reasons, a nominal-income-level rule is superior to a price-level rule.)

The change rule is stable only for a few, very low, weights on inflation and output. It is not difficult to see why. The change rule dictates that policy is continually changed until inflation is at target and output at potential, without reference to the level of the interest rate. Policy, however, operates with a lag, and so by the time inflation and output are where the central bank wants them to be, the forces are already in train to move them off. If lags are important, as the econometric evidence suggests (Gruen and Shuetrim 1994; Gruen, Romalis and Chandra 1997), then this rule is particularly undesirable since it puts policy on a knife-edge – if policy-makers make a small mistake with such a rule, putting just a little too much weight on the target variables, the system becomes dynamically unstable. This is not the case with the Taylor rule, indicating that the level of the interest rate needs to be kept in mind when interest rates are changed.

The Taylor rule is not only better than other rules which respond to deviations of inflation from target, but, at least in the framework used here, it is also superior to nominal-income rules, in either growth or levels form, and to price-level rules.[12] Consistent with Ball's (1997) model, nominal-income rules are relatively inefficient, with the efficient frontier lying outside the Taylor-rule frontier. If inflation rises, interest rates rise and output falls. As inflation is brought back to target, output should be brought back to potential, which implies that output growth is initially above trend but then stabilises at trend. A Taylor rule accommodates the initial rapid growth, since what matters is not whether growth is fast or slow, but how much spare capacity there is in the economy. A nominal-income rule, however, does not. Under a nominal-income-growth rule, for example, inflation plus the above-trend growth (which is needed to close the gap) violate the rule, and policy is tightened, pushing inflation and output down. The economy is set on an unending series of cycles. Since the lags in the system are quite long, increasing the weight on nominal income beyond the weights in the efficient frontier soon makes the oscillations unstable.

This result is at odds with much of the literature on policy modelling, which finds that Taylor rules and nominal-income rules are basically on par.[13] The difference is that expectations are adaptive in this model rather than rational as is typical in the literature. An important implication of this is that inflation is more persistent than in rational-expectations models, and this tends to improve the performance of Taylor rules relative to nominal-income rules.[14] For example, if we make expectations more forward-looking and reduce the persistence of inflation, the efficient frontiers tend to move closer to the origin for both rules, but the move is relatively larger for the nominal-income rule. This

12. In the framework used here, unit labour costs respond to the output gap, and not also to output growth. If we include the change in the output gap in the unit labour cost equation, so that the *speed* with which the gap is closed also has a direct impact on inflation, then the Taylor rule still outperforms nominal-income rules. In this case, however, the Taylor rule should be augmented to include output growth, such that interest rates are higher the faster the output gap is closed after a recession.

13. See, for example, Bryant, Hooper and Mann (1993). Henderson and McKibbin (1993) and Levin (1996) find that a Taylor rule with a large weight on output performs relatively well. Hall and Mankiw (1994) and Levin (1996), however, conclude that the Taylor rule dominates nominal-income rules.

14. In a framework where interest rates change in response to actual values of particular target variables, the impact of an inflation shock on the path of inflation is smaller the more forward-looking are inflation expectations. In a rational-expectations model, for example, inflation expectations are tied to equilibrium inflation, which is the inflation target if policy is credible. Since the path of inflation, therefore, is less variable, interest rates and output are also less variable. This benefits the nominal-income-growth rule more than the Taylor rule, since, as explained in the text, nominal-income-growth rules respond to inflation plus the growth of output rather than inflation plus the output gap. Lower variability in inflation and output growth implies smaller oscillations, and hence a stronger policy response is less likely to make the system unstable.

highlights that the ranking of rules can depend on how one believes the economy works. Given the strong persistence of inflation and the observation that measures of inflation expectations lag actual inflation (Fuhrer 1995; Gagnon 1997), it seems appropriate to model inflation expectations as backward-looking.

Finally, a constant-real-interest-rate rule yields one value for the trade-off between the variability of inflation and the output gap, but this point is not shown in Figure 1, as the variance of inflation is technically undefined. If the real interest rate is kept constant, monetary policy does not respond to shocks to inflation, but accommodates them. If inflation rises, for example, the nominal interest rate rises by the same amount that inflation rose by. But inflation is not brought back to where it was before the shock, since the real interest rate, which is what affects activity and the real exchange rate, is unchanged. The path of inflation depends purely on past shocks to inflation. Such a rule is clearly not viable as a means to achieve an inflation target.

3.2 Properties of efficient Taylor rules

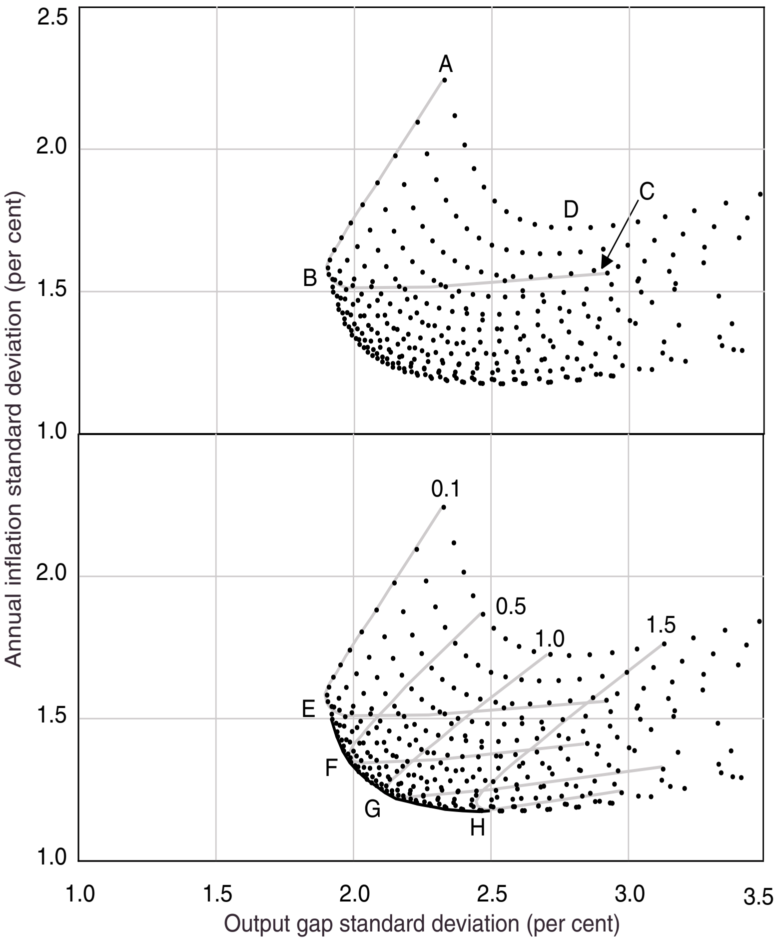
Figure 1 shows that, for the description of the economy used here, the Taylor rule is the most efficient. This section examines the properties of this rule in more detail. Recall that the Taylor-rule frontier in Figure 1 shows outcomes from the efficient Taylor rules. Here we look at the full set of outcomes for the rule for the range of reaction coefficients on inflation and output from 0 to 2. Figure 2 sets out the different combinations of variability in inflation and the output gap associated with different weights in the Taylor rule (with the outcomes confined to standard deviations at or below 3.5 per cent).

Panel 1 of Figure 2 shows the nature of the trade-offs between inflation and output-gap variability. This is repeated in panel 2, with the bottom envelope of the trade-offs constituting the efficient set shown in Figure 1. Consider point *A* in panel 1 where the weight on inflation is 0.1 and the weight on the output gap is zero.[15] As the weight on output is increased, with the weight on inflation kept constant, the trade-off moves down towards the origin, to point *B*, where the weight on output is 0.9, and then to point *C*. As the weight on output increases from *A* to *B*, the variability of *both* inflation and output falls. As argued in Section 3.1, excess demand is a key determinant of inflation, and so reducing the variability of output relative to potential helps to stabilise inflation. But there is a limit to this: if interest rates move too much in response to output, the stabilising properties of the rule are weakened, and the variability of inflation and output start to rise to point *C*, where the weight on output is 1.8. As shown in panel 2, this pattern is repeated when the constant weight on inflation is set higher, at, for example, 0.5, 1 and 1.5.

Analogous to the line *AB*, the points from *A* to *D* in panel 1 represent an increasing weight on inflation for a constant weight on output. Increasing the weight on inflation stabilises inflation but, unlike in the previous case, it increases the variability in output. While the output gap is a key predictor of inflation, in our simple framework the opposite is not true. Again, increasing the weight on inflation beyond the value associated with point *D* becomes counterproductive, and the variability in inflation starts to increase.

15. We do not show the outcomes which have a zero weight on inflation since the sample variance of inflation increases at rate *t*, and so approaches infinity as the sample size increases.

Figure 2: Inflation and Output Variability for Taylor Rules



Increasing the reaction of policy to inflation and output improves stability in inflation and output, but responding too much is counterproductive. A set of efficient Taylor rules is, therefore, well defined. This is shown in panel 2 as the highlighted collection of points closest to the origin of zero. The efficient frontier minimises the variability of either inflation or the output gap given the variability of the other.

This efficient set does not generally put the economy on a knife edge where the variability of inflation and output explode when the weights are just above the efficient weights. For example, the points that follow on from the line *AD* in Figure 2 represent higher weights on inflation that increase the variability in inflation, but they are certainly not explosive. Only if the weights on inflation and output are both relatively high (close to 2) does variability become explosive. In other words, inflation and output are only unstable when interest rates are moved around 'an awful lot'. Efficient Taylor rules are generally viable for policy since small mistakes do not have big consequences.

Table 1 summarises some key economic properties at different points on the efficiency frontier shown in panel 2 of Figure 2. The first column of data gives some of the actual properties over the 1990s. Then four outcomes are examined. Points *E* and *H* are the extremes of the frontier (with point *E* in panel 2 the same as point *B* in panel 1); *F* is the point where the sum of the variability in inflation and the output gap is minimised (that is, where the frontier is closest to the origin of zero). Point *G* is included so that points *E* through to *H* roughly represent equal-sized increases in the weight on inflation.

While the weight on inflation along the frontier varies from 0.1 to 1.5, the weight on output only ranges from 0.9 to 1.2 (with a mean of 1.06 and median of 1.1) in the empirical framework used here.[16] If lags are important and output helps to predict inflation, then the efficient rule puts a fairly high weight on output. Henderson and McKibbin (1993) and Levin (1996) report a similar result for large international economic models. Excess demand is an important determinant of inflation, both directly and indirectly through wages, but policy also has to respond to other systematic influences on inflation, such as effects through the exchange rate, and to inflationary shocks. The characteristics of inflation change substantially as the weight on inflation is increased. At *E*, for example, the weight on inflation is very low, and inflation variability and persistence high.

Table 1: Properties of the Efficient Rules

	Quarterly data	1990s	Point E	Point F	Point G	Point H
Weight	**Annual inflation**		**0.1**	**0.5**	**1.0**	**1.5**
	Output gap		**0.9**	**1.0**	**1.1**	**1.2**
Standard deviation:	Annual inflation	1.31	1.58	1.35	1.22	1.18
	Output gap	1.95	1.90	1.99	2.18	2.53
	Δ cash rate	0.73	0.91	1.06	1.32	1.71
Autocorrelation (1)	Annual inflation	0.96	0.96	0.95	0.93	0.92
Autocorrelation (2)		0.96	0.91	0.87	0.82	0.79
Autocorrelation (4)		0.70	0.76	0.64	0.52	0.41
Autocorrelation (1)	Output gap	0.92	0.90	0.90	0.91	0.91
Autocorrelation (2)		0.76	0.74	0.74	0.75	0.75
Autocorrelation (4)		0.25	0.38	0.36	0.33	0.28
Autocorrelation (1)	Δ cash rate	0.73	0.29	0.39	0.50	0.60
Autocorrelation (2)		0.65	0.18	0.23	0.31	0.41
Autocorrelation (4)		0.52	-0.10	-0.09	-0.08	-0.07
Δ cash rate:	Mean (absolute)	0.60	0.72	0.85	1.04	1.36
	Median (absolute)	0.50	0.60	0.70	0.88	1.11
	Reversals rate (%)[(a)]	0.26	0.43	0.39	0.35	0.28
	$\lvert\Delta\rvert > 0.5\%$ (%)[(b)]	0.48	0.57	0.64	0.69	0.77

Notes: (a) Per cent of observations that the sign of interest-rate changes reverses.
(b) Per cent of observations that the change in interest rates exceeds half a percentage point.

16. The efficient weights for the nominal-income-growth rule range from 2.75 to 3.65 inclusive, with increments of 0.05. For the nominal-income-level rule, the range is from 1 to 1.5 inclusive, with increments of 0.1.The efficient weights on the inflation rule are from 0.5 to 1.1 inclusive, and for the price level are 0.001 to 0.003. The efficient frontier for the change rule has a constant weight on inflation of 0.005, while the weights on the output gap range from 0.065 to 0.08.

Inflation is close to a random walk since policy hardly responds to inflationary shocks at that point. But as the weight on inflation rises, inflation variability and persistence fall.[17]

In this simple framework, the trade-off between inflation and output variability lies largely in the choice of the inflation weight in the reaction function. As in Debelle and Stevens (1995), the trade-off is convex: at relatively high levels of inflation variability, the costs to output stabilisation of moderating movements in inflation are quite small, but they get bigger and bigger as the variability in inflation falls. For example, increasing the weight on inflation by 0.1 at point *E* reduces the inflation standard deviation by 0.063 per cent and increases the output-gap standard deviation by 0.01 per cent, a trade-off rate of 1 to 0.15. But increasing the weight on inflation by 0.1 to arrive at point *H* reduces the inflation standard deviation by 0.0023 per cent and increases the output-gap standard deviation by 0.07 per cent, which is a trade-off rate of 1 to 30.

As the weight on inflation increases, the nominal cash rate becomes more variable and policy changes become bigger.[18] The fall in inflation variability associated with more weight on inflation increases the variability in the output gap, since output is not a function of inflation in this model, and so interest-rate variability has to increase. The mean absolute quarterly change of the nominal cash rate, for example, rises from about $^3/_4$ per cent to $1^1/_4$ per cent. The persistence of changes in the interest rate also increases, and the frequency of reversals declines.[19] This issue is discussed further in Lowe and Ellis (1997).

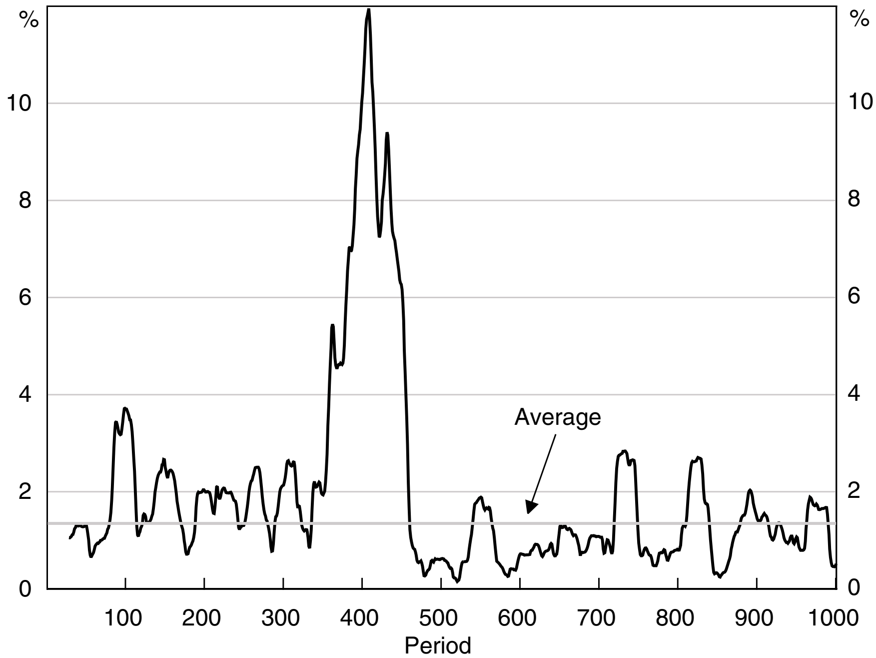
It is obvious that a simple feedback rule like the Taylor rule reduces, and does not eliminate, the amplitude of the cycles in inflation and output. The extent to which it can dampen fluctuations, however, depends on the sorts and size of shocks hitting the economy over time. It is much easier to meet an inflation target, for example, when inflationary shocks are small and offsetting. But big shocks can occur which push inflation off target. Figure 3, for example, shows the 7-year rolling standard deviation of inflation from target associated with Point *F* in Figure 2. A simple backward-looking rule applied mechanistically cannot ensure that inflation equals target inflation over every business cycle. This does not mean that the central bank has become less serious about inflation – the target and the responsiveness of the monetary authorities are unchanged

17. The results that follow are robust to a series of significant changes to the structure of the model. For example, the efficient weights on inflation and output do not change when the covariances between the shocks of the equations are set to zero, so that only the variances matter. The weights are also similar when key relationships, such as the sacrifice ratio or the speed with which policy directly affects output, are changed. The sacrifice ratio, which is the amount of output that is given up to reduce inflation, is estimated over the past 15 years to be about 6, which is quite high (Stevens 1992). Reducing this to 2.5, however, hardly alters the weights on the efficient frontier; it only increases the variability in inflation since output shocks feed more quickly into wages and inflation. Similarly, reducing the lags from policy to output by one period hardly changes the weights on the efficient frontier.

18. It should be noted that the real interest rate is occasionally negative. At point *E*, for example, with a neutral real rate of 3.5 per cent, the real interest rate is negative for 43 of the 1 000 periods, or about 4 per cent of the time (but the nominal interest rate is always positive). A low single-digit inflation rate target makes negative real interest rates much easier to achieve than an inflation target of zero.

19. It may seem odd that as policy is more active in responding to inflation, the persistence of interest-rate changes increases, but the increased correlation in interest rates is caused by smaller negative correlations between inflation and output.

Figure 3: 7-Year Average Inflation Standard Deviation for a Taylor Rule with (0.5, 1.0) Weights



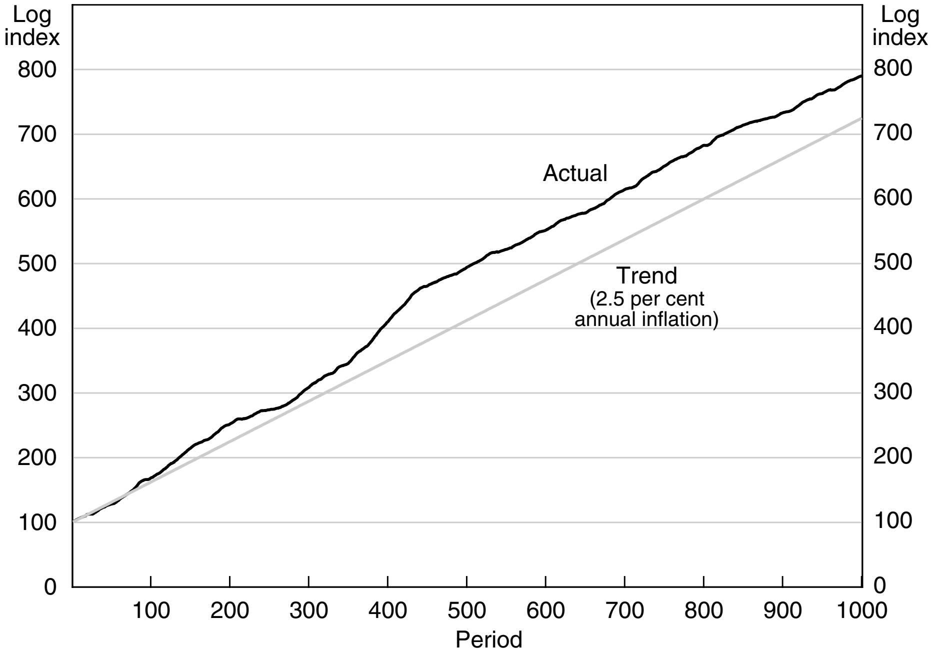
– but shocks may be sufficiently large at some point in time as to make the target difficult to achieve in the short term.

This also serves to highlight the difference between inflation and price-level rules. Given the Reserve Bank's inflation target, expected annual inflation over the course of a business cycle is $2^1/_2$ per cent. Similarly, if the Bank had a price-level target by which the price level was set to grow at $2^1/_2$ per cent a year, expected annual inflation would also be $2^1/_2$ per cent. But the outcomes for each of these targets may well differ. In an inflation-target regime, past deviations from target are bygones. But in a price-level-target regime, past deviations from target have to be corrected. Consequently, the price level is not stationary in an inflation-targeting regime, although it is in a price-level-target regime. This is apparent in Figure 4 which shows the history of the price level associated with Point *F* in Figure 2. Inflationary shocks permanently change the price level under an inflation target.

3.3 The unknowns in a Taylor rule

While the Taylor rule indicates how the policy instrument should be set based on what is currently known about inflation and output, it still contains two unknowns – the 'neutral' real interest rate and potential output. There is, in fact, considerable debate among economists about the 'true' value of these variables – witness the lively argument in the United States over the past few years about potential output and the natural rate of unemployment. Indeed, these values are probably changing over time, and estimates

Figure 4: The Price Level for a Taylor Rule with (0.5, 1.0) Weights



based on econometric and episodic analysis will tend to lag reality. (This highlights that even a policy rule based on the latest data still involves a lot of judgment on the part of policy-makers.)

Consider what happens when the central bank uses the rule mechanically and under-estimates potential output. In the first place, policy is tighter than it otherwise would be, and output and inflation both fall. Since inflation is falling and an output gap is emerging, interest rates are lowered. Output is brought back to its true potential, but inflation stays lower and does not return to target, since output has gone back to true potential but not exceeded it. Interest rates are stable, however, since inflation is now lower than the target rate by the exact amount that offsets the weighted difference between true potential output and the central bank's estimate of potential output which enters the Taylor rule.[20] A similar result follows when the central bank thinks that the neutral real interest rate is higher than it actually is, and so tries to keep interest rates higher than otherwise. In short, misperceptions of the neutral real rate or potential output generate a disinflationary recession or an inflationary boom, ultimately leaving the economy in equilibrium but with a different inflation rate.

20. Inflation will deviate from the target rate by $-\gamma_2/(1+\gamma_1)$ times the difference between true potential output and the central bank's judgment about potential output. When the central bank responds relatively strongly to inflation, inflation will end up closer to the inflation target than otherwise.

Putting a rule on auto-pilot is not viable. The appropriate response to uncertainty about the neutral real rate or potential output is to use a rule heuristically, or with learning, to find the true structure of the economy. If policy-makers' judgments are wrong, then, barring major shocks occurring at the same time, the course of output and the fact that inflation is stable but not at the target rate should tell policy-makers that they have policy too loose or too tight, and hence that they need to reassess their assumptions about the structure of the economy and the stance of policy.[21] This can be thought of as second-stage policy feedback from a policy rule. Indeed, the need to use common sense is reinforced by the likelihood that potential output and the neutral real rate are changing over time, with policy-makers striving to understand these changes.

Generally speaking, policy should not be less activist because of such uncertainty. In simulations, the response coefficients in the efficient rule do not fall as uncertainty or mistakes about potential output and the neutral real interest rate are introduced. For example, even if policy-makers persistently think that the real neutral rate is 0.5 per cent higher than its true value, or that potential annual growth is 0.5 per cent lower than its true value, the reaction weights on inflation and output in the efficient rule are very similar to before (although the overall variability of inflation and output is higher).

4. What are the Effects of Greater Credibility?

Analysis of rules using a fixed model is useful only so long as people do not substantially change their behaviour because of the operation of the rule (Lucas 1976). This applies, of course, to the results in this paper. But it is especially pertinent, since one of the primary motivations for introducing an inflation target – which underpins the Taylor rule – is that it induces a regime change by providing an anchor for inflation expectations. When an inflation target is credible, it should influence the behaviour of people, including price setters in labour, goods and financial markets.

While a credible inflation target can affect price setting in the gamut of markets, in the simple framework used here it is easiest to demonstrate what these effects may be by looking at the labour market, since this is the only market where price-setting is explicitly modelled. The analysis applies analogously to other price-setting behaviour in the economy.

Greater credibility of an inflation target can have at least three effects:

- It provides a nominal anchor for inflation expectations. An inflation target, if credible, can tie down expectations and hence prices and wages, making a reduction in inflation less costly than for simple backward-looking wage processes.
- It may reduce the number or size of 'shocks' since it signals a commitment by the central bank that it will not accommodate inflationary shocks. For example, if wage-setters obtain pay increases which make unit labour cost growth inconsistent with the inflation target, then the central bank is likely to tighten monetary policy. If wage-setters know this and care about employment, they will be less inclined to

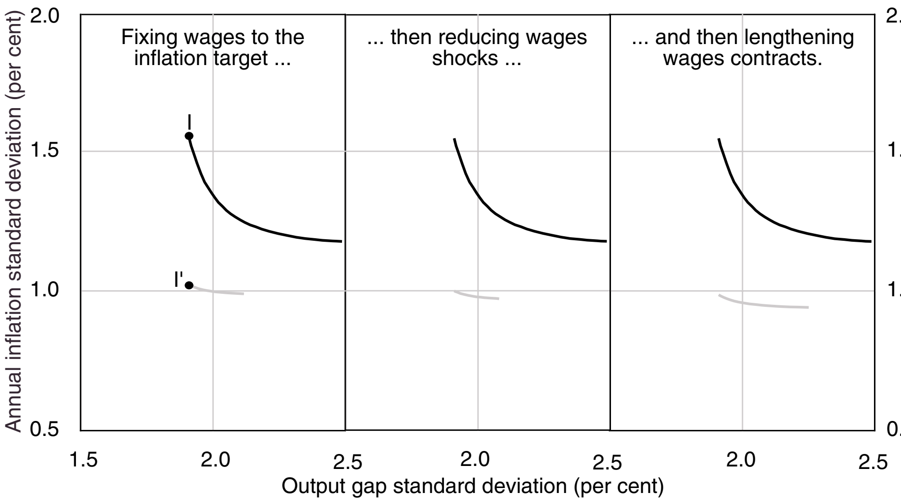
21. This also highlights the weakness of a constant real interest rate rule. If policy-makers want to set the real interest rate in a way which is consistent with output growing at potential, then they have no mechanism by which to judge whether the rate they choose is the right one or not.

pursue wage increases beyond the target rate of inflation and productivity growth. There should be fewer inflationary wage pushes as a result.[22]

- It tends to lengthen contracts since it stabilises inflation at a low rate. When inflation is variable, it is costly for both employees and employers to set wages too far ahead. As the fall in inflation in the early 1990s became seen as permanent, wage contracts lengthened (Department of Industrial Relations 1996). This slows down the speed with which changes in the interest rate feed through to prices, making it longer, and harder, for policy to bring inflation back to target after a shock. But as contract periods become longer, they are also likely to become staggered, with the effect that changes in the output gap are more muted than before, and variability in wages and prices smaller.

The consequences of a credible inflation target for the trade-off between variability in inflation and the output gap in efficient Taylor rules are shown in Figure 5. The effect of anchoring inflation expectations on the target is modelled by assuming that wage-setters set unit labour cost growth based on the central bank's inflation target, rather than past inflation, and on the strength of domestic demand (panel 1). The effect of smaller wages shocks on inflation and output variability is modelled by assuming that such shocks are (arbitrarily) half as big as they were before (panel 2). The effect of longer wages contracts is modelled by (arbitrarily) splitting wage-setters into four groups whose wages stay in effect for four periods (panel 3). The variability of both inflation and output falls in all three cases.

Figure 5: Inflation and Output Variability: Changing the Wages Process



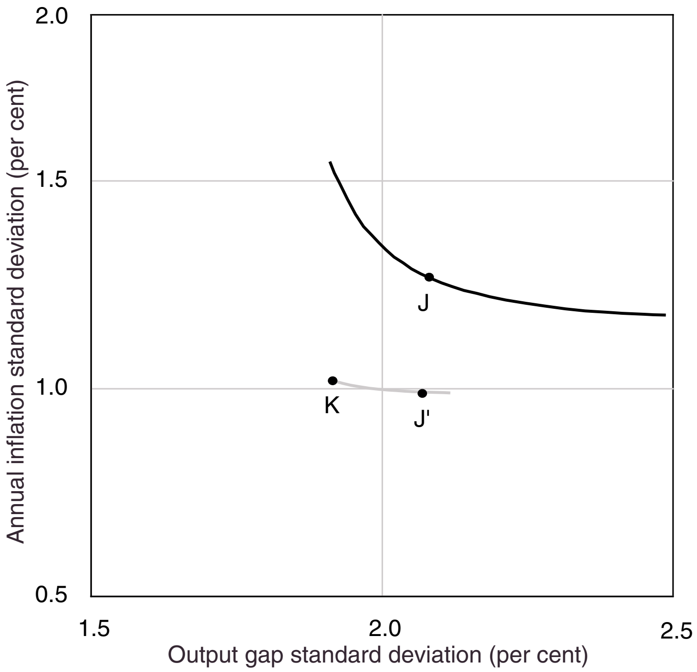
22. There are also other factors, like increasing international integration of goods markets, deregulation of labour markets and declining unionisation rates, which suggest that wages shocks in the future will be smaller or less frequent than in the past (Grenville 1997b).

When there is full credibility, so that wage-setters decide to fix the growth in unit labour costs to the central bank's inflation target, the variability in inflation and output falls. Anchoring wages shifts the efficient frontier from the black line to the grey line in the first panel. Points *I* and *I′* identify one point on each frontier for the same reaction function. The fall in inflation variability is striking, but perhaps not all that surprising since anchoring wages substantially reduces the variability in wages, and wages are a key part of the inflation process.

This does not mean that the output gains from credibility are negligible. Since inflation expectations do not change when inflation changes, the economy does not move onto a different short-run Phillips curve, which substantially reduces the output costs of stabilising inflation at target. This alters the trade-off between inflation and output variability, shown by the flattening of the efficiency frontier.

This has a profound implication for monetary policy: if policy is fully credible so that prices are linked to the inflation target, then policy can react more to output without compromising the commitment to low and stable inflation. Figure 6 is an enlarged version of the first panel of Figure 5. Suppose that the efficient frontier is given by the black line, and the preferences of the central bank are such that it choses point *J* where a one-unit reduction in inflation variability is roughly equivalent to a one-unit increase in output variability. At *J*, the inflation and output weights in the Taylor rule are 0.8 and 1, yielding a standard deviation in inflation and output of 1.26 and 2.08 per cent. When price-setters focus on the inflation target, rather than just past inflation, the efficient

Figure 6: Fixing Wages to the Inflation Target



frontier shifts to the grey line. If the central bank applies similar Taylor-rule weights, it then choses point J', with inflation and output standard deviations of 0.99 and 2.07 per cent. But the trade-off between inflation and output variability at J' is different to J, since the slope of the efficient frontier is different. If the central bank wants to maintain the same trade-off, the best it can do is to select point K, where inflation variability is only marginally higher than at J' (1.03 compared to 0.99) but output variability is considerably lower (1.90 compared to 2.07).

At K, the weight on inflation is lower than at J' but the weight on output is about the same. The authorities still care about inflation variability as much as before – the slope of the trade-off has not changed – but they do not need to react to inflation as much since anchored inflation expectations partly do the job for it. At K both inflation *and* output variability are substantially reduced. This underscores why central banks are so concerned that price-setters know about, and focus on, their inflation targets. The gains to the community are obviously much higher when prices and wages are centred on the inflation target rather than being dependent on recent past inflation.

The second panel of Figure 5 shows that when the size of wages shocks is halved, there is a further, but modest, fall in the variability of inflation and output.

The third panel shows that lengthening contracts also improves the trade-off, since it softens the impact of output shocks on inflation variability. When wages growth is tied to the inflation target, inflation shocks are not passed on into wages and hence are not fed back into the inflation process. But output shocks are still passed on into wages since wages are sensitive to the state of the cycle. Lengthening wage contracts, however, smooths out output shocks to some degree, and so directly reduces the variability in wages and inflation and indirectly reduces the variability in output.

Putting these three effects together, the largest gains come from price-setters taking the inflation target seriously. When policy is perfectly credible and the inflation target is fixed in the minds of price-setters, there is a new dynamic in the economy which forces the inflation rate to converge back to target, reducing the variability in both inflation and output. This has an important implication for the selection of policy regimes. Rules which focus explicitly on the inflation target, like a Taylor rule, are likely to yield larger credibility gains than those that do not, like a nominal-income rule (Bernanke and Mishkin 1997). It is instructive that inflation, not nominal income, is the object of the policy-target regimes that several central banks have introduced in the 1990s. Moreover, while the issue is obviously complex, this may suggest that the preferred weight on inflation may be initially higher than otherwise in order to establish the credibility of the inflation target, and so reap the gains of greater stability in both inflation and output.

5. Is the Simple Taylor Rule Efficient in an Open Economy?

The logic of a feedback rule is that the monetary-policy instrument responds to the variables which contain the most information about the ultimate targets of policy. In the Taylor rule, the nominal interest rate reacts to the inflation rate and output gap. In a simple model of a closed economy, inflation and output are the only two variables which determine the path of inflation and output over time. Other information variables do not need to be included in the reaction function (Ball 1997). But, in principle, it may be necessary to include other variables in a simple feedback rule if they have *extra* information about the ultimate targets of policy. This may be the case, for example, when the economy is open – so the exchange rate, foreign financial prices and foreign output matter for domestic inflation and output – or when labour has market power in setting wages. In this case, a simple rule premised on inflation and output alone is not necessarily efficient. The extent to which reacting to other variables helps reduce the variability of inflation and output depends on how the inflation and output processes – and the system of lags in particular – are specified.

In this exercise, we examine the reduction in variability from including unit labour costs and the real exchange rate in efficient Taylor rules. In the characterisation of the economy used in this paper, these variables start to affect inflation and output almost immediately but the full effect takes a long time. This suggests that there may be some gain to including these variables in the reaction function, although the amount of the gain is an empirical issue. We examine this by calculating the change in the variability of inflation and the output gap when the deviation of unit labour cost growth from $2^1/_2$ per cent (Equation 5), or the deviation of the real exchange rate from its equilibrium value (Equation 6), is included in a reaction function. The expanded Taylor rules are

$$i_t = \bar{r} + \pi_{t-1} + \gamma_1(\pi_{t-1} - \pi^T) + \gamma_2(y_{t-1} - \tilde{y}_{t-1}) + \gamma_3\left(\Delta ulc_{t-1} - \pi^T\right) \tag{5}$$

$$i_t = \bar{r} + \pi_{t-1} + \gamma_1(\pi_{t-1} - \pi^T) + \gamma_2(y_{t-1} - \tilde{y}_{t-1}) + \gamma_3\left(rtwi^* - rtwi_t\right). \tag{6}$$

Table 2 reports results of how the efficient frontier from a simple Taylor rule can be improved by considering other sources of information about future inflation and output. The first row lists selected inflation weights, and the next two the efficient weights on the output gap and wages associated with each inflation weight. The fourth and fifth rows report the change in the standard deviation in inflation and the output gap when wages are included. A negative number means that variability is reduced. The next set of rows repeats the exercise for the real exchange rate.

Consider, first, the effect of including deviations of annual unit labour cost growth from $2^1/_2$ per cent in an efficient Taylor rule. The reduction in inflation variability from responding to wages depends on how strongly policy is already reacting to inflation, with the response to wages becoming more muted, the more vigorous is the response to inflation. Wages depend on past inflation and the past output gap, so taking account of wages last period does little to reduce the variability in the system when the authorities are already moving the interest rate by a relatively large amount when inflation is away from target. Of course, if deviations of inflation from target elicit only a small policy reaction, better outcomes on inflation can be achieved by reacting more aggressively to deviations of unit labour cost growth from its target. Moreover, while the reaction coefficients on unit labour costs are relatively small on average, if the authorities can identify wages shocks then they are able to reduce inflation variability further by reacting more than the results above suggest.

Table 2 also includes the effect on the efficiency frontier of including the deviation of the real exchange rate from its equilibrium value in the reaction function. Since the

Table 2: Responding to Wages and the Real Exchange Rate

	Inflation weight					
	0.1	0.5	1.0	1.2	1.5	1.7
Output-gap weight	1.1	1.0	1.1	1.1	1.1	1.1
Wages weight	0.19	0.11	0.05	0.04	0.00	0.00
Δ inflation standard deviation	-0.14	-0.05	-0.01	-0.00	0.00	0.00
Δ gap standard deviation	0.08	0.05	0.05	0.04	0.00	0.00
Output-gap weight	1.3	1.3	1.2	1.2	1.2	1.2
Exchange-rate weight	0.02	0.02	0.01	0.02	0.04	0.06
Δ inflation standard deviation	0.00	0.00	0.00	0.00	-0.01	-0.01
Δ gap standard deviation	-0.01	-0.01	-0.01	-0.01	-0.02	-0.06

exchange rate for the current period is known, the current, rather than lagged, value is included. Efficiency gains accrue to both inflation and output: when the exchange rate is above its equilibrium value it is both disinflationary and contractionary, and so responding to the exchange rate reduces the variability in both inflation and the output gap. The weight on the exchange-rate deviation increases as the weight on inflation increases, and the reduction in the variability in inflation and the output gap increases as the weight on the exchange rate increases. If the level of the real exchange rate is out of alignment with fundamentals, say by 10 per cent, this rule suggests that the appropriate policy response is to move short-term interest rates by up to about half a percentage point, depending on inflation preferences.[23]

6. Is a Forward-looking Rule Better?

The policy rules discussed above set the interest rate based on the most recent available information, which we assume to be the data from the previous quarter. Output data for a particular quarter, for example, are usually released two to three months after the quarter has passed. Output and inflation are relatively persistent, as the autocorrelations in Table 1 indicate, so the recent past contains considerable information about the near future. By reacting to the most recent values of inflation and output, therefore, policy-makers capture some of the future movement in these variables. But the issue is whether policy-makers can stabilise the cycle more if they explicitly exploit this information by reacting to forecasts of the target variables.[24] This is examined in this section.

The forecasts of inflation and output used in the reaction function for this exercise are model consistent: they are the future outcomes implied by the system described in Section 2.2 when shocks in the current and future periods are not known and when the

23. Reacting directly to the terms of trade, which is the key determinant of the real exchange rate, is never efficient.

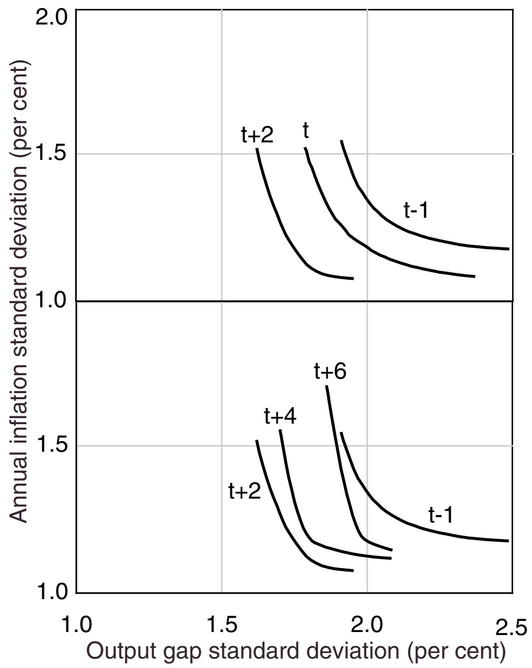
24. In a simple model where the policy instrument affects output with a lag and where output affects inflation with a lag, Svensson (1996) argues that it is optimal for policy-makers to set the nominal instrument using forecasts of inflation since this captures all relevant information.

nominal interest rate is unchanged from the period before the forecasts are made. In other words, they are no-policy-change forecasts. These forecasts are calculated for the current period and for the next six periods out. The current period is also a forecast since the outcomes – or, more specifically, the 'shocks' – have happened but are not yet known. Figure 7 shows the efficient frontiers of the Taylor rule for the base case (information at *t-1*) and some of the cases when values are predicted for the current and future periods.

Clearly, model-consistent forecasts of inflation and output improve the efficiency of policy since the variability of inflation and output declines. As shown in panel 1, even using forecasts for the current period, rather than just using information at hand, yields significant gains. The gains are largest two periods out from the current period, after which, as shown in panel 2, they start to contract back to the base case. This pattern of rising then declining gains reflects two offsetting features in the analytical framework.

On the one hand, given that policy takes at least two quarters to have a direct effect on output in this framework, setting policy based on forecasts of the target variables two or more periods ahead automatically allows for a significant part of the lag process. This ensures that policy is moved earlier and so can better stabilise the economy. This explains why more of the gains from being forward-looking accrue to output than to inflation. It also implies that if the lag structure is in fact much shorter than that used here, so that policy has a more immediate direct impact on output, then the gains from being forward-looking are likely to be smaller.

Figure 7: Forward-looking Efficient Frontiers



On the other hand, the longer the forecast time horizon, the more likely it is that unexpected events will drive future values of inflation and output from the forecast values. If policy reacts to forecasts that are not realised, then variability in inflation and the output gap rises. Moreover, a key assumption in this exercise is that the forecast nominal cash rate is unchanged over the forecast period. As the forecast horizon is extended and inflation evolves, the real interest rate changes and starts to have an impact on the real economy. This tends to increase variability in the system over longer forecast horizons. This impact is avoided, however, when policy-makers set an optimal path for the interest rate based on all available information, along the lines outlined in Lowe and Ellis (1997); in calculating this optimal path, policy-makers need to look at the expected path of the economy over the indefinite future.

It is also apparent that the trade-off between inflation and output variability steepens with longer forecast horizons. Reducing inflation variability comes, for the most part, with a smaller cost to output variability. Again, this relates to the lags in the system. Over longer horizons, policy is able to take advantage firstly of the lags between rate changes and output, and then of the lags between domestic demand and inflation, to reduce inflation variability. Since it does not have to wait until inflation is already in the system, the output costs of reducing the variability of inflation pro-actively are lower than otherwise.

What is not apparent from Figure 7 is that the pattern of weights in the efficient frontier changes in two ways as policy becomes more forward-looking. In the first place, policy becomes more activist.[25] For example, the median weight on output, which is 1.1 for the baseline rule, rises to 1.3 when forecasts for the current period are used, and then to 2, which is the top of the range examined, when forecasts for two periods are used. Past values of inflation and output may be good predictors of future inflation and output, but they are still imperfect. If policy responds too vigorously to past information, it generates additional instability. But forecasts generated from the system are better predictors of future inflation and output than past inflation and output themselves, and so policy is more activist when it has better information. To use a well-worn metaphor, everyone would drive more slowly if all they saw was the road behind them, and not the road in front.

This high degree of policy activism, however, probably exaggerates what is achievable in practice. The forecasts are model consistent – policy-makers are assumed to know how the economy works, they just do not know the shocks, and so they cannot be systematically wrong. But the actual economy is dynamic and policy-makers only learn the structure of the economy with a lag. This may recommend caution. Indeed, if the economy is evolving and policy-makers only learn about this gradually, the weights in an efficient forward-looking Taylor rule are smaller than otherwise.[26]

25. More activist policy is not the only, or main, reason why the variability of inflation and the output gap declines. If forecasts are fed into the rule with baseline weights, there is still a marked reduction in variability.

26. We tested this by estimating a forward-looking model where the coefficients in the equations of the system evolve over time. Policy is less activist when policy-makers learn the true model with a lag than when they know how the system is evolving.

Moreover, as Lowe and Ellis (1997) argue, policy change requires consensus, and it is much easier to persuade others with data than with someone's forecasts. The cold hard facts are more likely to generate consensus than an assertion about the outlook for the economy. Finally, greater activism implies that the nominal interest rate becomes more variable. For example, using weights which minimise the sum of inflation and output variability, the standard deviation of the quarterly change in the nominal interest rate is 1.1 per cent for the base rule but 2.4 per cent for the 2-period ahead forecast rule. This degree of variability is unprecedented, and may have other, deleterious, effects on the economy; see Lowe and Ellis (1997).

The second effect is that, for a given trade-off between the variability in inflation and the output gap, the relative weight on inflation increases as policy becomes more forward-looking. For example, the average ratio of the inflation weight to the output weight at points where the slope of the efficient frontier is 1, rises from about 0.6 for the backward rule to about 0.8 for the $t+2$ rule, and then to about 3 for the $t+6$ rule. The relative weight on the output gap is higher in a backward-looking rule since it helps predict future inflation. When the rule is forward-looking, however, the information about incipient inflation embodied in the output gap has already been exploited, and so the relative importance of the gap in further reducing the variability of inflation falls. Overall, the relative weight on inflation should increase as policy becomes more forward-looking.

7. Conclusion

This paper uses a data-consistent small open-economy model for Australia to assess the properties of various nominal interest-rate rules. We reach three main conclusions.

First, while no rule can eliminate all the variability in inflation and output, a rule is more efficient if it explicitly incorporates an inflation target. Efficient Taylor rules, which (like all Taylor rules) explicitly include the inflation target, reduce the variability in inflation and the output gap more than do price-level or nominal-income rules. This reduction is even larger if the inflation target is fully credible, with price and wage setters focusing on the central bank's inflation target, rather than recent inflation, in setting prices and wages. This suggests that an inflation target is also superior to a nominal-income target since it provides an identifiable anchor for inflation expectations.

Second, a feedback rule which pays considerable attention to the output gap substantially lowers the variability in inflation. Since inflation itself depends in part on the degree of excess demand, good policy focuses on the state of the business cycle in order to help stabilise inflation. Consequently, in a policy framework which is based on an inflation target, an efficient Taylor rule is preferred to a rule which only adjusts the nominal interest rate in response to deviations of inflation from target. But since inflation is also affected by factors other than excess demand, the nominal interest rate also has to respond to what is happening to inflation if the inflation target is to be met (and this response is relatively bigger, the more forward-looking policy becomes). Each efficient Taylor rule is distinguished primarily by the weight on inflation. Increasing this weight initially comes at a very low cost to greater output variability. But squeezing as much variability out of inflation as possible comes at the cost of considerably more variability in output.

Third, since the simple Taylor rule uses data from the previous quarter, any variable which provides information about inflation and output in current and future periods improves the efficiency of the rule. Efficiency can be modestly improved, for example, if policy-makers also take account of recent developments in wages and the real exchange rate. Interest-rate feedback rules can stabilise the economy much more, however, if they are forward-looking, rather than backward-looking, and so take some account of forecasts. Forward-looking policy is also more activist, and it reacts relatively more to inflation.

The numerical results in this paper are obviously model-dependent. A model with shorter lags, less persistence in prices, and a more detailed supply side may very well generate different results. As a consequence, the efficient rules and reaction coefficients discussed in this paper are largely illustrative. Nonetheless, the general conclusions that monetary policy should focus on an inflation objective, should take account of the output gap, and should be forward-looking all seem to capture critical elements of the monetary-policy framework currently used in many countries.

Appendix 1: A Framework for Analysis

Most equations are written in error-correction form to capture long-run tendencies and relationships between variables, as well as dynamics.[27] Parameters are generally estimated. The specifications of the equations, diagnostics and comments are given below. Numbers in parentheses ( ) are standard errors. Numbers in brackets [ ] are p-values. When lags of a variable enter an equation, the p-value for a joint test of their significance is given. All variables except interest rates are in log levels multiplied by 100. Equations are estimated using quarterly data from 1980:Q3 to 1996:Q3 unless otherwise noted. The analytical framework draws on a number of published Bank papers and the contribution of several Reserve Bank economists, especially David Gruen, Geoff Shuetrim and John Romalis.

Endogenous variables

Output

$$\begin{aligned}\Delta y_t = \alpha_1 &- \underset{(0.05)}{0.23} y_{t-1} + \underset{(0.06)}{0.27} y^*_{t-1} + \underset{(0.05)}{0.06} tot_{t-1} - \underset{(0.05)}{0.05} rtwi_{t-1} + 0.01 \Delta fy_{t-1} + \underset{[0.08]}{0.02 \Delta fy_{t-2}} \\ &+ \underset{(0.18)}{0.95} \Delta y^*_t - 0.03 r_{t-2} - 0.05 r_{t-3} + \underset{[0.00]}{0.10 r_{t-4}} - 0.16 r_{t-5} - 0.06 r_{t-6} \qquad \text{A1.1}\end{aligned}$$

ARCH(4) test: 1.62 [0.81]	LM(4) serial correlation: 4.61 [0.42]	$\bar{R}^2 = 0.53$
Jarque-Bera test: 1.44[0.49]	Breusch-Pagan test: 17.7 [0.06]	Standard error: 0.60

where y is non-farm output, y^* is OECD output, *tot* is the terms of trade, *rtwi* is the real TWI, r is the real cash rate and *fy* is farm output. The coefficients on the lagged levels of the terms of trade and the real exchange rate are calibrated so that a 10 per cent rise in the terms of trade boosts output by 2.4 per cent and a 10 per cent appreciation of the real exchange rate reduces output by 2 per cent in the long run. The equation is based on Gruen and Shuetrim (1994) and Gruen, Romalis and Chandra (1997).

Prices

$$\Delta p_t = \alpha_2 - \underset{(0.01)}{0.10} p_{t-1} + \underset{(0.01)}{0.06} ulc_{t-1} + \underset{(0.01)}{0.04} ip_{t-1} + \underset{(0.03)}{0.13} \Delta ulc_t + \underset{(0.01)}{0.02} \Delta ip_{t-3} + \underset{(0.02)}{0.07} gap_{t-3} \qquad \text{(A1.2)}$$

ARCH(4) test: 2.79 [0.59]	LM(4) serial correlation: 3.51 [0.48]	$\bar{R}^2 = 0.89$
Jarque-Bera test: 2.59 [0.27]	Breusch-Pagan test: 10.3 [0.07]	Standard error: 0.24

where p is the Treasury underlying CPI, *ulc* is a measure of underlying unit labour costs, *ip* is tariff-adjusted import prices and *gap* is actual less linear-trend output. The restriction that the coefficients on prices, unit labour costs and import prices sum to zero is imposed. The equation is based on de Brouwer and Ericsson (1995).

27. Moreover, if there is non-stationarity in the data, as may be the case for output, prices, unit labour costs and possibly the real exchange rate, this representation is a way to deal with important statistical issues.

Unit Labour Costs

$$\underset{}{\Delta ulc_t} = \underset{(0.05)}{0.33\Delta p_{t-1}} + \underset{(0.05)}{0.67\Delta p_{t-2}} + \underset{(0.06)}{0.17 egap_{t-1}} \qquad \text{(A1.3)}$$

ARCH(4) test: 5.48 [0.24] LM(4) serial correlation: 4.13 [0.39] $\bar{R}^2 = 0.28$
Jarque-Bera test: 0.08 [0.96] Breusch-Pagan test: 4.43 [0.22] Standard error: 0.46

where *egap* is the output gap plus 1 per cent (which is an estimate of the output gap required to generate the disinflation that occurred over the sample period). The equation was estimated by generalised least squares to correct serial correlation, and with the restriction that the coefficients on lagged inflation sum to unity. The equation is based on de Brouwer (1994) and Cockerell and Russell (1995).

Real Exchange Rate

$$\Delta rtwi_t = \alpha_4 + \underset{(1.72)}{7.25 dum_t} - \underset{(0.08)}{0.32 rtwi_{t-1}} + \underset{(0.12)}{0.33 tot_{t-1}} + \underset{(0.32)}{0.36 dum_{t-1}(r_{t-1} - r^*_{t-1})} +$$

$$\underset{(0.21)}{0.63(1 - dum_{t-1})(r_{t-1} - r^*_{t-1})} + \underset{(0.19)}{1.32\Delta tot_t} - 0.14\Delta rtwi_{t-2} - \underset{[0.15]}{0.09\Delta rtwi_{t-3}} - 0.17\Delta rtwi_{t-4} \qquad \text{(A1.4)}$$

ARCH(4) test: 4.51 [0.34] LM(4) serial correlation: 5.97 [0.20] $\bar{R}^2 = 0.59$
Jarque-Bera test: 1.43 [0.49] Breusch-Pagan test: 5.46 [0.79] Standard error: 2.74

where *dum* is a dummy variable which takes a value of one for 1980:Q3 to 1984:Q4 inclusive and zero otherwise; and r^* is the world real short interest rate. The equation is based on Gruen and Wilkinson (1991), Blundell-Wignall, Fahrer and Heath (1993) and Tarditi (1996).

Import Prices

$$\Delta ip_t = \alpha_5 - \underset{(0.05)}{0.11(ip_{t-1} - wpi_{t-1} + twi_{t-1})} - \underset{(0.04)}{0.53(\Delta twi_t - \Delta wpi_t)} - \underset{(0.05)}{0.24(\Delta twi_{t-1} - \Delta wpi_{t-1})} \qquad \text{(A1.5)}$$

ARCH(4) test: 0.51 [0.97] LM(4) serial correlation 4.59 [0.33] $\bar{R}^2 = 0.78$
Jarque-Bera test: 3.42 [0.18] Breusch-Pagan test: 4.96 [0.17] Standard error: 1.42

where *wpi* is Australia's trading-partner weighted-average export prices and *twi* is the nominal TWI.

Exogenous variables

Farm output, foreign output and foreign export price are estimated as 'trend-correction' models by which growth in the variable is regressed against a constant and the deviation of the level from a linear trend. This implies that the exogenous variables are not random walks, but return to trend after a shock.[28]

Farm Output

$$\Delta fy_t = \alpha_6 - \underset{(0.09)}{0.32}(fy_{t-1} - fy_{t-1}^{trend}) \tag{A1.6}$$

ARCH(4) test: 3.60 [0.46]	LM(4) serial correlation : 10.7 [0.03]	$\bar{R}^2 = 0.15$
Jarque-Bera test: 179 [0.00]	Breusch-Pagan test: 17.65 [0.00]	Standard error: 8.32

where fy^{trend} is the trend level of farm output.

Foreign Output

$$\Delta y_t^* = \alpha_7 - \underset{(0.03)}{0.05}(y_{t-1}^* - y_{t-1}^{*trend}) + \underbrace{0.42\Delta y_{t-1}^* + 0.20\Delta y_{t-2}^*}_{[0.00]} \tag{A1.7}$$

ARCH(4) test: 8.32 [0.08]	LM(4) serial correlation: 2.50 [0.64]	$\bar{R}^2 = 0.25$
Jarque-Bera test: 1.51 [0.47]	Breusch-Pagan test: 0.50 [0.92]	Standard error: 0.36

where y^{*trend} is the trend level of OECD output, estimated from 1980:Q4 to 1996:Q3.

Foreign export price

$$\Delta wpi_t = \alpha_8 - \underset{(0.04)}{0.10}(wpi_{t-1} - wpi_{t-1}^{trend}) + \underbrace{0.36\Delta wpi_{t-1} + 0.22\Delta wpi_{t-2}}_{[0.00]} \tag{A1.8}$$

ARCH(4) test: 3.29 [0.51]	LM(4) serial correlation: 7.12 [0.13]	$\bar{R}^2 = 0.24$
Jarque-Bera test: 1.74 [0.42]	Breusch-Pagan test: 0.12 [0.99]	Standard error: 1.05

where wpi^{trend} is the trend of the Australian trading-partner weighted average of world export prices. The trend was estimated over 1980:Q3 to 1996:Q3, while Equation (A1.8) was estimated over 1981:Q2 to 1996:Q3.

Terms of Trade

$$\Delta tot_t = \alpha_9 - \underset{(0.04)}{0.13}tot_{t-1} + \underbrace{0.11\Delta tot_{t-1} + 0.34\Delta tot_{t-2} + 0.36\Delta tot_{t-3}}_{[0.00]} \tag{A1.9}$$

ARCH(4) test: 0.01 [0.99]	LM(4) serial correlation: 1.86 [0.76]	$\bar{R}^2 = 0.31$
Jarque-Bera test: 4.20 [0.12]	Breusch-Pagan test: 3.30 [0.35]	Standard error: 1.74

28. While the debate on whether GDP follows a deterministic or stochastic trend is large, the tide seems to have turned in favour of deterministic trends (Diebold and Senhadji 1996). Whatever the case, our equation is diagnostically clean. What may be more controversial is the assumption that the foreign price level is trend stationary. This is unimportant since the exchange rate is floating, and so foreign nominal shocks have no effect on the domestic economy or inflation rate.

Foreign real interest rate

$$\underset{(0.16)}{r_t^* = 0.5} + \underset{(0.06)}{0.8 r_{t-1}^*} \quad \text{(A1.10)}$$

ARCH(4) test: 9.11 [0.06]	LM(4) serial correlation: 6.89 [0.14]	$\bar{R}^2 = 0.72$
Jarque-Bera test: 1.86 [0.40]	Breusch-Pagan test: 3.84 [0.05]	Standard error: 0.64

Identities

Real Interest Rate

$$r_t = i_t - \Delta_4 p_t \quad \text{(A1.11)}$$

where i is the nominal cash rate.

Nominal Exchange Rate

$$twi_t \equiv rtwi_t - p_t + p_t^* \quad \text{(A1.12)}$$

where p^* is the foreign price level, a trade-weighted average of foreign consumer price indices.

Data Sources

Australian Data

Data	Source
Non-farm gross domestic product (average)	ABS Cat. No. 5206.0, Table 48.
Farm gross domestic product (average)	ABS Cat. No. 5206.0, Table 48.
Australian terms of trade (goods and services)	ABS Cat. No. 5302.0, Table 9.
Underlying consumer price index	Treasury underlying CPI ABS Cat. No. 6401.0, Table 10.
Real TWI	RBA 22-country real export-weighted exchange rate.
Real cash rate	Official cash rate (RBA, *Bulletin*, Table F.1) less four-quarter-ended percentage change in the Treasury underlying CPI.
Unit labour costs	RBA underlying series. Total wage and non-wage labour costs divided by output. Wages are average weekly earnings (ABS Cat. No. 6302.0, Table 2) re-weighted using Labour Force Survey weights. Non-wage labour costs are calculated from ABS Cat. No. 5206.0, Table 36, and other sources. Output is given by trend non-farm GDP(A) ABS Cat. No. 5206.0, Table 47. Adjustments are made to these data series to give an underlying measure.
Import prices	This series has been constructed from merchandise imports data (ABS Cat. No. 5302.0, Tables 16 and 18). Total computer (ADP and ADP parts) import values are deducted from underlying (RBA definition) total import values to give computer-adjusted underlying import values. This is divided by the difference between underlying total import volumes and computer import volumes, to give an import implicit price deflator.
Tariff rate	Seasonally adjusted customs duty divided by seasonally adjusted underlying import values. Underlying import values are defined as for import prices, above. Customs duty is provided by the Treasury, Budget Revenue Section, and seasonally adjusted using X-11.

Data Sources *(continued)*

Foreign Data

Data	Source
OECD gross domestic product	Datastream, OCDGDP..D
World real short interest rate	Real rates for the US, Japan and Germany are calculated by subtracting the four-quarter-ended percentage change in the CPI from the discount rate. The real rates are aggregated using a GDP share-weighted average. Discount rates: RBA *Bulletin*, Table F.11. CPI: RBA *Bulletin*, Table I.1.
World price of exports	This series has been constructed from quarterly export price indices for Australia's major trading partners where available on Datastream. These are aggregated using an export-share weighted arithmetic average. Up to 19 countries are included in the index.

Appendix 2: Simulation Analysis

To assess the properties of the various rules, simulations were run for each rule and set of weights using the framework of equations described in Appendix 1. Starting in equilibrium, the system was run over 1 000 periods using normal random errors for each equation which embody the historical covariance of those errors. The methodology follows Byrant, Hooper and Mann (1993, pp. 240–241).

For all the equations excluding the import-price equation, a variance-covariance matrix of the residuals is generated from the variances of the equations and the correlation matrix of the historical residuals. The upper triangle of Table A2.1 shows the correlation coefficients, the main diagonal the variances of each of the series, and the lower triangle the covariances of the variables. The lower triangle of Table A2.1 is copied and transposed into the upper triangle to obtain the symmetric variance-covariance matrix, Σ. The variance-covariance matrix is transformed by a Choleski decomposition to yield two triangular matrices, P and P', which multiply together to give the original matrix: $\Sigma = PP'$. In each period a vector of random errors, e_t, is drawn from a distribution of a standard normal random variable with a mean of 0 and a variance of 1. To calibrate the shocks with the historical covariances, e_t is multiplied by the lower triangular P, giving a vector $u_t = Pe_t$. The elements of u_t are the shocks used in the simulations. The same shocks were used in all the simulations. The simulations are performed using GAUSS, and the seed for the random number generator for 1 000 shocks is 1.

For the purposes of the simulations, the constant terms in the equations in Appendix 1 are calibrated to place the system in equilibrium at the initial period. Also, the initial values for output, prices, unit labour costs, the exchange rate, farm output, import prices, the terms of trade are 100. The calibrated constant term for output is -3.80, for inflation is 0.53, for the real exchange rate is -1.55, for import prices is 11.21, for world output is 0.26, for the terms of trade is 13.46, for world prices is 0.26, and for farm output is 0.56.

Table A2.1: Covariance-correlation Matrix

	Farm output	Foreign output	Non-farm output	Unit labour costs	Prices	Terms of trade	Real exchange rate	World export prices	World real interest rate
Farm output	**69.2451**	0.1494	0.0810	0.0649	-0.1442	-0.1713	0.1993	0.0209	-0.0824
Foreign output	0.4520	**0.1322**	-0.1078	-0.0329	0.1814	0.1677	-0.0225	-0.1627	-0.1803
Non-farm output	0.4028	-0.0234	**0.3567**	0.1134	-0.0035	-0.1389	0.0500	0.0324	-0.1206
Unit labour costs	0.2499	-0.0055	0.0313	**0.2141**	-0.1177	0.1579	0.0084	0.1636	-0.1487
Prices	-0.2894	0.0159	-0.0005	-0.0131	**0.0582**	-0.0791	-0.1147	-0.2011	-0.0611
Terms of trade	-2.4811	0.1062	-0.1444	0.1272	-0.0332	**3.0292**	0.1348	0.3592	0.1806
Real exchange rate	4.5409	-0.0224	0.0817	0.0106	-0.0758	0.6425	**7.4982**	0.1636	-0.0311
World export prices	0.1831	-0.0623	0.0204	0.0798	-0.0511	0.6588	0.4720	**1.1104**	0.0494
World real interest rate	-0.4368	-0.0418	-0.0459	-0.0439	-0.0094	0.2004	-0.0543	0.0332	**0.4063**

References

Ball, L. (1997), 'Efficient Rules for Monetary Policy', NBER Working Paper No. 5952.

Bernanke, B.S. and F.S. Mishkin (1997), 'Inflation Targeting: A New Framework for Monetary Policy?', NBER Working Paper No. 5893.

Blundell-Wignall, A., J. Fahrer, and A. Heath (1993), in A. Blundell-Wignall (ed.), 'Major Influences on the Australian Dollar Exchange Rate', *The Exchange Rate, International Trade and the Balance of Payments*, Reserve Bank of Australia, Sydney, pp. 30–78.

Bryant, R.C., P. Hooper, and C.L. Mann (1993), 'Design and Implementation of the Empirical Simulations', in R.C. Bryant, P. Hooper and C.L. Mann (eds), *Evaluating Policy Regimes*, Brookings Institution, Washington, D.C., pp. 219–260.

Cockerell, L. and B. Russell (1995), 'Australian Wage and Price Inflation', Reserve Bank of Australia Research Discussion Paper No. 9509.

Debelle, G. and G.R. Stevens (1995), 'Monetary Policy Goals for Inflation in Australia', Reserve Bank of Australia Research Discussion Paper No. 9503.

de Brouwer, G.J. (1994), 'Modelling and Forecasting Wages: First Steps', Reserve Bank of Australia, mimeo.

de Brouwer, G.J. and N.R. Ericsson (1995), 'Modelling Inflation in Australia', Reserve Bank of Australia Research Discussion Paper No. 9510.

de Brouwer, G.J. and J. Romalis (1996), 'External Influences on Output: An Industry Analysis', Reserve Bank of Australia Research Discussion Paper No. 9612.

Department of Industrial Relations (1996), *Review of Wage Trends*, March.

de Roos, N. and B. Russell (1996), 'Towards an Understanding of Australia's Co-Movement with Foreign Business Cycles', Reserve Bank of Australia Research Discussion Paper No. 9607.

Diebold, F.X. and A.S. Senhadji (1996), 'The Uncertain Unit Root in Real GNP: Comment', *American Economic Review*, 86(5), pp. 1291–1298.

Edey, M. (1997), 'The Debate on Alternatives for Monetary Policy in Australia', paper presented at this conference.

Fuhrer, J. (1995), 'The Persistence of Inflation and the Cost of Disinflation', *New England Economic Review*, January/February, pp. 3–16.

Gagnon, J. (1997), 'Inflation Regimes and Inflation Expectations', Reserve Bank of Australia Research Discussion Paper No. 9701.

Grenville, S.A. (1995), 'The Monetary Policy Transmission Process: What Do We Know? (And What Don't We Know?)', Reserve Bank of Australia *Bulletin*, September, pp. 19–33.

Grenville, S.A. (1997a), 'The Evolution of Monetary Policy: From Money Targets to Inflation Targets', paper presented at this conference.

Grenville, S.A. (1997b), 'The Death of Inflation?', Reserve Bank of Australia *Bulletin*, May, pp. 34–41.

Gruen, D., J. Romalis, and N. Chandra (1997), 'The Lags of Monetary Policy', Reserve Bank of Australia Research Discussion Paper No. 9702.

Gruen, D. and G. Shuetrim (1994), 'Internationalisation and the Macroeconomy', in P. Lowe and J. Dwyer (eds), *International Integration of the Australian Economy*, Reserve Bank of Australia, Sydney, pp. 309–363.

Gruen, D. and J. Wilkinson (1991), 'Australia's Real Exchange Rate – Is It Explained by the Terms of Trade or by Real Interest Differentials?', Reserve Bank of Australia Research Discussion Paper No. 9108.

Hall, R.E. and N.G. Mankiw (1994), 'Nominal Income Targeting', in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 71–94.

Henderson, D. and W.J. McKibbin (1993), 'A Comparison of Some Basic Monetary Policy Regimes for Open Economies: Implications of Different Degrees of Instrument Adjustment and Wage Persistence', *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 221–318.

Levin, A. (1996), 'A Comparison of Alternative Monetary Policy Rules in the Federal Reserve Board's Multi-County Model', in *The Determination of Long-Term Interest Rates and Exchange Rates and the Role of Expectations*, Bank for International Settlements, Basle, pp. 340–366.

Lowe, P. and L. Ellis (1997), 'The Smoothing of Official Interest Rates', paper presented at this conference.

Lucas, R.E. (1976), 'Econometric Policy Evaluations: A Critique', in K. Brunner and A.H. Meltzer (eds), *The Phillips Curve and Labour Markets*, Amsterdam, North-Holland, pp. 19–46.

McCallum, B.T. (1990), 'Targets, Indicators, and Instruments of Monetary Policy', in W.S Haraf and P. Cagan (eds), *Monetary Policy for a Changing Financial Environment*, AEI Press, Washington, D.C., pp. 44–70.

McTaggart, D. and T. Hall (1993), 'Unemployment: Macroeconomic Causes and Solutions? Or Are Inflation and the Current Account Constraints on Growth?', Bond University Discussion Paper No. 39.

Quiggin, J. (1997), 'The Welfare Effects of Alternative Choices of Instruments and Targets for Macroeconomic Stabilisation Policy', paper presented at this conference.

Stevens, G.R. (1992), 'Inflation and Disinflation in Australia: 1950–91', in A. Blundell-Wignall (ed.), *Inflation, Disinflation and Monetary Policy*, Reserve Bank of Australia, Sydney, pp. 182–244.

Stuart, A. (1996), 'Simple Monetary Policy Rules', *Bank of England Quarterly Bulletin*, 36(3), pp. 281–287.

Svensson, L.E.O. (1996), Comment on J.B. Taylor, 'How Should Monetary Policy Respond to Shocks While Maintaining Long-Run Price Stability?', in *Achieving Price Stability*, Federal Reserve Bank of Kansas City, Kansas City, Missouri, pp. 209–219.

Tarditi, A. (1996), 'Australian Exchange Rates, Long Bond Yields and Inflationary Expectations', Reserve Bank of Australia Research Discussion Paper No. 9608.

Taylor, J.B. (1993), 'Discretion Versus Policy Rules in Practice', *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 195–214

Taylor, J.B. (1996), 'Policy Rules as a Means to a More Effective Monetary Policy', *Bank of Japan Monetary and Economic Studies*, 14(1), pp. 28–39.

Treasury (1993), 'Documentation of the Treasury Macroeconomic (TRYM) Model of the Australian Economy', *TRYM Paper*, No. 2.

Discussion

1. Tiff Macklem*

Once the objective of monetary policy has been established, the next question is how best to achieve this objective. With central banks increasingly focusing on the objective of maintaining low and stable rates of inflation, research on the question of how best to accomplish this objective has expanded rapidly, both in academia and at central banks. The paper by Gordon de Brouwer and James O'Regan provides a valuable addition to this literature, and will no doubt serve as a benchmark for future research on monetary-policy rules for the Australian economy. Their analysis of alternative policy rules proceeds in two steps.

In the first step, they examine the stochastic behaviour of the Australian economy under several familiar types of monetary-policy rules, including a nominal-income rule, an inflation-only rule, a Taylor rule and a price-level rule. All the rules are constrained to be backward-looking, by which I mean they do not include any expected future values of the variables in the rule. The conclusion that emerges from this analysis is that the Taylor rule is the best rule in the sense that it yields both lower inflation variability and lower output variability. As the authors point out, this arises because future inflation is determined largely by the current output gap, so by responding to the current excess demand, the monetary authority also reduces the variability of inflation.

In the second step, de Brouwer and O'Regan go on to consider three important issues for monetary control: the implications of increased credibility for low stable inflation; the role for an explicit open-economy dimension in the monetary rule; and the potential for forward-looking rules to outperform backward-looking rules. Perhaps because they find the Taylor rule is 'best' in the first-stage analysis, de Brouwer and O'Regan examine each of these three issues in the context of the Taylor rule alone. The main conclusions can be summarised as follows:

- Credibility is a good thing in the sense that it shifts the efficient policy frontier for the Taylor rule closer to the origin, allowing lower output and inflation variability to be simultaneously achieved.
- In an open economy such as Australia's, adding the deviation of the real exchange rate from its equilibrium value to a Taylor rule can, for some parameter values, reduce both the variability of output and inflation.
- Forward-looking 'Taylor' rules tend to outperform the standard version which uses contemporaneous values of the output gap and the deviation of inflation from target.[1]

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* The views in these comments are my own and do not necessarily reflect those of the Bank of Canada. I am grateful to Hope Pioro for valuable technical assistance with the simulations presented herein.

1. I put Taylor in quotes, since once leads are used in the reaction function I think it is stretching things to call this a Taylor rule. In my remarks, a Taylor rule will refer to the case using either contemporaneous values (or one lag if those contemporaneous values are viewed as being unavailable as in de Brouwer and O'Regan).

I have summarised de Brouwer and O'Regan's main findings because, as far as they go, I think they are exactly right. In addition, the authors do a good job of explaining why these results come about. I particularly appreciate the care that was taken to discuss what features of the model explain why some of the finer points of the results differ from those in previous work on Taylor and nominal-income rules.

So in the rest of my remarks, I want to talk about something that de Brouwer and O'Regan do not do in their paper. What they do not do is reconsider the full set of rules when they examine the implications of increased monetary credibility, the open-economy dimension, and the relative performance of forward-looking rules. I am going to argue that when the implications of these considerations are taken into account for the full set of alternative rules considered in the first step of their analysis, the Taylor rule is unlikely to emerge as the best rule. More specifically, I am going to focus on the two rules that do the worst among the stable rules that de Brouwer and O'Regan consider – the inflation-only rule and the price-level rule – and argue that once these rules are made forward-looking and some attempt is made to address the implications of the Lucas critique, these rules will outperform the Taylor rule.

Forward-looking inflation-only rules

Svensson (1997) and Ball (1997) have recently shown that in the context of a small, linear, closed-economy model, a Taylor rule (using contemporaneous values) is equivalent to a forward-looking inflation-only rule when the lead on inflation is set equal to the control lag in the model between the monetary instrument and inflation. This result reflects the fact that in these simple models, the current output gap and the current rate of inflation are optimal predictors of future inflation. So in a simplified setting, Taylor rules are neither better nor worse than forward-looking inflation rules – they are the same.

This result provides a useful benchmark, but it does not carry over to more realistic settings in which there are other influences on inflation (such as exchange-rate pass-through) or non-linearities in the model (such as an asymmetry in price adjustment). In this setting, which rule is better is again a meaningful question. My hypothesis is that in this setting a forward-looking inflation-only rule will usually outperform a Taylor rule. The intuition for this is as follows. To control future inflation, the monetary authority must lean against the output gap, so the forward-looking inflation rule will stabilise output. The advantage of the forward-looking inflation rule is that the forecast of inflation in the rule is based on the model-consistent solution for inflation, whereas the Taylor rule uses only contemporaneous information on inflation and output to forecast future inflation. The model-consistent solution takes account of the full structure of the model, as well as other useful information for inflation, such as exchange-rate movements. The forward-looking rule therefore uses more information, and this will tend to produce better outcomes.

I do not have an elegant analytic proof of this hypothesis, but I can illustrate it numerically based on a recent paper I co-authored with Richard Black and David Rose (Black, Macklem and Rose 1997; hereafter BMR). In that paper we used a model of the Canadian economy to evaluate alternative policy rules for price stability. The model itself is somewhat different from the model used by de Brouwer and O'Regan, although it embodies the same basic view of the monetary-transmission mechanism. Our model is bigger (about 30 equations describe the essential agent behaviour), it is calibrated rather than estimated, and it has an asymmetry in price adjustment whereby excess demand is more inflationary than an equivalent amount of excess supply is disinflationary. In addition, private agents form forward-looking though not entirely model-consistent expectations, there is complete stock-flow accounting, separate equations for the main components of demand, and reaction functions for both the monetary and fiscal authorities.

As in de Brouwer and O'Regan, the monetary instrument is the short-term interest rate, but we express the reaction function in terms of the spread between short and long rates. The basic inflation-only reaction function is of the form

$$rsl_t = rsl^* + \theta[(\pi_{t+j} - \pi^T) + (\pi_{t+j+1} - \pi^T)] \tag{1}$$

where *rsl* is the yield spread (the 90-day interest rate less the 10-year rate), rsl^* is the equilibrium yield spread, π_j is inflation in period *j*, and π^T is the inflation target. We use a two-period moving average of the deviation of inflation from target in the rule to avoid any excess sensitivity to inflation developments in a particular quarter.

Figure 1 shows the efficient policy frontiers in our model generated by two backward-looking versions of the reaction function given in Equation (1). Specifically, the cases shown are j = -1 (so π_{t-1} and π_t are in the reaction function) and j = -2 (so π_{t-2} and π_{t-1} are used). As expected, increasing *j* shifts the frontier towards the origin. These two frontiers should be compared to the frontier for the inflation-only rule that de Brouwer and O'Regan consider.

Figure 1: Efficient Policy Frontiers for Inflation-only Rules

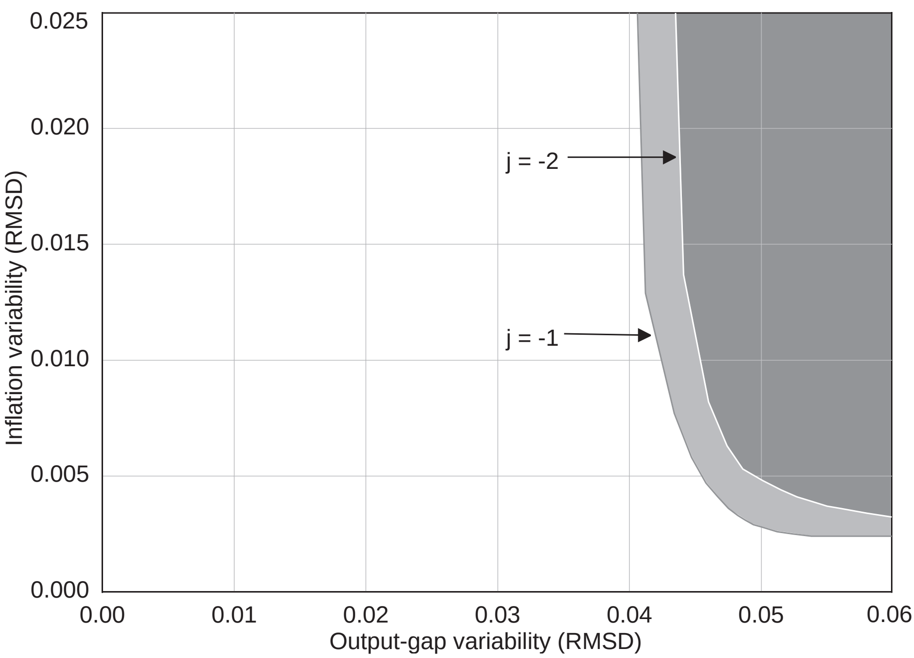


Figure 2 shows the efficient frontier for the reaction function (Equation 1) when *j* is allowed to vary between -2 and 10. When $j > 0$, the reaction function uses the expected future rate of inflation *j* periods ahead, which is defined as the fully model-consistent solution for inflation.[2] As shown, the forward-looking rules (shaded in light grey) do considerably better than the backward-looking versions. Two points on the efficient policy frontier are of particular interest. At point *B*, $j = 4$. This is roughly the control lag in the model between movements in the monetary instrument and the direct effects on prices of the associated exchange-rate changes. At point B, inflation control is very good, but output variability remains high. At point *A*, $j = 8$, which is roughly the control lag from the monetary instrument to inflation through the output gap. Since the lags in this transmission mechanism are about two years, inflation control is somewhat imprecise, but since it is achieved by dampening cycles in output, output variability is relatively low.

Figure 2: Efficient Policy Frontiers for Inflation-only Rules

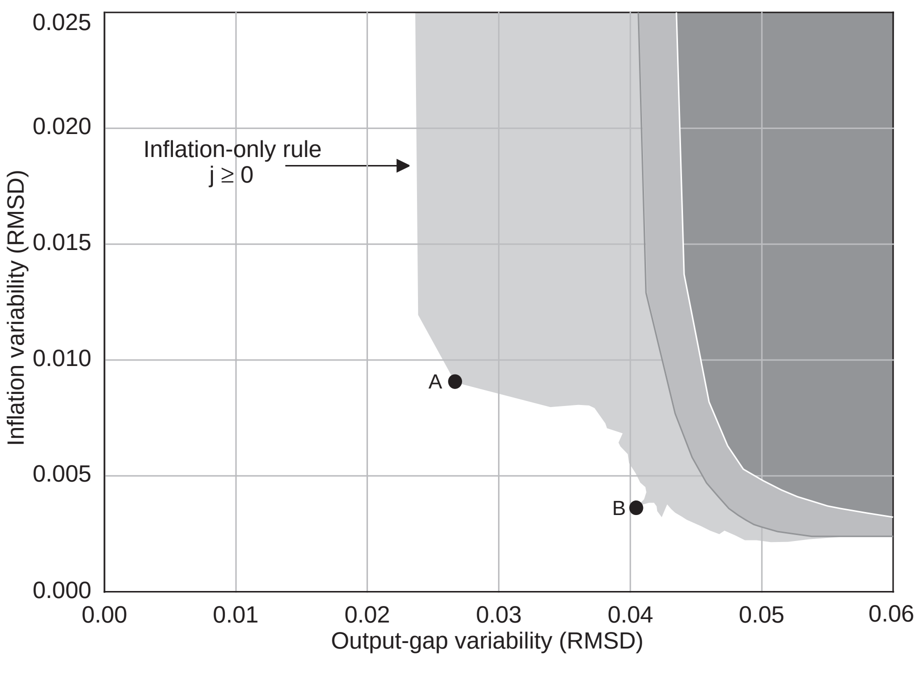


Figure 3 superimposes Figure 2 on the efficient frontier obtained in our model using the Taylor-style rule

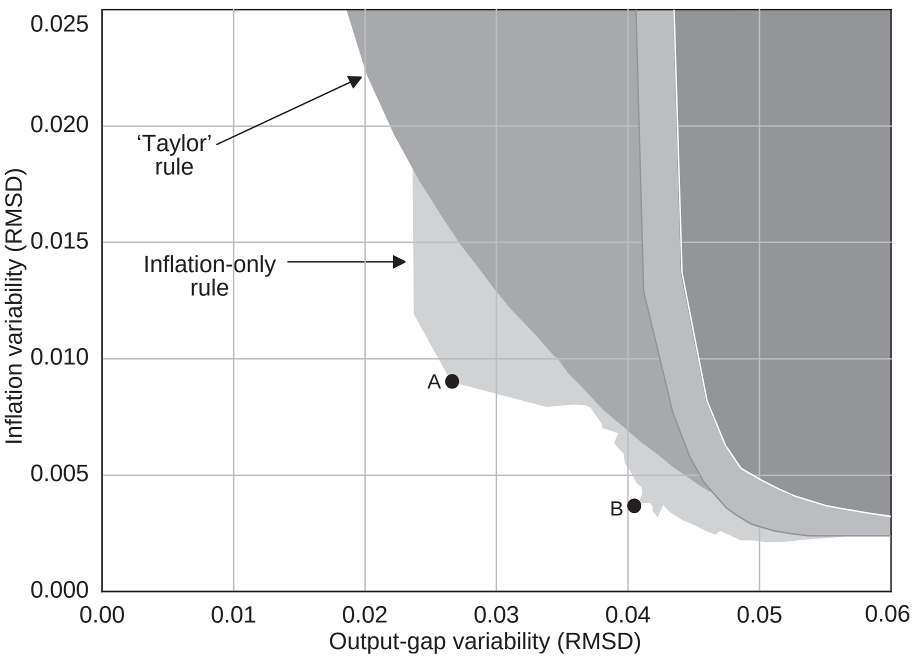
$$rsl_t = rsl^* + \delta(\pi_{t-1} - \pi^T) + \lambda(ygap_{t-1}) \tag{2}$$

where *ygap* is the output gap. Following de Brouwer and O'Regan, information is dated at time *t*-1. The forward-looking inflation-only rule does noticeably better than this Taylor

2. I use the word 'fully' model consistent to indicate that it takes into account the effects of current and future monetary-policy actions. De Brouwer and O'Regan's forward-looking experiments use the model solution for the inflation rate with the interest rate held fixed at its pre-forecast setting.

rule. As shown in BMR, if contemporaneous information is used in the Taylor-style rule instead of lagged information, the efficient policy frontiers for the Taylor-style and inflation-only rules are very close in inflation-output variability space, with no clear winner. However, the forward-looking inflation-only rules have the clear advantage along another dimension – they achieve about the same outcomes in output-inflation variability space with considerably less variability in interest rates. The reason is that the inflation forecast that is embodied in the output gap in the Taylor rule is not as good as the model-consistent forecast, so the Taylor-style reaction function includes some extra noise that results in excessive interest-rate volatility.

Figure 3: Efficient Policy Frontiers for 'Taylor' Rules and Inflation-only Rules



De Brouwer and O'Regan do implicitly examine forward-looking inflation-only rules since they consider forward-looking Taylor rules and there is nothing preventing the optimal weight on the output gap from falling to zero. Indeed, as they point out, the weight on the output gap does fall when they use leads in the Taylor rule. Their results differ from ours, though, in that they find that the optimal lead is quite short, only about two quarters. This result, however, may be a reflection of the way in which their forward-looking rules are implemented. The *j*-period ahead variables are determined by the model solution with *the interest rate unchanged from the period before the forecast is made*. In other words, the forecast does not take into account the reaction function. For the first few quarters ahead, this inconsistency has little practical significance, given the lags in the effects of monetary policy. But, as de Brouwer and O'Regan acknowledge, for forward-looking rules looking further ahead, it means that the forecasts become seriously biased and this reduces the effectiveness of the forward-looking rule. The results presented in BMR and Figure 3 suggest that when the forecasts take into account the effects of policy, much longer leads are optimal, and these substantially improve the performance of forward-looking inflation-only rules.

Credibility and the effects of price-level control

The usual argument against a price-level rule is that if it is costly to fight against inflation shocks, it will be costlier still to return the price level to a predetermined path. This standard argument, however, does not allow for possible changes in the way expectations are formed in response to the implied change in the properties of prices and inflation. With an element of price-level control, there would be an expectation of reversion to the (trend) stationary path for the price level, so that expectations of *inflation rates* would change sign more quickly. This would tend to make it easier for the monetary authority to control inflation.

Expectations are adaptive in de Brouwer and O'Regan's analysis, so agents in their model take no account of the important change in regime associated with a move to price-level control. Had expectations adjusted to reflect this regime shift (and the price-level rule was forward-looking), the price-level rule would, I think, have done much better, and possibly better than the alternatives.

In BMR, we examined the role for a price-level condition as part of a policy of price stability by adding a price-level gap term to the forward-looking inflation-only reaction function that generated point *A* in Figures 2 and 3. Specifically, we considered reaction functions of the form

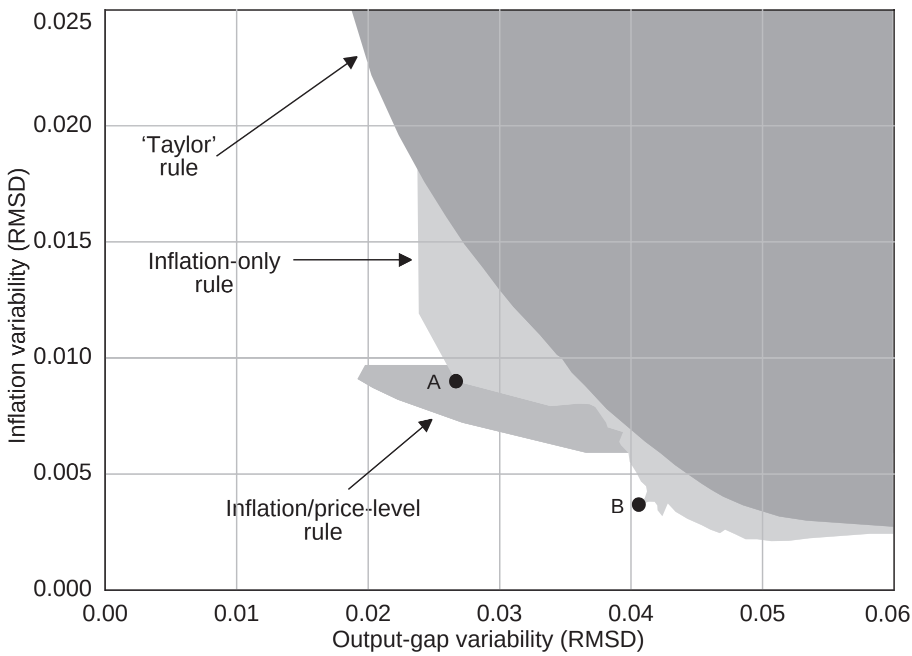
$$rsl_t = rsl^* + 3.5[(\pi_{t+8} - \pi^T) + (\pi_{t+9} - \pi^T)] + \tau pgap_{t+f} \tag{3}$$

where $pgap_{t+f}$ is the expected difference between the *f*-quarter-ahead level of prices and the price-level target path, where the price-level target path is defined as the level of prices that is implied by a constant rate of inflation of π^T from some given starting point. For the results presented here, *f* is fixed at six since this lead produces the most interesting results. Note that this reaction function reduces to an inflation-only rule with τ, the weight on the price-level gap, set to zero. Thus, the effects of adding an element of price-level control are considered on the margin.

As a first, and admittedly arbitrary, way of adjusting expectations to reflect the impact that the introduction of a price-level controller might have, we modified the equations for expected inflation in the model by including the current *pgap* term with a small negative coefficient. The effect of this term is to reduce expected inflation on the margin when the current price level is above its target, and increase expected inflation when the price level is currently below its target.

The results of this exercise are shown in Figure 4. As shown, introducing an element of price-level control opens up a new region with lower variability of both inflation and output. Note also, we have not re-optimised the inflation-only part of the reaction function, so it may well be possible to get even closer to the origin. In addition, as shown in BMR, when no adjustment is made to expectations to take account of the new emphasis placed on price-level control, the inflation/price-level rule does not produce points that are better than those for the inflation-only rule. So adjusting expectations is the key. This

Figure 4: Efficient Policy Frontiers for Inflation/Price-level Rules, Inflation-only Rules and 'Taylor' Rules



highlights the importance of accounting for the Lucas critique. It also highlights the need to better understand how expectations might in fact adjust.

In closing let me try and pull these thoughts together. Given the lags in the effects of changes in interest rates, monetary policy has to be forward-looking to be effective. Taylor-style rules perform reasonably well because the current state of excess demand is a good leading indicator of inflation, but explicit forward-looking rules will, in general, do even better. Of course, using an explicitly forward-looking rule requires a forecast of the variables in the rule, and this introduces an additional element of uncertainty into the policy-setting problem. This uncertainty should be taken account of in the policy process, but this does not mean that policy rules should be restricted to using only lagged variables. Rather it means that the policy response should be adjusted appropriately to reflect the type and the degree of uncertainty. In particular, if uncertainty enters multiplicatively, you may want to proceed more cautiously than the efficient forward-looking rule suggests, but you will still want to use the information in the forward-looking rule. To expand on de Brouwer and O'Regan's own metaphor, if you are driving a car and the road ahead is foggy, you may want to drive more slowly, but you are still going to look primarily through the front windshield as opposed to the rear-view mirror.

De Brouwer and O'Regan have provided a very interesting and careful analysis of alternative policy rules in the Australian context, as well as some useful experiments regarding the effects of credibility in the context of the Taylor rule. I hope this research on policy rules continues. My message is that I hope future research includes more emphasis on explicitly forward-looking rules, and, among these, rules with an element of price-level control deserve particular attention.

References

Ball, L. (1997), 'Efficient Rules for Monetary Policy', NBER Working Paper No. 5952.

Black, R., T. Macklem and D. Rose (1997), On Policy Rules for Price Stability, paper presented at Bank of Canada Conference, 'Price Stability, Inflation Targets and Monetary Policy', Bank of Canada, 3–4 May.

Svensson, L.E.O. (1997), 'Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets', *European Economic Review*, 41(6), pp. 1111–1146.

2. General Discussion

Two issues were the focus of discussion in this session:

- the appropriate weights on output and inflation in a Taylor rule; and
- the appropriate way to model inflation expectations.

Some participants thought that it would be interesting to know what weights on the output gap and inflation in the Taylor rule best summarised recent Australian monetary policy. It was noted that analysis in the United States has suggested that a reasonable characterisation of the Taylor rule in that country has weights on the output gap and the deviation of inflation from target of 0.5 and 0.5. These are considerably less than the efficient weights derived in this paper, which tend to lie around 1 for both variables. It was pointed out that simple policy rules estimated using Australian data are very sensitive to the time period over which the rules are estimated and assumptions about the target rate of inflation in the 1980s and early 1990s. Furthermore, a number of participants cautioned that, while Taylor rules may be a useful way to describe history, one should be careful about interpreting them as optimal policy rules.

There was general discussion about the authors' use of backward-looking expectations but forward-looking policy rules. It was argued by some that if forward-looking expectations were used in the empirical analysis in the paper, then the differences between the various monetary-policy rules would diminish. Despite this, there was support for modelling some degree of backward-looking behaviour into inflation expectations, as this seemed to be a reasonable approximation of reality. One suggestion was to model expectations as a weighted average of a backward- and forward-looking component.

It was noted that even this approach has its difficulties. In Australia, estimating an equation for the backward-looking component of inflation expectations is complicated by the changes in the monetary-policy regime. These changes should have altered the way inflation expectations are formed. A possible solution would be to allow time-varying coefficients on the backward- and forward-looking expectations components. It was suggested that the role of learning is important in this regard, and could perhaps be built into the modelling exercise. Learning by the policy-makers is also important. In the real world, there is uncertainty regarding the structure of the economy, the neutral real interest rate and the size of the output gap. One suggestion for further research was modelling how this uncertainty affects the various policy rules.

Some speakers expressed concern that the rules discussed in the paper implied an unrealistic degree of policy activism, and that the more forward-looking was policy, the more activist policy became. In response, it was noted that, in reality, policy-makers are likely to use these rules as broad cross-checks against their judgments about the correct setting of monetary policy. In a sense the use of the word *rules* to describe this approach to setting interest rates is confusing, as few would advocate setting policy in strict accordance with some form of fixed Taylor *rule*.

The Smoothing of Official Interest Rates

Philip Lowe and Luci Ellis*

1. Introduction

Central banks tend to move official interest rates in a sequence of relatively small steps in the same direction, a practice known as interest-rate smoothing. This paper documents this practice, examines its implications and discusses reasons why central banks move interest rates in this way.

The practice of interest-rate smoothing is evident in many countries. In the most recent interest-rate cycle in Australia, the target cash rate was increased three times in 1994 and has been reduced four times in 1996 and 1997. Similarly, in the United States, the federal funds target rate was increased seven times in 1994 and 1995, and then reduced three times in 1995 and 1996. The fact that official interest rates are moved multiple times in the same direction leads to a clear cycle in interest rates. Some commentators have argued that this interest-rate cycle contributes to, rather than ameliorates, the business cycle. By implication, the argument is that if interest rates exhibited a less cyclical pattern, with central banks being prepared to move rates in large steps and more decisively, the amplitude of the business cycle could be reduced.

In contrast, the central argument of this paper is that some degree of interest-rate smoothing represents optimal behaviour on the part of central banks. The lags between a change in monetary policy and its effect on economic activity, and the fact that the economy is subject to shocks from many sources, mean that frequent changes in the level and direction of interest rates are unlikely to reduce substantially the variability of inflation and output. Furthermore, frequent directional changes in the level of official interest rates risk rendering ineffectual the 'announcement' effects of monetary policy, increasing instability in financial markets and reducing the credibility and accountability of the monetary authorities. None of these developments would be expected to contribute to the stability of either output or inflation.

The paper itself is structured as follows. Section 2 examines common features across countries in the pattern of changes in official interest rates. Section 3 briefly reviews the existing literature on the causes and effects of interest-rate smoothing. Sections 4 and 5 then examine the proposition that interest-rate smoothing is responsible for the business cycle and represents suboptimal behaviour. In the first of these sections, we use a simple linear model of the Australian economy to examine the implications for the dynamics of output, inflation and interest rates of a constraint which imposes a cost when interest rates are changed. In the following section we go beyond this linear model and discuss reasons why changes in interest rates might have some non-linear effect on the variables of concern to the monetary authorities. These non-linear effects add to the arguments for smoothing official interest rates. Finally, Section 6 draws together the main conclusions of the paper.

* We are indebted to Melissa Clarkson, Alan Krause and Christopher Thompson for excellent research assistance. We are also indebted to our colleagues at the Reserve Bank of Australia for useful discussions.

2. Common Patterns in Official Interest Rates

While there are differences in the pattern of changes in official interest rates across countries, there are also a number of important similarities. These similarities are most pronounced amongst countries which are explicit about using an interest rate as the operating mechanism for monetary policy. In these countries, as well as in many others, central banks smooth changes in official interest rates. This involves:

- changing official interest rates relatively infrequently;
- changing official interest rates in a sequence of steps in the same direction; and
- leaving official interest rates unchanged for a relatively long time before moving in the opposite direction.

These characteristics can be seen in Table 1 which presents statistics on the frequency, and number, of changes in official interest rates over the period since July 1985 for Australia, the United States, the United Kingdom, Japan and Germany. Figure 1 shows the levels of the various interest rates.

Figure 1: Official Interest Rates

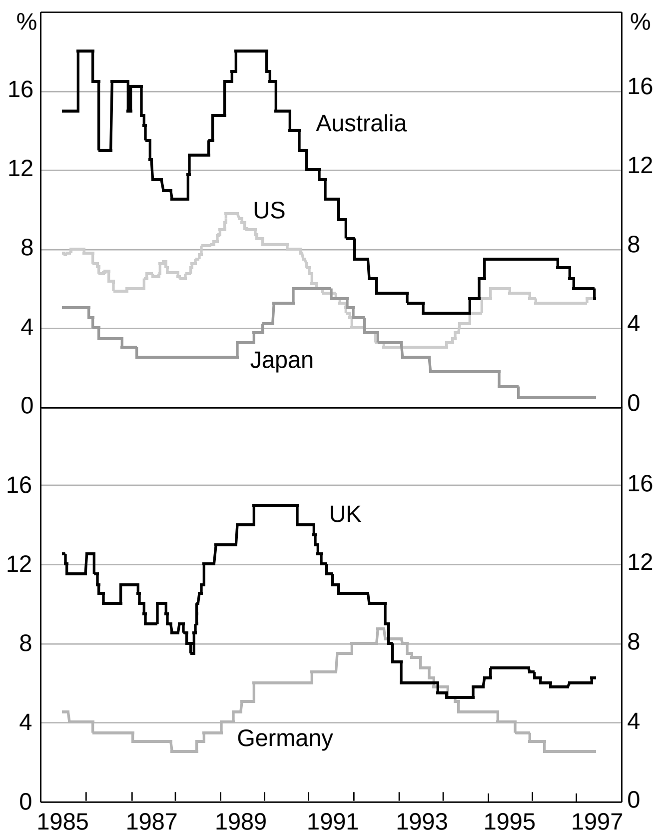


Table 1: Patterns in Official Interest-rate Changes

Country	Official policy rate	Sample period	Number of business days between change in policy rates: All changes Mean	All changes Median	Reversals Mean	Reversals Median	Continuations Mean	Continuations Median	Ratio of continuations to reversals	Absolute size of changes (average basis points): All changes	Reversals	Continuations
Australia	Cash rate target	7/85 – 5/97	74	52	144	98	54	46	3.3	108	142	99
		1/92 – 5/97	121	78	349	349	75	59	5.0	71	63	73
United States	Federal funds target rate	7/85 – 5/97	38	20	87	34	28	19	5.3	24	21	24
		1/92 – 5/97	98	63	260	299	54	56	3.7	36	25	39
United Kingdom	Base lending rate	7/85 – 5/97	57	34	102	100	43	26	3.2	59	65	57
		1/92 – 5/97	92	63	161	154	77	55	4.3	52	33	56
Japan	Discount rate	7/85 – 5/97	139	97	405	405	106	89	8.5	61	63	60
		1/92 – 5/97	161	122	–	–	161	122	–	67	–	67
Germany	14-day repo rate	7/85 – 5/97	14	5	14	6	14	5	2.0	12	13	11
		1/92 – 5/97	14	5	20	15	14	5	11.3	8	12	8
	Discount rate	7/85 – 5/97	103	85	96	96	104	85	8.3	52	50	52
		1/92 – 5/97	75	51	42	42	78	65	14.0	47	50	46

Notes: (a) Prior to January 1990, the Reserve Bank of Australia did not announce its target for the cash rate. The observations on the target cash rate prior to this time are derived from internal documents, including the informal trading ranges that guided the Bank's domestic-market operations.

(b) Interest-rate data for the United States, United Kingdom, Japan and Germany were obtained from Datastream.

The first characteristic is that changes in official interest rates are relatively rare given the frequency with which information about the state of the economy and inflation is released. Almost every day some new piece of information becomes available. While, in general, this should not lead to large day-to-day changes in the central bank's forecasts of inflation and activity, these forecasts should change (at least at the margin) each time information is released. This would suggest that frequent changes in interest rates should be observed. In practice, most central banks adjust interest rates less frequently than once a month and often go several quarters without a change in rates. For example, since July 1985, the Reserve Bank of Australia's target cash rate has been adjusted, on average, once every 3$^1/_2$ months (74 business days), with 18 months being the longest period without a change. More frequent changes have occurred in the base lending rate in the United Kingdom, while the federal funds target rate has, on average, been adjusted once every eight weeks. Of the five countries for which data are presented in Table 1, German interest rates have been moved most frequently, with the average time between changes in the repo rate being around three weeks; the discount rate, however, has been changed much less frequently.

Further, there is some evidence that the frequency of interest-rate changes has declined over recent years (Table 1 and Figure 1); this seems to be particularly the case in the United States. Whether or not this represents a permanent change is difficult to judge as the frequency of interest-rate changes is a function not only of operating procedures but also of the shocks that are hitting the economy. However, a possible reason is that the move towards explicit announcement and explanation of policy changes has had some effect on the pattern of changes in official interest rates. This issue will be discussed in more detail later in the paper.

When official interest rates are actually changed, the changes are generally made in multiples of a quarter of a percentage point. In the United States, the most common size of move over the past decade has been a quarter of a percentage point, with the largest move being three-quarters of a percentage point. In Australia, moves have tended to be larger (and correspondingly the amplitude of the interest-rate cycle larger) with the most frequent size of move being one percentage point, although the four most recent moves have each been half this size. Half of a percentage point has also been the most common size of change in the base lending rate in the United Kingdom and the discount rate in Germany.

The second characteristic of interest-rate smoothing is that changes in the direction of interest rates are relatively rare. Central banks appear to have a strong preference for implementing a sequence of interest-rate changes in the same direction. It is not unusual for three or four moves to be made in the same direction before a move is made in the opposite direction. This pattern means that changes in policy interest rates are autocorrelated, and as a result, partly predictable. This can be seen in the autocorrelation coefficients shown in Table 2. In all five countries, quarterly changes in official interest rates are positively autocorrelated; if an increase in interest rates is observed this quarter, on average, an increase will occur in the following quarter. Over the period from July 1985, the first autocorrelation is significant for all countries except for Australia. The low value for Australia reflects the volatility in the target cash rate during 1985 and 1986 when the exchange rate was under significant downward pressure; if we start the sample period at the beginning of 1987, the first autocorrelation is similar in magnitude to that for the United States and is highly significant.

The positive autocorrelations extend to an horizon of three quarters in all countries, although the correlations are generally insignificant. By the time eight quarters is reached, the autocorrelations are negative, implying that if one observes an increase in interest rates in the current quarter, it is more likely than not that there will be a decline in rates in two years' time. The negative autocorrelations at these long horizons are largest for Australia and the United States.

Table 2: Autocorrelations of Quarterly Changes in Official Interest Rates, 1985:Q3 – 1997:Q1

	Lags (in quarters)							
	1	2	3	4	6	8	10	12
Australia	0.07	0.12	0.18	-0.02	-0.21	-0.32*	-0.08	-0.09
United States	0.51*	0.22	0.19	0.06	0.10	-0.12	-0.45*	-0.17
United Kingdom	0.35*	0.11	0.20	0.07	0.07	-0.14	-0.26	-0.22
Japan	0.30*	0.35*	0.39*	0.05	-0.05	-0.09	-0.32	-0.31
Germany	0.34*	0.42*	0.41*	0.17	0.03	-0.06	-0.04	-0.02

Notes: (a) An asterisk (*) denotes significantly different from zero at the 10 per cent level.

(b) For Australia the first autocorrelation is 0.51, and significantly different from zero, if the sample period commences in 1987:Q1.

(c) For Germany the discount rate is used.

(d) End-of-quarter observations are used to calculate autocorrelations.

Just as the frequency of interest-rate changes appears to have declined in recent years, the frequency of directional changes also appears to have declined. Again this is partly attributable to the changes in operating procedures and the monetary-policy framework as well as the nature of the shocks. In the mid 1980s, considerable instability in foreign-exchange markets translated into variability in official interest rates in the United Kingdom and Australia. It may be that as the focus of monetary policy has shifted towards medium-term inflation targets, the need for official interest rates to react to exchange-rate changes has declined, and as a consequence, official interest rates show a smoother pattern. Notwithstanding this, a period of considerable exchange-rate instability would probably lead to more frequent directional changes in interest rates than seen over recent years.

The third feature of interest-rate smoothing is that when reversals in the direction of official interest rates do occur they are generally preceded by a relatively long period without a change in rates. In all five countries examined, the average time between interest-rate changes is greater for reversals than it is for continuations. Typically, central banks have left interest rates unchanged for at least three months before they have reversed the previous move.

3. The Literature on Interest-rate Smoothing

The literature on interest-rate smoothing has two broad strands. The older strand centres around the issue of whether a central bank should target a monetary aggregate or an interest rate. In this literature, a central bank that adjusts the money supply to accommodate a shock to money demand is said to be smoothing interest rates, for in the absence of such an adjustment, interest rates would have changed. The most widely documented example of this type of smoothing is the elimination of the cycle in interest rates that arose out of the seasonal pattern of tax collections (Mankiw and Miron 1991).

There is also a related literature which describes interest-rate smoothing as the practice of setting the interest rate so that the best forecast of the future interest rate is the current rate. Such a practice has been described as smoothing since a constant expected interest rate means a smooth *ex ante* interest-rate profile. Of course, *ex post* the interest rate will not exhibit such a profile as shocks will cause the rate to change. Under this older definition of smoothing, interest-rate changes are uncorrelated with the interest rate being a random walk. Mankiw (1987) and Barro (1989) have argued that such an outcome is appropriate on the grounds that it smooths the inflation tax. Their argument is that changes in the inflation tax should not be predictable, so that changes in the nominal interest rate should not be predictable. The task for the monetary authorities is simply to move the nominal interest rate in line with the random changes in the real interest rate. While earlier work found some evidence that official interest rates could be described as random walks, this evidence stands in stark contrast to the empirical regularity of autocorrelated changes in official interest rates discussed in the previous section.

The second and more recent strand of literature on interest-rate smoothing takes it as given that the central bank targets an interest rate and that the rate is changed in pursuit of macroeconomic objectives. It then notes that the target interest rate tends to adjust slowly, and in a relatively smooth pattern (as discussed above). It is this more recent concept of interest-rate smoothing that is of interest here.

This type of smoothing is often captured in models by some form of partial-adjustment mechanism, with the central bank adjusting its target rate slowly towards the desired target rate (McCallum 1994a; Clarida and Gertler 1996). In other models, smoothing is captured by including a penalty for changing rates in the central bank's objective function, with the penalty increasing, at an increasing rate, in the size of the change (Debelle and Stevens 1995; Söderlind 1997).

Much of the recent literature on interest-rate smoothing has focused on the implications of the pattern of changes in official interest rates for tests of the term structure of interest rates.[1] McCallum (1994a) argues that the failure of standard empirical tests to support the expectations theory of the term structure arises from the tests not taking account of a monetary-policy reaction function which smooths interest rates and responds to the slope of the yield curve. Similar arguments have also been made by McCallum (1994b) to explain the failure of tests of uncovered interest parity, while Söderlind (1997) argues that the practice of interest-rate smoothing has implications for tests of the Fisher effect.

1. See for example McCallum (1994a), Rudebusch (1995), Dotsey and Otrok (1995) and Balduzzi, Bertola and Foresi (1993). Much of this literature builds upon Mankiw and Miron (1986).

There are relatively few thorough treatments of why central banks actually engage in the practice of interest-rate smoothing. The explanations that have been discussed are generally based on the following hypotheses:

- that policy-makers dislike frequently reversing the direction of interest rates;
- that the nature of the decision-making process leads to conservatism; and
- that smooth changes in the target rate provide greater control over long-term interest rates and thereby greater control over inflation and economic activity.

A number of authors have attributed the practice to a desire by central banks to avoid large movements in financial-market prices. The argument is that by moving gradually and predictably, and minimising the frequency of directional changes, the central bank can reduce financial-market volatility. In doing so it reduces the possibility that the stability of the financial system is threatened by particular institutions incurring large losses.

Cukierman (1996) proposes a variant of the financial-stability argument. He notes that in the United States the average maturity of banks' assets is considerably greater than the average maturity of their liabilities. By reducing unpredictable volatility in official short-term interest rates (and thus volatility in the yield curve), the central bank can reduce the risks to the banking system that arise from the maturity mismatch. One difficulty with this argument is that smoothing appears just as prevalent in countries such as Australia, where the maturity mismatch is much smaller due to the predominance of variable-rate loans.

Caplin and Leahy (1997) suggest that policy-makers' dislike of frequent changes in the direction of interest rates arises not from a concern about financial stability, but rather from the perception that such changes make the policy-maker look poorly informed. The argument is that if a central bank lacks credibility, frequent turning points in interest rates could undermine confidence in the central bank. The authors conclude that as a central bank's reputation improves, the incentive to engage in smoothing declines. Again this conclusion appears not to be supported by the evidence, with even the most credible central banks smoothing interest-rate changes.

Explanations based on the decision-making process are emphasised by Chinn and Dooley (1997) and Goodhart (1996). The former imply that natural conservatism is at the heart of smoothing, while Goodhart argues that central banks cannot obtain broad-based political support for a change in interest rates until there is solid evidence that such a change in needed. That evidence only accumulates slowly, so that interest rates can only be changed slowly.

Another argument, advanced by Goodfriend (1991) and Roley and Sellon (1995), is that implementing a predictable path for short-term interest rates allows the central bank to exercise greater influence over long-term bond yields, and thus over future economic activity and inflation. In a similar vein, Poole (1991) argues that a good explanation for why central banks move in small steps is that it allows them to see how longer rates respond; if the rates do not respond sufficiently another move can be made.

While there is a variety of explanations, there is little, if any, published empirical work examining these hypotheses. On the whole, central banks also have had little to say on the pattern of interest-rate changes. One exception has been in the United States where

Chairman Greenspan has been quoted as arguing that the current pattern of interest-rate changes contributes to the stability of the financial system. Further, Blinder (1995, p. 13), when vice-chairman of the Board of Governors, argued that 'a little stodginess at the central bank is entirely appropriate'. In his Marshall lectures he proposed that central banks should calculate the change in policy required to 'get it right', then do less. Such a 'rule' appears to be motivated by the uncertainties that policy-makers face and, in particular, by the uncertainty that policy-makers have about the parameters of the underlying model (Brainard 1967).

The impact that interest-rate smoothing has on the economy has also received relatively little attention, although the idea that central banks move too little and too late is an old one. Recently this argument has been made by Goodhart (1996) who argues that the process of smoothing has contributed to the cycles in activity and inflation. A more subtle argument is made by Caplin and Leahy (1996). They argue that the practice of moving in small steps actually alters the reaction of the economy to changes in monetary policy. The idea is that individuals recognise the pattern of interest-rate changes employed by central banks, and that as a result, they react less to a change in policy than would otherwise be the case, waiting for further changes in the same direction. By implication, the protracted nature of recessions is a by-product of central bank behaviour. The authors conclude that, rather than adjusting policy gradually, 'policy needs to be more aggressive than the reaction it seeks to elicit' (p. 699).

The issues of why central banks smooth interest rates and the effect of the smoothing are taken up in the following sections.

4. The Impact of Interest-rate Smoothing in a Simple Model

Goodhart (1996) argues that the practice of smoothing leads central banks to respond too slowly to shocks, and that this slow response leads to unnecessary cycles in economic activity and inflation. Goodhart and Huang (1996) present a simple model in which a central bank with an inflation objective should deliver interest-rate changes which are uncorrelated, with the best guess of tomorrow's interest rate being equal to the (constant) equilibrium rate. In their model, such a policy would eliminate cycles in activity and inflation.

Cecchetti (1996) makes a similar point although he does not claim that larger movements in interest rates could eliminate the cycles in inflation and output. Rather, he argues that interest-rate changes in the United States are smoother than would be suggested by a policy that was attempting to minimise the variability of either inflation or nominal income. He concludes that this smoother pattern has increased inflation variability (although not output variability).

Comprehensive evaluation of these propositions is a difficult exercise. Goodhart's argument that cycles in inflation and activity could be eliminated by a central bank moving interest rates more aggressively is inevitably model-dependent. If one uses a model with a more complicated lag structure than that used by Goodhart, it is possible to show that serially correlated interest-rate changes can represent optimal policy, with such a policy leading to serially uncorrelated changes in output (Battellino, Broadbent and Lowe 1997).

While it is relatively easy to construct theoretical models to demonstrate particular propositions about interest-rate smoothing, the effects of smoothing are ultimately an empirical question. Without empirical work it is unclear to what extent insights from simple models are useful to policy-makers. Our approach in this paper is to use the simple empirical model of the Australian economy outlined in de Brouwer and O'Regan (1997) to conduct a series of simulation exercises examining some of the implications of interest-rate smoothing. In particular, we examine how changes in the degree of smoothing affect the variability and dynamics of inflation and output.

As is the case with theoretical models, the results from this empirical exercise are model-dependent; a different model may well produce different results. Nevertheless, using a model which captures the principal macro-economic relationships for the Australian economy, and is calibrated using actual data, should provide more robust insights than can be provided by a simple theoretical model. Our motivation is not to judge whether the observed degree of autocorrelation in interest-rate changes has been optimal. Rather it is to examine whether the results from simple theoretical models stand up in slightly richer models which capture some, but certainly not all, of the relationships in an actual economy.

The model we use has equations that explain the Australian business cycle, inflation, unit labour costs, import prices and the real exchange rate (see de Brouwer and O'Regan (1997) for details). Using the model, the strategy is to ask what would the patterns in official interest rates, inflation and output look like if the central bank pursued a 'model-optimal' interest-rate policy. By 'model-optimal' policy we mean setting the interest rate each period at the value which minimises the following objective function:

$$\sum_{t=0}^{L}\left[\lambda\left(y_t^f-\tilde{y}_t\right)^2+(1-\lambda)\left(\pi_t^f-\pi^T\right)^2+\omega\left(i_t^f-i_{t-1}^f\right)^2\right] \tag{1}$$

where $y-\tilde{y}$ is the output gap, π is the year-ended inflation rate, π^T is the inflation target (2.5 per cent), i is the nominal interest rate and f denotes the current forecast of the relevant variable. The first two terms in this objective function are standard, with the central bank aiming to minimise deviations of the expected values of output and inflation from their target values. The third term captures the idea that central banks do not like to move interest rates by a large amount from period to period. The larger is the value of ω, the more the central bank will want to smooth interest rates. This form of objective function has been used by Debelle and Stevens (1995) and Söderlind (1997).

At each point in time the task for the central bank is to choose the expected path of interest rates that minimises the objective function, subject to the equations that describe how the economy evolves. After solving this problem, the central bank sets the interest rate at its optimal value for the current period. Each of the exogenous and endogenous variables is then shocked, with the shocks being drawn from a multivariate normal distribution with the covariance matrix estimated from actual data.[2] The problem is then

2. We use the same shocks as used by de Brouwer and O'Regan (1997); see their Appendix 2 for more details.

solved again next period, with the first interest rate on the new solution path being chosen. This procedure is performed 1 000 times, so that a time series of 1 000 interest rates is generated.

When solving for the optimal path of interest rates we assume that the policy-maker does not know the current or future values of the shocks, or the current or future values of the endogenous or exogenous variables. Only values for the last quarter are known; this matches reasonably well with the situation in practice. The policy-maker does, however, know the structure of the economy and the data-generating processes for the exogenous variables. Based on this information, forecasts of all exogenous and endogenous variables are made.[3]

The exercise of solving for a time series of 1 000 interest rates is repeated multiple times using different weights on output (λ) and on the change in nominal interest rates (ω).

Figure 2 summarises the results of the simulations. The first panel shows the standard deviations of four-quarter-ended inflation and the output gap for different values of ω when we set the weight on output (λ) to be equal to 0.2; this value of λ generates a loss from output variability broadly equivalent to the loss from inflation variability. The minimum value of the smoothing parameter that we consider is 0.05; lower values have the potential to lead to instability of the model (since the objective function does not discount future losses).[4] This value still produces very volatile interest rates with the standard deviation of the quarterly change in nominal interest rates equalling 2.7 per cent. Results for different weights on output and inflation, when the penalty on interest-rate changes is very low (ω=0.1), are shown in the second panel of Figure 2. Not surprisingly, placing more weight on the variance of output in the objective function tends to reduce the variance of output and increase the variance of the inflation rate.[5] Both panels also show the frontier generated by efficient Taylor rules using only information from the previous period (see de Brouwer and O'Regan (1997) for more details).

Table 3 presents summary information on the evolution of inflation, the output gap and nominal interest rates for a number of the points shown in Figure 2. Again as a basis for comparison, it also shows the outcomes from the following efficient Taylor rule (this rule generates the point *A* on Figure 2):

$$i_t = \alpha + \pi_{t-1} + 1.0(\pi_{t-1} - 2.5) + 1.1(y_{t-1} - \tilde{y}_{t-1}). \qquad (2)$$

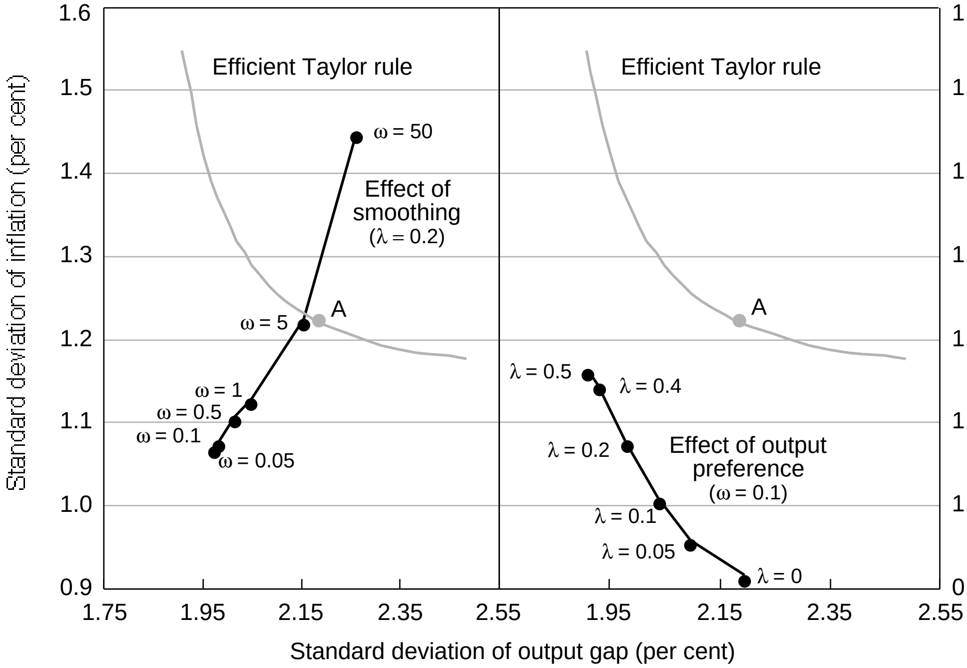
Two points stand out from the results in Figure 2 and Table 3. The first is that some degree of interest-rate smoothing, provided that it is done optimally, is not costly in terms

3. The optimisation problem that is actually solved involves choosing the path for interest rates over the next 25 periods (L=25), rather than the complete path for the indefinite future. Using longer paths makes virtually no difference to the first interest rate on the path.

4. The objective function (Equation 1) contains no discount factor. This makes the system potentially unstable (Backus and Driffill 1986). Introducing a discount factor itself tends to lead to more stable interest rates. Rather than introducing stability through the discount factor, our approach has been to introduce it through the penalty on interest-rate changes. Consequently, we do not report results for the case where there is a zero penalty on changes in interest rates. If we were to introduce discounting, setting ω=0 would generate the lowest combination of standard deviations of the output gap and inflation.

5. Note that while the weight on output can be set to zero it cannot be set to 1 as this would make the inflation rate a random walk.

Figure 2: Optimal-policy Outcomes



of generating significantly higher variances of output and inflation. The second is that while smoothing does not appreciably change the variances of output and inflation, it does change the serial correlation of these series.

Not unexpectedly, as the penalty for moving interest rates increases, the pattern of changes in interest rates changes markedly. With only a small penalty for changing interest rates, the model-optimal policy is to move interest rates around considerably and to change the direction of moves frequently. For instance, in the case where ω=0.05 (the smallest penalty on changing interest rates that we consider), the standard deviation of the quarterly change in the nominal interest rate is 2.7 percentage points, the average absolute size of quarterly interest-rate changes is around 2 percentage points and the level of the interest rate is uncorrelated with the level a year earlier. In comparison if we increase the penalty for changing interest rates substantially (ω=1.00), the standard deviation of quarterly changes falls to around 1 percentage point; the average absolute quarterly change in interest rates falls to around three quarters of a percentage point and interest rates become much more autocorrelated. In fact this value of ω generates an interest-rate pattern not too different to that which has occurred in practice. Imposing even higher penalties for interest-rate changes (ω=50) leads to smaller average changes in interest rates and longer interest-rate cycles.

The more surprising result is that quite different patterns in official interest rates generate similar degrees of variability in output and inflation. It is not the case that large and frequent changes in interest rates could eliminate the variability of output or

Table 3: The Variability of Inflation, the Output Gap and Interest-rate Changes

	Model-optimal Policy						Taylor Rule
	$\lambda = 0.2$ $\omega = 0.05$	$\lambda = 0.2$ $\omega = 0.1$	$\lambda = 0.2$ $\omega = 0.5$	$\lambda = 0.2$ $\omega = 1.0$	$\lambda = 0.2$ $\omega = 5.0$	$\lambda = 0.2$ $\omega = 50$	
Standard Deviations							
– Annual inflation rate	1.07	1.08	1.11	1.10	1.22	1.45	1.22
– Output gap	1.97	1.98	2.02	2.07	2.15	2.26	2.18
– Changes in the official interest rate	2.68	2.14	1.25	0.97	0.66	0.56	1.32
Autocorrelations							
– Annual inflation rate							
1 quarter	0.91	0.92	0.92	0.92	0.94	0.96	0.93
2 quarters	0.77	0.78	0.80	0.79	0.84	0.89	0.82
4 quarters	0.41	0.42	0.47	0.45	0.59	0.71	0.52
– Output gap							
1 quarter	0.87	0.88	0.89	0.91	0.92	0.93	0.91
2 quarters	0.64	0.67	0.73	0.76	0.81	0.84	0.75
4 quarters	0.14	0.19	0.34	0.42	0.55	0.63	0.33
– Level of official interest rate							
1 quarter	0.79	0.84	0.92	0.93	0.96	0.97	0.92
2 quarters	0.44	0.56	0.76	0.82	0.91	0.94	0.77
4 quarters	-0.01	0.10	0.40	0.53	0.75	0.86	0.35
– Changes in official interest rate							
1 quarter	0.31	0.38	0.45	0.39	0.12	-0.16	0.50
2 quarters	-0.11	-0.03	0.18	0.25	0.24	0.16	0.31
4 quarters	-0.24	-0.25	-0.20	-0.17	-0.19	-0.31	-0.08
Average Length of Cycles (years)							
– Annual inflation	5.5	5.6	6.6	7.6	7.7	7.7	6.7
– Output gap	4.6	4.6	5.5	6.0	7.4	6.6	5.2
– Official interest rate	4.0	4.4	5.8	6.6	11.0	14.1	5.1
Official Interest-rate Changes							
– Average absolute size	2.14	1.70	0.99	0.79	0.54	0.44	1.04
– Percentage of quarters with an absolute change $\geq \frac{1}{2}$ percentage point	85.3	81.6	65.8	58.2	45.6	34.9	69.0

Notes: (a) The average length of cycles is calculated by first smoothing the various series using a Henderson moving average and then calculating the average time for a full cycle around the mean of the series.

(b) The Taylor rule is given by Equation (2) in the text.

inflation. In the case with minimal smoothing, the standard deviation of the quarterly output gap is just less than 2 per cent, with the standard deviation of the inflation rate just above 1 per cent. When we move to a much smoother pattern of interest-rate changes, the standard deviations increase, but only by a relatively small amount; for the case in which $\omega=1$, the standard deviations of the output gap and inflation are 2.07 and 1.1 per cent. Of course, moving to extreme penalties for interest-rate changes ($\omega=50$) does add appreciably to the standard deviations of inflation and output (Figure 2); in this case the standard deviations of the output gap and inflation increase to 2.3 per cent and 1.5 per cent. An idea of how strong the preference for smoothing is in this extreme example, can be gauged from noting that for optimal interest-rate paths, the total loss from interest-rate variability is around 15 times that from output variability.

The result that moderate interest-rate smoothing does not significantly increase the variances of inflation and output reflects the fact that much of this variability is a consequence of factors other than monetary policy; aggressive changes in interest rates cannot eliminate this. This stands in contrast to the theoretical results of Goodhart (1996), where activist monetary policy can eliminate the business cycle. In the real world, where there are long and complicated dynamics and shocks from many sources, moving interest rates frequently and by large amounts has little advantage. The impact that the monetary authorities have on the current level of economic activity depends, in large part, on the average interest rate over the preceding couple of years.[6] Interest-rate smoothing, provided that it is not excessive, need not substantially alter this average rate, and therefore need not substantially alter the variability of inflation and output.

In part, this result is driven by the structure of the lags in the model. It is assumed that an increase in real interest rates in the current quarter has no effect on aggregate activity in that quarter, or the next quarter. In the model an increase of one percentage point in the real interest rate, sustained for one year, will reduce activity by around 0.2 of a per cent in the first year, and a further 0.4 of a per cent in the second year. If the lags were substantially shorter than this, and a change in monetary policy in the current quarter had a significant impact on output in the next couple of quarters, then the gains from a more activist monetary policy may be more substantial.

While smoothing interest rates does not appear to increase the variance of output and inflation it does increase the serial correlation of output and inflation. Increasing ω from 0.05 to 1 increases the correlation between today's output gap and the output gap four quarters ago from 0.14 to 0.42, with the correlation between today's inflation rate and that four quarters ago increasing from 0.41 to 0.45. These changes imply that the greater is the degree of smoothing, the longer will be the cycles in output and inflation. This can be seen in Table 3. If ω is 0.05, the average length of a full business cycle is around $4^1/_2$ years; this increases to almost 6 years if ω equals 1. A similar increase is also recorded in the average length of inflation cycles.

It is difficult to judge whether or not the increased persistence in output and inflation induced by smoothing is important for policy. Certainly, standard objective functions only include the variances of inflation and the output gap, and not the degree of serial correlation. Further, while smoothing increases the variance of the output gap, it tends

6. For a more detailed discussion of the lags of monetary policy see Gruen, Romalis and Chandra (1997).

to reduce the variance of the quarterly growth rates. There is no consensus on whether or not this is desirable.

One final issue relates to the performance of a Taylor rule compared to model-optimal policy. Figure 2 suggests that optimal interest-rate paths with low or moderate degrees of smoothing will produce less variability in the output gap and inflation than an efficient backward-looking Taylor rule. However, when one moves to forward-looking Taylor rules it is possible to have a reaction function which actually produces lower variances of inflation and output than that produced by optimal policy with only a moderate penalty on changes in interest rates. Despite the lower variances, the outcomes from the forward-looking Taylor rules generate larger losses (in terms of Equation 1), as they are associated with considerable variability in nominal interest rates. If one chooses forward-looking Taylor rules which generate the same standard deviation of changes in nominal interest rates as those generated by optimal policy, the variances of both output and inflation are higher than those generated by optimal policy. In most cases these differences are quite large; optimal policy is indeed optimal!

The central conclusion from these simulation exercises is that interest-rate smoothing, provided that it is done optimally, need not appreciably increase the variances of output and inflation. As noted earlier, this conclusion is, in part, a function of the model used. Amongst other things, the model assumes that the relationship between interest rates and economic activity is linear, and that the structure of the economy, and the way it reacts to monetary policy, is independent of the way policy is implemented. While these are useful assumptions for modelling work, they are unlikely to accurately depict the real world. In the following section we examine some possible non-linearities in the relationship between the policy interest rate and output and inflation.

Notwithstanding the fact that the particular results are model-dependent, they do highlight a couple of general points. First, in realistic models of the economy, optimal policy is consistent with autocorrelated changes in official interest rates. It is not the case that optimal monetary policy involves making the nominal interest rate a random walk, or a random variable. The second general point is that the lags between a change in official interest rates and activity and inflation mean that the *average* level of interest rates over the preceding couple of years is more important than the exact profile of rates over that time. On most occasions, placing some constraint on the volatility of official interest rates need not substantially alter the average interest rate applying over a period as long as a couple of years. As a result, a policy that reduces volatility in official interest rates need not have detrimental effects on output or inflation variability.

5. Other Rationales for Smoothing

There are many reasons to suspect that the relationships between changes in official interest rates and activity and inflation are non-linear.

In practice, large changes in interest rates might have little effect on economic activity if people expect the changes to be reversed quickly. Presumably, variable-rate debt would become less common, with long-term interest rates becoming more important. Large changes might also add to financial-market volatility, make accountability of the central bank more difficult and affect the way that the central bank communicates with the public. Such changes could substantially alter the underlying relationships upon which the above simulation results were generated. More generally, it is difficult to know what effect a significant change in operating procedures would have on the transmission channels of monetary policy. We do not have examples of central banks moving interest rates around aggressively and at the same time announcing and explaining those changes. This makes us cautious in extrapolating estimated relationships that depend upon the limited variability of historical interest rates.

In the absence of any good historical experiments (or robust theory) one is restricted to looking on relatively infertile ground for evidence that there is a non-linear relationship between changes in the official short-term interest rate and subsequent economic activity and inflation. Certainly, in the model of the business cycle used in Section 4 it is not possible to find strong evidence of non-linearities. Again this may reflect that history has not provided us with the right 'experiments', or it may simply reflect the point that identifying non-linear relationships in general is difficult when parameters are not tightly estimated.

Despite these difficulties, this section examines two empirical issues. The first is whether the effect of a change in interest rates on consumer sentiment is independent, at least over some range, of the size of the change. The second is whether turning points in interest rates generate increased short-term volatility in bond markets. We close the section with a discussion of how increased volatility in official interest rates might affect the way in which central banks communicate with the public.

5.1 Official interest rates and announcement effects

In Section 4 we were not explicit about the transmission mechanism through which a change in official interest rates affects economic activity and inflation;[7] we simply assumed a linear relationship between the real interest rate and economic activity. This may not be an accurate assumption. One element of the transmission mechanism is the effect that the announcement of a policy change has on people's expectations of the future, and thus their current spending decisions. This is sometimes known as the 'announcement effect'; it is one reason why central banks have moved to explicitly announcing and explaining changes in official interest rates. The size of this effect might depend in a non-linear way on the size of the interest-rate change; if it does, then moving interest rates in a series of steps may be desirable.

Changes in official interest rates generate considerable media attention. On the day the policy change is announced, it is usually the lead story in the media and there is extensive commentary regarding the implications of the change. This is generally reinforced by a second round of media coverage when financial institutions announce a change in their variable-rate lending rates. This is typically done within a short time of the change in the policy rate and is explicitly linked to the policy change.

It is arguable that the degree of attention given to changes in official interest rates depends, in part, upon the size and frequency of the changes. If official interest rates were moved by only a few basis points at a time, the changes would be on the business pages of the newspapers, and not the front pages. In addition, financial institutions would

7. See Grenville (1995) for a thorough discussion of the monetary-transmission mechanism in Australia.

probably delay changing their variable-rate loan rates until some minimum cumulative change in the official interest rate had occurred. In this world, the direct announcement effects of a change in interest rates might be very small. On the other hand, very large (and frequent) changes in interest rates may not generate proportionally more media coverage than moderate changes in interest rate. Furthermore, if people expected the change to be reversed quickly, it may have little effect on their expectations. Certainly this was one of the explanations advanced to explain why the high level of interest rates in the late 1980s had little immediate impact on private spending.

The approach adopted here is to examine the relationship between consumer sentiment and changes in interest rates. Studies in the United States have demonstrated that a rise in sentiment stimulates household expenditure; this result survives even when other variables such as household income are controlled for.[8] While in general, the incremental explanatory power of consumer sentiment is quite small, changes in sentiment might indirectly affect expenditure through their dynamic effect on household income.

To examine the issue of how changes in interest rates affect consumer sentiment we use the monthly responses to the Melbourne Institute Survey of Consumer Sentiment. The survey asks five questions:

1. Are your family finances better off or worse off than a year ago?
2. Do you expect your family finances to be better off, or worse off, over the next year?
3. Do you expect Australia to have good or bad economic conditions during the next 12 months?
4. Do you expect Australia to have good or bad economic conditions during the next 5 years?
5. Is it a good or bad time to buy major household items?

The Better Off/Worse Off (or Good/Bad) answers are used to calculate a net balance statistic for each question. The statistics are then averaged to calculate the overall Index of Consumer Sentiment.

Our strategy is to see whether changes in official interest rates affect these measures of sentiment and whether or not any relationship is non-linear. Our investigations are limited by the relatively small range of interest-rate changes (half to one percentage point) implemented over recent years. As a result, we test a very simple hypothesis: that is, that the effect of interest-rate changes on consumer sentiment is independent of the size of the change in rates. To do this we estimate the following equation using monthly data,

$$\Delta S_t = \alpha + \beta_1 \Delta S_{t-1} + \beta_2 \Delta S_{t-2} + \beta_3 \Delta E_t + \beta_3 \Delta \bar{R}_t + \beta_4 \Delta I_t + \beta_5 UP_t + \beta_6 DOWN_t + \varepsilon_t \quad (3)$$

where: S_t is the relevant index of consumer sentiment;

E_t is the log of the estimate of employment published *prior* to the survey being conducted;

8. See for example Bram and Ludvigson (1997), Carroll *et al.* (1994) and Throop (1992).

$\overline{R}_t$ is the log of the trend estimate of retail sales in the month that the survey is undertaken;

I_t is the cash rate target at the time that the survey is undertaken;

UP_t is a dummy variable that takes a 1 if there has been an increase in the target cash rate since the previous survey; and

$DOWN_t$ is a dummy variable that takes a 1 if there has been a decrease in the target cash rate since the previous survey.

If the effect of a change in the official interest rate is independent of the size of the change, the coefficients on the dummy variables in Equation (3) should be significant, while the coefficient on the change in the cash rate should be insignificant. The sample period runs from May 1990 to December 1996.[9]

The major challenge in identifying any causal relationship between changes in interest rates and sentiment is that an improvement in sentiment is often driven by strong economic growth which itself might lead to an increase in interest rates. The issue here is whether, given the state of the business cycle, an increase (decrease) in interest rates causes a decline (increase) in sentiment. To control for the effect of the business cycle we use the latest published change in employment and the estimate of trend growth in retail sales; both variables should have positive coefficients. Published employment growth is used since monthly employment statistics attract considerable media attention and therefore might be expected to have a larger effect on sentiment than the trend estimate. In contrast, retail sales data attract less attention, and the trend estimate is likely to provide a better estimate of the strength of demand than the noisier monthly headline number.

The estimation results are reported in Table 4. The model's fit is best for the two questions that relate to the family's financial situation (columns 1 and 2). All measures of sentiment are volatile from month to month and this is reflected in the generally significant and negative coefficients on the lagged values of the indices of sentiment. The business-cycle variables have the expected sign, although they are only jointly significantly different from zero (at the 5 per cent level) in the questions relating to family finances and the overall measure of sentiment.

Somewhat surprisingly the coefficient on the change in the cash rate is positive in all equations and significantly different from zero in a number of them. In part, this may reflect our inability to fully control for the effect of the business cycle on sentiment. The most consistent result, however, is that the coefficients on the dummy variables for increases and decreases in the cash rate are significantly different from zero and are of the expected sign. This suggests that there is an announcement effect and that it may not be linear in the size of the change.

As a basis of comparison, the last column of the table reports regression results for the question regarding the change in family finances over the past year, estimated over a sample period commencing in June 1986 (the first month for which we have the necessary data). The most notable difference between these results and those reported in

9. While announcements of changes in the target cash rate commenced in January 1990, the first useable observation is for May 1990 as the Survey of Consumer Sentiment was not conducted in January 1990.

Table 4: Changes in Consumer Sentiment and Interest Rates

	Finances compared with a year ago	Finances during the next year	Economic conditions during next year	Economic conditions during next 5 years	Time to buy household goods	Overall index of consumer sentiment	Finances compared with a year ago
Sample Period	*May 1990 – December 1996*						*Jun 1986 – Dec 1996*
Constant	-0.88 (1.01)	-1.38 (1.03)	-2.19 (1.99)	-0.65 (1.54)	-0.03 (1.25)	-1.15 (1.05)	-0.74 (0.97)
Lag 1 of dependent variable	-0.49* (0.12)	-0.34* (0.11)	-0.11 (0.11)	-0.24* (0.09)	-0.48* (0.12)	-0.25* (0.12)	-0.53* (0.09)
Lag 2 of dependent variable	0.35* (0.10)	-0.22* (0.11)	-0.05 (0.09)	-0.23* (0.09)	-0.28* (0.11)	-0.09 (0.11)	-0.20* (0.10)
Percentage change in employment	1.77 (1.03)	3.57* (1.31)	1.10 (2.53)	2.09 (1.83)	0.69 (1.36)	1.86 (1.21)	1.20 (1.10)
Percentage change in trend retail sales	2.89 (1.84)	4.36* (1.91)	8.29* (4.12)	3.59 (3.16)	2.69 (2.51)	4.30* (2.15)	0.80 (1.76)
Change in cash rate	6.11 (3.86)	0.65 (5.04)	19.78* (6.90)	15.96* (4.56)	10.13 (5.22)	10.60* (3.81)	0.97 (0.84)
Dummy if cash rate increased	-11.28* (3.69)	-7.72 (4.58)	-30.14* (7.61)	-17.84* (5.16)	-19.85* (5.79)	-16.96* (4.17)	-2.92 (1.98)
Dummy if cash rate decreased	6.27* (2.89)	0.56 (4.55)	15.54* (6.39)	12.02* (3.41)	8.92* (3.56)	9.18* (3.04)	2.82 (1.53)
$\bar{R}^2$	0.27	0.21	0.04	0.07	0.19	0.10	0.23

Notes: (a) Numbers in parentheses are (White) standard errors.
(b) An asterisk (*) indicates that the variable is significantly different from zero at the 5 per cent level.

column 1, is the decline in the absolute size of the coefficients on the interest-rate terms. When we include the period before announcements in the target rate, changes in the cash rate appear to have a smaller effect on sentiment; this is hardly surprising given that it was sometimes unclear that a change in the target rate had taken place.

While these results should be interpreted cautiously, two points suggest themselves. First, the move to announcing the target cash rate appears to have led to interest-rate changes having a larger immediate effect on consumer sentiment. There is also some weak evidence that interest-rate increases have a more pronounced effect than interest-rate decreases. Second, it seems clear that the effect of a change in official interest rates on sentiment is not a linear function of the change in interest rates. At least over the range of interest-rate changes that have occurred over the past seven years, there is some evidence that simply announcing a change in rates affects sentiment, independent of the size of the change. This means that a sequence of say two half-percentage point changes may have a larger announcement effect than a single one-percentage point change.

There are two important qualifications to these results. The first is that strong conclusions are difficult to draw as there has been relatively little variation in the size of changes in official interest rates. The second is that the estimation results are not entirely satisfactory as the coefficient on the cash rate has a positive sign. This perhaps reflects our inability to fully capture the effects of the business cycle on sentiment. These qualifications mean that the conclusions remain suggestive rather than definitive.

5.2 The cost of reversals

While the existence of non-linear announcement effects might make it sensible to change interest rates in a sequence of moderate-sized steps, another explanation for smoothing is that there are costs involved in reversing the direction of interest rates. Just as the costs of reversing investment decisions have been used to explain why the capital stock evolves slowly towards the desired level (Abel *et al.* 1996; Dixit and Pindyck 1994) so too can costs of interest-rate reversals be used to explain the slow adjustment of interest rates.

If interest-rate reversals are costly, there is an option value to waiting. Suppose that the central bank believes that the official interest rate needs to be increased and that the higher level is needed for some time. Such a judgment is inevitably surrounded by a considerable degree of uncertainty and there is always the possibility that the interest-rate increase might need to be reversed soon after being implemented. If such a reversal is costly, there is some value to waiting. If things turn out as expected, the probability of having to make a reversal will have declined and interest rates can be increased. If the unexpected happens, and a lower interest rate is required, the costs from reversing will have been avoided.

The results reported in Table 1 provide circumstantial evidence that central banks view frequent reversals as costly. Before a reversal takes place, rates tend to be left unchanged for a relatively long period of time. One interpretation of this is that central banks are only prepared to change direction when there is a high probability that the move is in the correct direction and that the change will not need to be reversed for some considerable period of time.

For this justification for smoothing to be valid there need to be significant costs of (frequent) reversals. Identifying and providing convincing evidence of these costs is a difficult task. In part, this is because we have few cases in which there have been frequent reversals. The two general areas where we might expect there to be some effect are in financial-market volatility and the reputation of the central bank. We discuss each of these in turn.

5.2.1 Reversals and the bond market

It is sometimes argued that if central banks were to move interest rates more frequently and in larger steps, this would add to volatility in financial markets. This rise in volatility could increase the probability of failure of financial institutions, which ultimately might prejudice the stability of the entire financial system. It could also have adverse effects on general resource allocation within the economy.

Certainly, larger and more frequent moves in official rates would add to volatility at the short end of the yield curve. There are numerous studies which show a strong positive relationship between the size of the change in the official policy rate and short-term money-market yields. However, it is unlikely that greater volatility in these short-term interest rates would have the sort of adverse effects which might alone justify the degree of smoothing seen in practice.

If, on the other hand, this increased volatility was transmitted to long-term interest rates, this might provide a rationale for smoothing. To examine the link between turning points in official interest rates and the volatility of bond yields we estimate the following equation for interest rates in Australia, the United St}˝Ms and the United Kingdom,

$$\left|\Delta B_{t,t+j}\right| = \alpha + \beta\left|\Delta I_t\right| + \gamma D_t\left|\Delta I_t\right| + \varepsilon_t \qquad (4)$$

where: $\Delta B_{t,t+j}$ is the change in the 10-year bond yield between the day on which the policy rate is changed (day t) and j days after;

ΔI_t is the change in the policy interest rate; and

D_t is a dummy variable which takes a value of 1 if the change in the policy rate is a reversal.

Each policy change represents one observation in the regression. For each country we estimate equations for the change in the bond rate on the day of the change in the official rate ($j=0$), as well as equations for the cumulative change over the following one, two, five and ten days ($j = 1, 2, 5$ and 10). If reversals generate larger absolute changes in bond yields then γ should be positive and significantly different from zero.

In choosing the estimation period we were confronted with the problem that changes in official rates have not always been announced; this argues for a short sample period. On the other hand, given that reversals are rare, a relatively long period is desirable. Given these conflicting considerations we estimate Equation (4) over two sample periods; the first running from January 1987 to May 1997 and the second from January 1990 to May 1997.

The results are reported in Table 5. In almost all cases γ is positive. However, over the full sample period, it is generally not significantly different from zero for Australia and the United States. In contrast, over the shorter sample period – over which changes in official interest rates have been more quickly recognisable – it is often significant.[10] In Australia and the United Kingdom the additional volatility associated with reversals

10. Dale (1993) finds that in the United Kingdom, a change in the base lending rate leads to a larger change in market interest rates if the change is a reversal, rather than a continuation. Similarly, Roley and Sellon (1996) find that for the United States, negative reversals contribute significantly to the volatility in interest rates.

Table 5: The Effect of Reversals on 10-Year Bond Yields

	Australia				United States				United Kingdom			
Sample period:					*January 1987 – May 1997*							
j	α	β	γ	R^2	α	β	γ	R^2	α	β	γ	
			0.06	0.06	0.03*	0.12*	0.19	0.07	0.02	0.09	0.18*	0.23
	(0.03)	(0.03)	(0.04)		(0.02)	(0.07)	(0.16)		(0.04)	(0.06)	(0.06)	
1	0.10*	-0.02	0.06	0.02	0.06*	0.10	0.28	0.06	0.03	0.13*	0.22*	0.24
	(0.03)	(0.03)	(0.04)		(0.02)	(0.08)	(0.18)		(0.04)	(0.05)	(0.08)	
2	0.09*	0.03	0.02	-0.03	0.08*	0.09	0.38*	0.07	0.04	0.14*	0.12*	0.14
	(0.04)	(0.05)	(0.04)		(0.02)	(0.08)	(0.23)		(0.04)	(0.07)	(0.06)	
5	0.16*	0.03	0.05	0.00	0.12*	-0.02	0.25	0.00	0.06	0.17*	0.11	0.10
	(0.05)	(0.05)	(0.04)		(0.03)	(0.09)	(0.22)		(0.05)	(0.09)	(0.10)	
10	0.24*	-0.03	-0.01	-0.05	0.20*	-0.16	0.36	0.04	0.09	0.14	0.21	0.11
	(0.05)	(0.06)	(0.04)		(0.03)	(0.10)	(0.31)		(0.06)	(0.10)	(0.14)	
No. of observations		37				66				47		
Sample period:					*January 1990 – May 1997*							
0	0.09*	-0.02	0.16*	0.34	0.04	0.12	0.16	0.03	0.00	0.14*	0.21*	0.33
	(0.04)	(0.04)	(0.07)		(0.04)	(0.12)	(0.10)		(0.05)	(0.07)	(0.07)	
1	0.06*	0.02	0.19*	0.38	0.02	0.20	0.21*	0.10	0.01	0.16*	0.24*	0.41
	(0.03)	(0.04)	(0.05)		(0.04)	(0.15)	(0.11)		(0.04)	(0.06)	(0.07)	
2	0.09	0.05	0.11*	-0.01	0.03	0.22	0.40*	0.14	0.02	0.20*	0.09*	0.20
	(0.06)	(0.07)	(0.06)		(0.04)	(0.14)	(0.09)		(0.06)	(0.07)	(0.05)	
5	0.18*	-0.01	0.08	-0.06	0.06*	0.11	0.23*	0.01	-0.01	0.31*	0.04	0.31
	(0.06)	(0.07)	(0.07)		(0.04)	(0.13)	(0.10)		(0.06)	(0.11)	(0.05)	
10	0.23*	-0.02	0.01	-0.11	0.15*	-0.03	0.48*	0.09	0.08	0.23*	-0.12	0.11
	(0.09)	(0.12)	(0.07)		(0.05)	(0.13)	(0.20)		(0.06)	(0.13)	(0.07)	
No. of observations		22				29				24		

Notes: (a) Numbers in parentheses are (White) standard errors.

appears to last only a couple of days, while in the United States, the effect seems to have been more persistent. In the United Kingdom, there appears to be a positive relationship between the size of the absolute change in bond yields and the size of the absolute change in the policy rate for continuations as well as reversals. In contrast, in the other two countries there seems to be no relationship if the interest-rate change is in the same direction as the previous change.

While these results are not inconsistent with the hypothesis that frequent directional changes in official interest rates could add to volatility, they hardly provide strong support for the hypothesis. There have been too few reversals to judge whether more frequent reversals would generate additional volatility. The strongest conclusion that the results warrant is that increased volatility in official interest rates *might* add to volatility in financial markets. Such an outcome is more likely in a transitional period between a regime in which official interest rates are smoothed and a new regime in which rates are moved frequently and by large amounts. It is arguable that if this new regime were established, financial markets would look through the volatility in the official interest rates, and it would not be reflected in bond-market volatility. However, this learning process may take some time and the costs paid during the transition period may not be outweighed by the (relatively small) benefits of a more activist policy.

5.2.2 Reversals and public perception of the central bank

A more convincing explanation for why interest-rate changes – and reversals in particular – are costly, centres on the need for the central bank to explain its actions to the public.

Given that, in most countries, elected governments have given operational responsibility for monetary policy to unelected central bankers, there is a need for central banks to be accountable and to communicate and explain their policy actions to the general public. Accountability and communication also help build confidence that the central bank is doing its job appropriately. Ultimately, if the public does not accept the policy framework, or the central bank's actions, the political process might deliver a change in the monetary-policy regime. The fact that such a possibility exists may make it harder for the central bank to achieve its current objectives, as uncertainty about the sustainability of the current regime is likely to have adverse implications for economic growth and long-term inflation expectations (Gagnon 1997).

One line of argument is that the credibility and accountability of the central bank rests solely on output and inflation outcomes. As a consequence, the central bank should implement the technically best pattern of interest-rate changes. Over time, the public would come to see that such a policy was optimal, even if it involved large and frequent reversals in official interest rates.

An alternative, and we argue more realistic, line of argument is that public acceptance of the central bank's policies relies not only on actual outcomes, but also on the way the bank communicates with the public. Even if the bank does its job perfectly, it can never eliminate variation in inflation and activity. In general it is difficult for the public (including professional economists) to determine exactly what role the authorities have played in contributing to, or ameliorating, the cycle. It is thus difficult to judge finely the bank's performance by just looking at output and inflation over the short run. Given this difficulty, additional ways of judging the central bank's performance are required. One of these is public assessment of whether the central bank's explanations for its policy actions are credible and appropriate.

By smoothing interest-rate changes, central banks can provide consistent explanations through time. For example, the practice of increasing interest rates multiple times in the upswing of a business cycle allows the bank to explain its actions in terms of the general shape of the observable (and perhaps expected) business cycle. If on the other hand, interest rates were initially raised significantly, then reduced quite quickly and then raised again, it would be difficult to tell a consistent story; the public would be left wondering what message the central bank was intending to send. The justification for such a volatile pattern would be that, given the bank's forecasts and understanding of how the economy worked, such a policy was optimal. However, such a justification, even if formally correct, may not meet with broad community acceptance. Given the uncertainties in forecasting, and the lack of a professional consensus about how the economy actually works, such a policy would most likely invoke substantial criticism.[11] As discussed above, such criticism could ultimately undermine the ability of the bank to meet its objectives.

Given the fact that there is no professional consensus on the correct model of the economy, it is difficult to use precise numerical forecasts alone to justify frequent announced directional changes in interest rates. This creates a dilemma since policy must be forward-looking and accountability requires the central bank to explain its view of the future. One resolution of this dilemma is that views about the future provided by the central bank are broad-brush statements about the shape of the cycle, rather than the detailed quarterly numerical estimates which would be needed to justify a more activist policy. These broad-brush views evolve only gradually so it is difficult, in general, to justify frequent directional changes in interest rates. Of course, large identifiable shocks – such as a substantial change in the exchange rate or an extraordinary change in commodity prices – can, and have been, used to explain large moves in official interest rates. However, in the absence of these shocks, frequent directional changes are likely to make the task of central banks more difficult.

The general trend to improved central bank accountability and communication with the public is likely to have had some effect on the pattern of interest-rate changes. The requirement that central banks explain changes in official interest rates has probably increased the cost of reversals and increased the need for central banks to have strong, publicly defensible, arguments for any change in interest rates. In turn, these developments may partly account for the decline in the frequency of interest-rate changes and the decline in the number of turning point discussed in Section 2.

Another reason that the interaction between the central bank and the public can lead to smoothing is that the costs of implementing policies that, *ex post*, turn out to have been

11. This lack of consensus about how the economy works is expertly illustrated by Robert Lucas (1996) in his Nobel Lecture. He argues 'Central bankers and even some monetary economists talk knowledgeably of using high interest rates to control inflation, but I know of no evidence from even one economy linking these variables in a useful way' (p. 666). As Lucas notes, his summary of the evidence differs from that of most, if not all, central bankers.

inappropriate, are likely to be non-linear in the size and direction of interest-rate changes. If the central bank increases interest rates when the economy is growing strongly, and *ex post* it turns out that larger increases were required, the bank is likely to come under criticism even though it followed the *ex ante* optimal policy. But at least there would be recognition that the central bank was appropriately leaning against the wind. In contrast, if it turns out that, *ex post*, the correct policy was to have reduced interest rates and the central bank increased rates, the bank is likely to come under even greater criticism, even if the absolute size of the 'error' is the same.

The possibility that clear directional mistakes may be costly, may partly account for the smoothing of interest rates. By moving cautiously, the central bank reduces the probability of making such mistakes. This can be seen in the results of the simulations discussed in Section 4. In the cases in which relatively high penalties were imposed on interest-rate changes, there were fewer cases in which the central bank changed interest rates by more than one percentage point, when *ex post* it should have moved in the opposite direction by more than one percentage point.

6. Conclusions

The central argument of this paper is that some degree of interest-rate smoothing is desirable. A policy which set official rates such that there was equal probability of the next move being up or down, or which made deviations from the equilibrium interest rate random, is unlikely to be optimal. Instead, optimal monetary policy is likely to deliver systematically positively autocorrelated interest-rate changes. This does not mean that interest-rate changes should *always* come in a sequence of steps; only that, on average, such a pattern is likely.

The argument has three parts. First, if we assume that the transmission channels of monetary policy are invariant to the way monetary policy is implemented, large and frequent changes in interest rates are likely to generate only a marginal improvement in outcomes. Given that a change in interest rates has a drawn-out effect on economic activity and inflation, the impact of monetary policy on current economic developments depends upon the past path of interest rates. Making this path more volatile in an attempt to reduce the fluctuations in output and inflation is likely to generate little reduction in the variability of output and inflation.

Second, and perhaps more fundamentally, large and frequent changes in interest rates are likely to change the transmission mechanism of monetary policy. They could weaken the announcement effects of interest-rate changes and could lead to a switch away from variable-rate debt, weakening the cash-flow transmission channel. They also risk adding to financial-market volatility.

Third, given the uncertainty surrounding future developments and the lack of consensus regarding the appropriate setting of monetary policy, central banks are unlikely to be able to obtain the necessary public support for a volatile path of official interest rates.

Finally, while some degree of smoothing is appropriate, central banks can smooth interest rates too much. This might occur as a consequence of a consensus-based decision-making process, or the central bank over-estimating the costs of changing interest rates or reversing a previous change. The task of assessing whether or not the degree of interest-rate smoothing seen in practice is optimal is beyond the scope of this paper. The only observations that can be made are that smoothing is not *prima facie* evidence that central banks are running suboptimal monetary policy, and that the broad pattern of interest-rate changes seen in practice is not inconsistent with that generated from simple models of optimal policy.

References

Abel, A., A. Dixit, J. Eberly and R. Pindyck (1996), 'Options, the Value of Capital and Investment', *Quarterly Journal of Economics,* 111(3), pp. 753–778.

Backus, D. and J. Driffill (1986), 'The Consistency of Optimal Policy in Stochastic Rational Expectations Models', Centre for Economic Policy Research Discussion Paper No. 124.

Balduzzi, P., G. Bertola and S. Foresi (1993), 'A Model of Target Changes and the Term Structure of Interest Rates', NBER Working Paper No. 4347.

Barro, R. (1989), 'Interest-Rate Targeting', *Journal of Monetary Economics,* 23(1), pp. 3–30.

Battellino, R., J. Broadbent and P. Lowe (1997), 'The Implementation of Monetary Policy in Australia', Reserve Bank of Australia Research Discussion Paper No. 9703.

Blinder, A. (1995), 'Central Banking in Theory and Practice, Lecture 1: Targets, Instruments and Stabilisation', Marshall Lecture presented at the University of Cambridge.

Brainard, W. (1967), 'Uncertainty and the Effectiveness of Policy', *American Economic Review,* 57(2), pp. 411–425.

Bram, J. and S. Ludvigson (1997), 'Does Consumer Confidence Forecast Household Expenditure? A Sentiment Index Horse Race', Federal Reserve Bank of New York Research Paper No. 9708.

Caplin, A. and J. Leahy (1996), 'Monetary Policy as a Search Process', *American Economic Review*, 86(4), pp. 689–702.

Caplin, A. and J. Leahy (1997), 'The Money Game', *New Economy*, 4(1), pp. 26–29.

Carroll, C., J. Fuhrer, and D. Wilcox (1994), 'Does Consumer Sentiment Affect Household Spending?: If So, Why?', *American Economic Review,* 84(5), pp. 1397–1408.

Cecchetti, S. (1996), 'Practical Issues in Monetary Policy Targeting', *Economic Review*, Federal Reserve Bank of Cleveland, 32(1), pp. 2–15.

Chinn, M. and M. Dooley (1997), 'Monetary Policy in Japan, Germany and the United States: Does One Size Fit All?', Macquarie University Centre for Japanese Economic Studies Working Paper Series No. 97-5.

Clarida, R. and M. Gertler (1996), 'How the Bundesbank Conducts Monetary Policy', NBER Working Paper No. 5581.

Cukierman, A. (1996), 'Why Does the Fed Smooth Interest Rates', in M. Belongia (ed.), *Monetary Policy on the 75th Anniversary of the Federal Reserve System,* Kluwer Academic Publishers, Norewell, Massachusetts, pp. 111–147.

Dale, S. (1993), 'The Effect of Official Interest Rate Changes on Market Rates since 1987', Bank of England Working Paper Series No. 10.

de Brouwer, G. and J. O'Regan (1997), 'Evaluating Simple Monetary-policy Rules for Australia', paper presented at this conference.

Debelle, G. and G. Stevens (1995), 'Monetary Policy Goals for Inflation in Australia', Reserve Bank of Australia Research Discussion Paper No. 9503.

Dixit, A. and R. Pindyck (1994), *Investment Under Uncertainty,* Princeton University Press, Princeton, New Jersey.

Dotsey, M. and C. Otrok (1995), 'The Rational Expectations Hypothesis of the Term Structure, Monetary Policy and Time-Varying Term Premia', *Economic Quarterly,* Federal Reserve Bank of Richmond, 81(1), pp. 65–81.

Gagnon, J.E. (1997), 'Inflation Regimes and Inflation Expectations', Reserve Bank of Australia Research Discussion Paper No. 9701.

Goodfriend, M. (1991), 'Interest Rates and the Conduct of Monetary Policy', *Carnegie-Rochester Conference Series on Public Policy*, 34, pp. 7–30.

Goodhart, C. (1996), 'Why do the Monetary Authorities Smooth Interest Rates?', LSE Financial Markets Group Special Paper No. 81.

Goodhart, C. and Huang, H. (1996), Appendix to C. Goodhart, 'Why do the Monetary Authorities Smooth Interest Rates?', LSE Financial Markets Group Special Paper No. 81.

Grenville, S. (1995), 'The Monetary Policy Transmission Process: What Do We Know (And What Don't We Know)', Reserve Bank of Australia *Bulletin,* September, pp. 19–33.

Gruen, D., J. Romalis and N. Chandra (1997), 'The Lags of Monetary Policy', Reserve Bank of Australia Research Discussion Paper No. 9702.

Lucas, R.E., (1996), 'Nobel Lecture: Monetary Neutrality', *Journal of Political Economy*, 104(4), pp. 661–682.

Mankiw, N.G. (1987), 'The Optimal Collection of Seigniorage: Theory and Evidence', *Journal of Monetary Economics*, 20(2), pp. 327–341.

Mankiw, N.G. and J. Miron (1986), 'The Changing Behaviour of the Term Structure of Interest Rates', *Quarterly Journal of Economics*, 101(2), pp. 211–228.

Mankiw, N.G. and J. Miron (1991), 'Should the Fed Smooth Interest Rates? The Case of Seasonal Monetary Policy', *Carnegie-Rochester Conference Series on Public Policy*, 34, pp. 41–70.

McCallum, B**.** (1994a), 'Monetary Policy and the Term Structure of Interest Rates', NBER Working Paper No. 4938.

McCallum, B. (1994b), 'A Reconsideration of the Uncovered Interest Parity Relationship', *Journal of Monetary Economics*, 33(1), pp. 105–132.

Poole, W. (1991), 'Interest Rates and the Conduct of Monetary Policy: A Comment', *Carnegie-Rochester Conference Series on Public Policy*, 34, pp. 31–40.

Roley, V. and G. Sellon (1995), 'Monetary Policy Actions and Long-Term Interest Rates', *Economic Review*, Federal Reserve Bank of Kansas City, 80(4), pp. 73–89.

Roley, V. and G. Sellon (1996), 'The Response of the Term Structure of Interest Rates to Federal Funds Rate Target Changes', Federal Reserve Bank of Kansas City, Research Working Paper No. 96-08.

Rudebusch, G. (1995), 'Federal Reserve Interest Rate Targeting, Rational Expectations and the Terms Structure', *Journal of Monetary Economics*, 35(2), pp. 245–274.

Söderlind, P. (1997), 'Monetary Policy and the Fisher Effect', Centre for Economic Policy Research Discussion Paper No. 1610.

Throop, A. (1992), 'Consumer Sentiment: Its Causes and Effects', *Economic Review*, Federal Reserve Bank of San Francisco, 1, pp. 35–59.

Discussion

1. David E. Lindsey*

I am pleased to discuss the paper on interest-rate smoothing by Lowe and Ellis. The authors have produced a paper notable for its insightful design and thoughtful execution. This paper, together with the companion piece by de Brouwer and O'Regan, represents frontier research on the issues currently being investigated, and with the advanced techniques currently being applied, in academia as well as by staff at the Board of Governors of the Federal Reserve System. Indeed, some of my comments are intended to compare the results of the most recent of this work in the United States with results presented at this conference.

The bulk of my comments will be directed to the fourth section of the paper, which reports on econometric model simulations. As for the fifth section, I agree with the authors' balanced interpretation of the empirical evidence on whether the effects of interest-rate changes on consumer sentiment are linear and on whether interest-rate reversals have a greater impact on bond yields than equal-sized continued changes in the same direction. Also, their discussion on communication issues is useful.

Turning to their main model-simulation results, Figure 2 and Table 3 show the effects of varying the weights on the output gap, the inflation gap, and the change in the official interest rate in the policy-maker's loss function. This optimal-control exercise suggests that some degree of interest-rate smoothing can be introduced at little initial cost in terms of enlarged deviations of output and inflation from target values.

This specific loss function, which penalises variation in the official interest rate as well as inflation and output gaps, has become standard and well captures the evident preferences of central banks to smooth official interest rates. I will appeal later to just such a loss function to rationalise my proposal to respecify the backward-looking Taylor rule in a way that also can well describe actual central bank behaviour. However, worth noting at the outset is that the theoretical justification for penalising the change in the official short-term *nominal* interest rate in the loss function is not so clear. In terms of effects on either financial or real behaviour, why should it not instead be the change in the short *real* rate that enters the loss function? To be sure, as a practical matter, these nominal and real rates are highly correlated in the short run. Perhaps the evident concern of central banks for smoothing the nominal – rather than real – short rate is simply because that is the rate central banks target, and quite visibly so.

The optimal control exercise presented by Lowe and Ellis is precisely the procedure that Blinder (1997), the previous Vice Chairman of the Federal Reserve Board, advocates for practical policy-making: that is, the Federal Open Market Committee (FOMC) at each meeting should work out not only the optimal current setting for the federal funds rate, but also the currently estimated optimal planned path for that rate over an extended horizon, with both based on an explicit long-term macroeconomic forecast.

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* The views presented are those of the author and do not necessarily represent those of the Board of Governors of the Federal Reserve System or other members of its staff.

Then, at the next meeting, the whole procedure should be updated reflecting new information. He criticises the FOMC for not in fact determining an optimal plan for the funds rate and for not considering a forecast extending far enough into the future.

As well exemplified by the present paper by Lowe and Ellis, the optimal-control exercise is a very productive technique for researchers to apply in addressing certain subjects. However, as a framework for actual policy-making, in my view it has fatal shortcomings. In the eyes of a practical policy-maker, the prescribed setting of the nominal short rate that is generated by the optimal-control exercise has the appearance of coming out of a 'black box'. Explaining to men and women of affairs the rationale for a given optimal setting of the short rate is difficult. This is precisely why using approximations such as Taylor-type rules as policy guideposts has gained in popularity. This consideration is why the appearance of the efficient Taylor-rule frontier on Figure 2 of the Lowe and Ellis paper is welcome. Knowing how good a job the backward-looking Taylor rules can do compared with optimal policy-making is of considerable interest.

The prescribed interest rate derived from a backward-looking Taylor rule has a transparency, and a plausible rationale, that the one coming from a complicated optimal-control exercise inherently lacks. This transparent character also applies to forward-looking Taylor rules that rely on forecasted rather than observed output and inflation gaps to derive the prescribed short rate. Such simple rules can incorporate the complicated, resource-intensive effort central banks actually undertake in constructing macroeconomic forecasts. So the question becomes how well can forward-looking Taylor rules do in model simulations relative both to backward-looking Taylor rules and to optimal policy? The results for forward-looking Taylor rules are shown in the paper by de Brouwer and O'Regan. In addition, Lowe and Ellis use their loss function, which penalises interest-rate variation, to assess the simulated performance of a variety of these forward-looking Taylor rules.

This observation brings me to some suggestions for extensions of this type of experiment in the next stage of research by the authors of these two companion papers. First, calculating the results of forward-looking Taylor rules based on model forecasts that are consistent with the actual implementation of those rules themselves could be worthwhile. That is, each rule could be appended to the model and then all the equations of the expanded model could be solved simultaneously.

Second, a nominal short rate lagged one period with its own coefficient could be added to the specification of each forward-looking Taylor rule examined.[1] This additional term could allow the researcher to vary a coefficient that directly captures the degree of interest-rate smoothing in a manner analogous to the initial investigation by Lowe and Ellis of the effects of varying the coefficient on the change in the nominal rate in the loss function. For example, one could examine forward-looking Taylor rules with substantial long-run responses to the forecasted inflation and output gaps but with a relatively large

1. Forward-looking Taylor rules with a one-period lag on the dependent variable were successfully estimated using regression analysis by Clarida, Gali, and Gertler (1997a) for the United States, and Clarida, Gali, and Gertler (1997b) for Germany, the United States, and Japan. Tetlow and von zur Muehlen (1996) simulate a backward-looking Taylor rule with a one-period lag on the dependent variable in a small US model with rational expectations.

coefficient on the lagged interest rate, making policy reactions relatively unresponsive – and hence interest rates relatively smooth – in the short run.

Such a specification can be derived from a simple theoretical model with a conveniently chosen lag structure.[2] In such a model, the multi-period loss function used by Lowe and Ellis collapses into a single-period expression for the loss whose first-order condition for minimisation can be expressed as a forward-looking Taylor rule with a lagged dependent variable.

Specifically, the lag structure in each of the two equations in the model examined in Ball (1997) can be adjusted by no more than one period to obtain this result. First, lengthen the lag in the effect of the real interest rate on the output gap in his dynamic IS curve to derive

$$gap_{t+2} = a_0 - a_1(i_t - \pi_{t+1}) + a_2(gap_{t+1}) + e_{t+2} \tag{1}$$

where $gap = y - \tilde{y}$; a_0, a_1, and a_2 are known positive parameters with a_2 less than 1; and e is a random error term. Next, shorten the lag in the effect of the output gap on the rate of inflation in his accelerationist Phillips curve to derive

$$\pi_{t+2} = \pi_{t+1} + b(gap_{t+2}) + u_{t+2} \tag{2}$$

where b is a known parameter and u is a random error term.

Because the nominal official interest rate, i_t, in this model specification directly affects *only* π_{t+2} and gap_{t+2}, the loss function considered by Lowe and Ellis in effect collapses to

$$Loss = \lambda(gap^f_{t+2})^2 + (1-\lambda)(\pi^f_{t+2} - \pi^T)^2 + \omega(i_t - i_{t-1})^2 \tag{3}$$

where f stands for the central bank's forecast.

Substituting Equations (1) and (2) into (3), differentiating with respect to i_t, setting the result equal to zero, and solving for i_t yields a forward-looking Taylor rule that includes a one-period lag on the i_t term,

$$i_t = constant + (1+\alpha)\pi^f_{t+1} + \beta(gap^f_{t+1}) + \rho i_{t-1} \tag{4}$$

where these coefficients incorporate all the parameters in Equations (1), (2) and (3). They are positive, with ρ less than 1. In other words, in such a simple model, the optimal policy setting would correspond exactly to a Taylor rule based on the central bank's one-period-ahead forecasts of both inflation and the output gap and on the lagged value of the official rate.

To be sure, this specific, simple lag structure does not characterise either the 'real world' or the econometric model of Australia simulated in these two companion papers. But extensions along these lines of the experiments conducted in the papers by de Brouwer and O'Regan and by Lowe and Ellis would be valuable because they could

2. I am indebted to Athanasios Orphanides for this analysis.

show just how closely different forward-looking Taylor rules embodying interest-rate smoothing could approximate optimal policy in model simulations.

This brings me back to the basic issue of interest-rate smoothing. Following the classic analysis of Brainard (1967), as re-emphasised by Blinder (1995), 'multiplier' uncertainty about the impact of a policy action on the economy could justify the kind of policy-maker caution that is embodied in the interest-rate smoothing behaviour we have been discussing. However, uncertainty about the exact location of the non-accelerating inflation rate of unemployment (NAIRU), and thus of potential output, which has been so much discussed in the US media of late, ironically is the kind of additive uncertainty that in theory would not induce partial adjustment of the policy rate with a quadratic loss function as assumed in Equation (3). Instead, if there were no uncertainty about the parameters a_1, a_2 and b in Equations (1) and (2) above, the policy-maker could impound the terms involving potential output, $-a_2\tilde{y}_{t+1}$ and $-b\tilde{y}_{t+2}$, into the intercepts of Equations (1) and (2), respectively, indicating that mis-estimates of the values of potential output represent additive errors. Thus, the policy-maker would simply use the best possible available estimate of potential output for calculating and forecasting the output gap in Equations (1) and (2), and proceed to solve for the optimal official rate with no support at all from Brainard for smoothing interest rates. On the basis of this type of macro-analytics, I infer that what underlies the penchant for interest-rate smoothing by the world's central banks must be either uncertainty about the behavioural parameters of the economy's structural equations or other reasons – perhaps those related to communication and accountability discussed by Lowe and Ellis.

I would now like to strike a bit of a discouraging note, not about this excellent paper's analysis of monetary-policy rules incorporating interest-rate smoothing *per se*, but rather about the prospects for getting definitive results from the massive worldwide research effort of which this paper is a part. My perspective stems partly from the model-specific nature of the results presented, which Lowe and Ellis readily acknowledge. It also stems partly from the widely differing results Williams (1997) recently has obtained from simulations of the Federal Reserve Board's newly installed large-scale US macroeconomic model, depending on whether he assumes that the public has adaptive or rational expectations.[3]

Williams shows that in models with adaptive expectations, an interest-rate-change rule, in which the coefficient on the lagged interest rate is 1, performs relatively poorly, a result also uncovered by de Brouwer and O'Regan in their Australian model simulations. Similarly, pure price-level rules also perform relatively poorly in both studies, as do rules tied to nominal income.[4]

These results are essentially overturned in Williams' (1997) simulations of the large-scale model with gradual adjustment of the inflation rate but with rational expectations on the part of the public that incorporate all the behavioural equations in the model,

3. This model is described in Brayton and Tinsley (1996), Brayton, Levin, Tyron and Williams (1997), and Brayton, Mauskopf, Reifschneider, Tinsley and Williams (1997).

4. Ball (1997) recently has stressed the problem of cycles for nominal-GDP rules in models with adaptive expectations, which is reminiscent of the warning of Anderson and Enzler (1987) about k-per cent money-growth rules in models with adaptive expectations.

including the policy rule. Although switching from adaptive to rational expectations should change the results somewhat, as was previewed in the tests of credibility effects in wage setting by de Brouwer and O'Regan, the reversal of relative rankings in Williams' 1997 paper came as a surprise to me. He finds that interest-rate-change rules, even when applied to pure price-level or nominal-GDP-level targets, not only come much closer to the frontier measuring the variation of inflation and output gaps than do conventional rules involving the interest-rate level, but they also do so with much less variation in interest rates than those conventional rules.[5]

He also shows that the coefficients of these rules can be adjusted to smooth interest rates even further at very little cost in terms of the movement away from the inflation/output variability frontier.[6] This conclusion about the low cost of interest-rate smoothing for nearly optimal policies in the context of a large-scale US model assuming rational expectations is a tantalising echo of the primary results found by Lowe and Ellis in a smaller model of the Australian economy that embodies adaptive expectations. On that crucial point of agreement, I can reach the following conclusion: once central banks around the world determine how their economies really work and how to structure appropriately their basic reaction to economic developments, then they certainly can smooth interest rates somewhat as their reward!

References

Anderson, R. and J.J. Enzler (1987), 'Toward Realistic Policy Design: Policy Reaction Functions that Rely on Economic Forecasts', in R. Dornbusch, S. Fischer and J. Bossons (eds), *Macroeconomics and Finance: Essays in Honor of Franco Modigliani*, MIT Press, Cambridge, Massachusetts, pp. 291–330.

Ball, L. (1997), 'Efficient Rules for Monetary Policy', NBER Working Paper No. 5952.

Blinder, A.S. (1995), 'Central Banking in Theory and Practice, Lecture I: Targets, Instruments, and Stabilization', Marshall Lecture presented at the University of Cambridge.

Blinder, A.S. (1997), 'Distinguished Lecture on Economics in Government: What Central Bankers Could Learn from Academics – and Vice Versa', *Journal of Economic Perspectives*, 11(2), pp. 3–19.

Brainard, W. (1967), 'Uncertainty and the Effectiveness of Policy', *American Economic Review*, 57(2), pp. 411–425.

5. This result is intriguing given the potential in rational expectations models for the public in effect to perceive a policy with excessive interest-rate smoothing as likely to fall 'behind the curve', so that the public's model-consistent expectations in principle could contribute to cyclical instabilities.

6. Williams also finds that a Henderson-McKibbin (1993) variant of a backward-looking Taylor rule – with coefficients of 1 and 2 on the lagged inflation and output gaps, respectively, as opposed to Taylor's 0.5 and 0.5 – comes much closer to the inflation gap/output gap variability frontier than does the Taylor rule with either rational or adaptive expectations. This Henderson-McKibbin rule in both cases, however, exhibits noticeably more interest-rate volatility. This Henderson-McKibbin rule also outperforms the Taylor rule starting from a steady state in Levin (1996) in simulations of the Federal Reserve Board's large-scale multi-country model with either adaptive or rational expectations, and in Orphanides *et al.* (1997) in simulations of a small model with rational expectations. The last article also uses stochastic simulations to evaluate the 'opportunistic' approach to attaining price stability, as discussed in Orphanides and Wilcox (1996).

Brayton, F., A. Levin, R. Tryon and J.C. Williams (1997), 'The Evolution of Macro Models at the Federal Reserve Board', Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series No. 97-29.

Brayton, F., E. Mauskopf, D. Reifschneider, P. Tinsley and J.C.Williams (1997), 'The Role of Expectations in the FRB/US Macroeconomic Model', *Federal Reserve Bulletin*, 83(4), pp. 227–245.

Brayton, F. and P. Tinsley (1996), 'A Guide to FRB/US: A Macroeconomic Model of the United States', Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series No. 96-42.

Clarida, R., J. Gali and M. Gertler (1997a), 'Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory', mimeo.

Clarida, R., J. Gali and M. Gertler (1997b), 'Monetary Policy Rules in Practice: Some International Evidence', mimeo.

de Brouwer, G. and J. O'Regan (1997), 'Evaluating Simple Monetary-policy Rules for Australia', paper presented at this conference.

Henderson, D. and W.J. McKibbin (1993), 'A Comparison of Some Basic Monetary Policy Regimes for Open Economies: Implications of Different Degrees of Instrument Adjustment and Wage Persistence', *Carnegie-Rochester Conference Series on Public Policy*, 39, pp. 221–317.

Levin, A. (1996), 'A Comparison of Alternative Monetary Policy Rules in the Federal Reserve Board's Multi-Country Model', BIS Conference Papers, Volume 2, pp. 340–366.

Lowe, P. and L. Ellis (1997), 'The Smoothing of Official Interest Rates', paper presented at this conference.

Orphanides, A., D.H. Small, V. Wieland and D.W. Wilcox (1997), 'A Quantitative Exploration of the Opportunistic Approach to Disinflation', Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series No. 97-37.

Orphanides, A. and D.W. Wilcox (1996), 'The Opportunistic Approach to Disinflation', Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series No. 96-24.

Tetlow, R. and P. von zur Muehlen (1996), 'Monetary Policy Rules in a Small Forward-Looking Macro Model', Board of Governors of the Federal Reserve System, mimeo.

Williams, J.C. (1997), 'Simple Rules for Monetary Policy', Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series (forthcoming).

2. General Discussion

The rationale for interest-rate smoothing was the main topic of discussion.

While most participants thought that frequent and large changes in interest rates were undesirable, this view was not shared universally. There was also no agreement as to why smoothing was justified. While variability in inflation and output have social costs, and so are clearly of concern to central banks, the social costs of interest-rate volatility – and hence the reason(s) why interest-rate changes should be in the central bank's loss function – are much less clear. A number of participants suggested that if volatility in official interest rates is costly, then these costs should be included in the model of the economy, rather than simply included in the central bank's loss function. It was argued that this approach might also allow empirical work to examine whether these costs actually exist.

It was noted that, to date, there had been few serious attempts to model these costs. Like this paper, most modelling work around the world suggests that interest rates should be changed by larger amounts, and more often, than occurs in practice. A number of participants agreed that frequent changes in the *direction* of interest rates were costly and that this provides a partial explanation for smoothing. Financial markets look to central banks for guidance about the path of the economy, and this guidance may be lost if central banks were frequently reversing the direction of interest-rate changes. Frequent changes in the direction of policy may also lead people to think that the central bank had 'lost the plot', although on this subject there was a variety of opinion. Some appealed to the Lucas critique, arguing that if the policy regime changed and people understood the change, then expectations as to what constituted 'normal' central bank behaviour would also change, eliminating the costs of volatility. In response, others argued that regardless of whether or not financial-markets participants understood the central bank's operating procedures, considerable interest-rate volatility would have adverse consequences for business investment and consumer confidence.

The discussion highlighted that judgments regarding the optimal size of interest-rate changes are complicated by the difficulties in calibrating the effects of changes in official interest rates on financial prices and the economy in general. One participant recalled the 1994 experience in the United States, where a small rise in short-term interest rates induced large movements in long-term yields. Similarly, econometric analysis identifies an 'average' effect of policy on activity and inflation, but economists and policy-makers do not think that the economy responds the same way to each change in interest rates.

Discussion of interest-rate smoothing raised a number of other issues for further consideration. Does smoothing of official interest rates mean that the exchange rate is more variable? Should policy aim at smoothing nominal or real interest rates? Would greater volatility in short-term interest rates imply greater volatility in longer-term interest rates, and which of these is more costly? Should policy-makers be concerned about the greater persistence of inflation and business cycles that is induced by interest-rate smoothing?

Round-up

Larry Ball

The Consensus on Inflation Targets

As ‘round-up’ discussant, I was asked to summarise the main themes of the conference and identify areas of consensus. I initially found this assignment daunting, but it has proven easier than expected. This is because an unusually clear consensus has emerged about many issues. There is a set of broad conclusions about inflation targets that most conference participants accept.

Current policies are pretty good!

The consensus at this conference is a happy one. There were few complaints about Australia’s current system of inflation targeting, and few proposals for major changes. We certainly didn’t hear any fiery speeches in favour of fixing the exchange rate or returning to money-supply targets.

I was a fan of inflation targets before the conference, so the discussion largely confirmed my prior beliefs. However, the conference also resolved one nagging doubt about current policy. This doubt concerns the practice of interest-rate smoothing discussed by Lowe and Ellis. I have suspected that this policy is suboptimal – that central banks move interest rates slowly because of some kind of inertia or timidity, causing unnecessary delays in policy. I am reassured by Lowe and Ellis’s finding that interest-rate smoothing has only small effects on the variances of output and inflation. Their explanation makes sense: the policy stance that is relevant to the economy is measured over a long period, so the precise timing of adjustments is unimportant. I still doubt that there are major benefits of interest-rate smoothing, but there do not seem to be major costs either.

The key benefits of inflation targets

The conference produced a consensus not just that inflation targeting is desirable, but also about why. Nobody claimed that this policy has magical effects such as eliminating the output-inflation tradeoff. But the discussion isolated two practical benefits of inflation targets. These two points are spelled out nicely in Mishkin’s paper.

First, inflation targets are a sensible response to the policy dilemma of rules versus discretion. Unlike rigid rules such as money targets, inflation targets allow appropriate responses to various kinds of shocks. But the scope for irrational policies or political mischief is much smaller than under pure discretion, because policies must be justified as moving inflation toward its target. As Bernanke and Mishkin (1997) put it, inflation targets are ‘constrained discretion’. They combine strong points of the rules and discretion approaches that have traditionally been viewed as incompatible.

The second, related advantage of inflation targets is that they focus policy discussions in a healthy way. Mishkin gives an example from Canada, where a political debate about whether to loosen policy was channelled into a discussion of what the inflation target should be and how quickly to achieve it. These are the right issues to debate. Mishkin's example concerns discussions among politicians, but inflation targets are also important for focusing discussions within central banks. The governor can start a policy meeting by noting that the inflation target is 2.5 per cent and current inflation is 3.2 per cent. The rest of the meeting can focus on how much tightening is needed to reduce inflation by 0.7 per cent – again, the right question. My impression is that policy meetings in countries without inflation targets, such as the United States, are more meandering. At FOMC meetings, people review a variety of statistics and present various rationales for tightening or easing. Different people at the table have different ideas about where inflation should go – different implicit inflation targets – and some may have quite idiosyncratic agendas or models of the economy. In this environment, there is a greater risk of erratic policy.

Inflation targets should be flexible

A stereotype is that inflation targeting means pushing the variance of inflation to its absolute minimum regardless of anything else. At this conference, however, participants agreed that inflation targets should be flexible, and are in practice. Policy stabilises inflation in the medium run, but it tolerates some short-run variability if doing so helps the real economy. In particular, 'caveats' to inflation targets allow flexible responses to supply shocks.

The target inflation rate should be positive

It is a stretch to say there is consensus on this point, but there is at least a majority. Although we heard arguments on both sides, the proposition 'Australia should lower its inflation target to zero' would lose a vote of conference participants. Haldane is ambivalent about the idea, but the arguments against zero inflation came out forcefully in the discussion of his paper.

As discussed by Haldane, Feldstein (1997) and others present calculations suggesting that the gains from disinflation outweigh the costs. But these calculations depend on the prediction that reducing inflation from two per cent to zero will cause a large increase in capital accumulation (because inflation raises the effective tax rate on capital). If Feldstein is right, imagine the tremendous rise in capital accumulation if inflation fell by a much larger amount, from 10 per cent to 2 per cent. Then realise that decreases of this magnitude were achieved in the 1980s and 1990s, with no apparent surge in capital accumulation (indeed, savings fell in many countries). This experience should also make us suspicious of Feldstein's calculations.[1]

Feldstein's cost-benefit analysis also understates the cost of disinflation, for at least two reasons. First, as Haldane points out, Feldstein assumes the costs are transitory, while in fact they may be long-lived – there may be hysteresis. Second, Feldstein measures the welfare cost of disinflation by the loss in aggregate output. This would be appropriate if a five per cent fall in GDP meant that every individual loses five per cent

1. Charles Goodhart made this argument at a recent conference at the Bank of Italy.

of his income. In reality, the losses fall disproportionately on certain individuals, such as those who become unemployed. If utility is concave in income, this concentration of losses implies a larger fall in average utility.

Convergence in monetary policies

The consensus about inflation targets is not limited to this conference. A consensus is growing around the world as more and more countries adopt similar policies. Countries such as New Zealand with relatively rigid targets have become more flexible, while 'just do it' countries such as the United States may be moving toward targets, at least implicitly. The worldwide picture is rosy: countries are converging toward the current best practice in monetary policy.

An Open Question

While we understand a lot about inflation targets, it is not yet time to disband the Economic Research Department at the Reserve Bank of Australia. There are still open questions that require research. I want to emphasise one unanswered question that is especially important. This is the choice of policy horizon – of the speed with which policy moves inflation toward its target. If a shock raises inflation, for example, should policy tighten sharply to bring inflation back quickly? Or should disinflation be gradual? This question came up several times at the conference, but here there was little progress toward consensus.

My views on this question, which are related to those of de Brouwer and O'Regan, are ambivalent. Suppose we believe that policy-makers face a fixed, linear Phillips curve. As shown by Taylor (1994) and others, this assumption implies a trade-off between the variance of output and the variance of inflation. Such a trade-off arises in de Brouwer and O'Regan's model, for example. Choosing a target horizon or adjustment speed means choosing a point on the output-variance/inflation-variance frontier. Slower inflation adjustment makes inflation more variable, but it smooths the path of output.

This analysis implies a strong case for slow adjustment, because output fluctuations are costly. We do not know whether the analysis is correct, however, because we do not know how the Phillips curve would change if policy changes. This point is the 'Lucas critique' discussed by de Brouwer and O'Regan. Suppose that policy-makers increase the speed with which they return inflation to target. Once this policy becomes established, people might anticipate the rapid mean-reversion in inflation, and this shift in expectations might steepen the short-run Phillips curve. If this effect is strong enough, adjusting inflation as quickly as possible would minimise the variance of output as well as the variance of inflation. In this case, such a policy is clearly the best.

This idea is speculative. In practice, we have not observed inflation targeting for long enough to know whether faster adjustment leads to more or less output variability. We should look for clues in the future experiences of inflation targeters.[2]

2. Ball (1994) presents some relevant evidence: in OECD countries, rapid disinflations have had smaller output costs than slow disinflations.

What We Did Not Discuss

The conference addressed lots of important issues, but one *very* important problem received little attention: the high unemployment in Australia and elsewhere. Ian McDonald and John Pitchford mentioned the issue, but most of us ignored it. The reason, presumably, is not indifference to unemployment, but rather the view that monetary policy cannot affect unemployment in the long run. To make an analogy, I am worried about whether Saddam Hussein will acquire nuclear weapons, but I am not surprised that the issue did not come up at this conference. If Saddam does try to get the bomb, there is not much that Ian Macfarlane can do to stop him.

Is there a similar reason for ignoring long-run unemployment? Is unemployment really like nuclear proliferation, a problem for which monetary policy is irrelevant? Friedman's natural-rate hypothesis says yes: if long-run unemployment is eight per cent, this fact is explained entirely by imperfections in the labour market. In my view, however, there is considerable evidence against this theory and in favour of the hysteresis effects discussed by Haldane. In particular, today's high unemployment in Australia is partly a legacy of the tight policy that has reduced inflation since the 1980s. So I do not think central bankers can completely wash their hands of the unemployment problem.[3]

I am not going to argue that the Reserve Bank of Australia should promptly reinflate to fight unemployment. (Among other reasons, I want to be invited back to this and other central banks.) I believe, however, that monetary policy may have a role in attacking unemployment at some point. Most economists believe that reducing unemployment requires reducing distortions in the labour market, such as open-ended unemployment insurance. Suppose we accept this view, and suppose that some day it is politically feasible to reform the labour market. At that point, monetary policy will have an important supporting role in lowering unemployment. When people lose unemployment benefits, they can go in two directions: they can rejoin the labour force, or they can stay unemployed and become more impoverished and cut off from society. If benefits are cut, the numbers that go in each direction will depend on the state of the economy – on whether jobs are available for people leaving unemployment insurance. Since labour-market reforms work best in a high-pressure economy, they should be accompanied by expansionary monetary policy.[4]

Such a policy would not *necessarily* raise inflation. In the best-case scenario, policy would just increase demand to match the supply of new workers, and the economy would not overheat. However, any monetary expansion, even one co-ordinated with supply-side reforms, creates a risk of higher inflation. We do not fully understand the forces causing changes in long-run unemployment, so we do not know how much expansion would be needed. In my view, some risk of higher inflation is acceptable given the importance of reducing unemployment.

3. For cross-country evidence on hysteresis, see Ball (1997). For a discussion of Australia, see Gregory (1986).

4. This proposal is similar to the 'two-handed approach' to unemployment advocated by Blanchard *et al.* (1986).

Therefore, despite my generally warm feelings for inflation targets, I do not believe they should *always* be the focus of monetary policy. There may be circumstances in which a central bank's top priority is contributing to a major structural change – a decrease in unemployment. In such circumstances, the normal practice of inflation targeting should be modified to help meet this goal.

References

Ball, L. (1994), 'What Determines the Sacrifice Ratio?', in N.G. Mankiw (ed.), *Monetary Policy*, University of Chicago Press, Chicago, pp. 155–182.

Ball, L. (1997), 'Disinflation and the NAIRU', in C.D. Romer and D.H. Romer (eds), *Reducing Inflation: Motivation and Strategy*, University of Chicago Press, Chicago, pp. 167–185.

Bernanke, B.S. and F.S. Mishkin (1997), 'Inflation Targeting: A New Framework for Monetary Policy?', *Journal of Economic Perspectives*, 11(2), pp. 97–116.

Blanchard, O.J., R. Dornbusch, J. Drèze, H. Giersch, R. Layard and M. Monti (1986), 'Employment and Growth in Europe: A Two-handed Approach', in O.J. Blanchard, R. Dornbusch and R. Layard (eds), *Restoring Europe's Prosperity*: *Macroeconomic Papers from the Centre for European Policy Studies*, MIT Press, Cambridge, Massachusetts, pp. 95–124.

Feldstein, M. (1997), 'The Costs and Benefits of Going from Low Inflation to Price Stability', in C.D. Romer and D.H. Romer (eds), *Reducing Inflation: Motivation and Strategy*, University of Chicago Press, Chicago, pp. 123–156.

Gregory, R.G. (1986), 'Wages Policy and Unemployment in Australia', *Economica*, Supplement, 53(210S), pp. S53–S74.

Taylor, J.B. (1994), 'The Inflation/Output Trade-off Revisited', in J.C. Fuhrer (ed.), *Goals, Guidelines and Constraints Facing Monetary Policymakers*, Federal Reserve Bank of Boston, Boston, Massachusetts, pp. 21–38.

2. General Discussion

The discussion focused on two practical aspects of implementing an inflation target:

- the stance of monetary policy while the labour market is being reformed; and
- the interaction of the inflation target with employment and economic-growth objectives.

There was no consensus about how monetary policy should respond to reform of the labour market. One view was that monetary policy should stimulate growth during the reform process so as to reduce the possibility that reform led to higher unemployment in the short run. Other participants thought that labour-market reform should be treated no differently to other 'shocks'. If reform eases inflationary pressures, policy could be relatively more accommodative since the expected inflation rate should be lower. But if reform is associated with higher short-run wage pressures, then policy may need to be tighter than otherwise.

Whatever the case, most participants thought it undesirable to prescribe a monetary-policy response to labour-market reform before some informed judgments about the effects of the reform could be made. Moreover, as market structure changes, policy-makers need to be aware that economic relationships which held in the past may change, and so existing rules-of-thumb may no longer be relevant.

The other practical issue that captured discussion was the interaction between inflation and economic-growth objectives. Some participants thought that more attention should be devoted to the employment and growth consequences of monetary policy. In response, others noted that a system based on some form of inflation target did not preclude policy actions to mitigate the business cycle; indeed arguably that is required by an inflation target. Again, the very rationale for low inflation was to improve the medium-term growth prospects for the economy.

While there was widespread agreement that unemployment remains Australia's main economic problem, a number of participants thought that there was a tendency by some to be unduly pessimistic about the prospects for the present macroeconomic policy regime delivering reductions in unemployment. They argued that declines in interest rates over the past year had contributed to an environment in which the economy was well placed to grow more strongly, and that this should see the unemployment rate decline. It was also noted that steady growth, rather than 'stop-start' growth, was more effective in reducing unemployment. Steady growth can eliminate problems associated with 'speed-limit' constraints and can reduce the probability of hysteresis in the labour market. The issue was what rate of growth could be sustained.

Finally, participants noted that a consensus now seems to have developed in favour of maintaining low and stable inflation, not just in Australia but through the world. In Australia's case, participants agreed that policy-makers should maintain inflation at an average rate of two to three per cent. This meant that inflation rates below the target need to be taken as seriously as inflation rates above the target; apart from being good public policy this was seen as important in maintaining public support for the inflation target.

Summaries of the Papers

Strategies for Controlling Inflation

Frederic S. Mishkin

This paper discusses the advantages and disadvantages of four strategies – exchange-rate pegging, monetary targeting, inflation targeting and 'just do it' – for controlling inflation. It concludes that inflation targeting is the preferred strategy in most situations.

The paper begins by arguing that the consensus for low inflation rests on two propositions. First, activist monetary policy which is too ambitious about reducing unemployment is likely to lead to higher inflation and higher unemployment in the longer term. Second, long-run price stability promotes a higher level of economic output and economic growth. High inflation distorts relative-price signals, causes over-investment in the financial sector and, through its interaction with the tax system, leads to less efficient, and lower, investment.

Exchange-rate pegging provides a nominal anchor for the economy and, because monetary policy is on 'automatic pilot', removes the time-inconsistency problem. An exchange-rate target is also easily understood by the public. It can be particularly useful in stabilising inflation quickly after bouts of very high rates of inflation. However, one of the main disadvantages is the loss of autonomy in monetary policy so that the policy-maker is unable to respond to developments in the domestic economy that are not present in the country to which the currency is pegged. Also, for some countries, there is no obvious currency to peg to.

Monetary targeting enables a policy-maker to take account of domestic developments in setting policy. It is also reasonably easily understood by the public, and it is easy to determine relatively quickly whether the target is being achieved. However, successful monetary targeting is reliant on the relationship between the targeted aggregate and the goal of monetary policy remaining stable, and the aggregate being controllable by the central bank. The failure of these two conditions in a large number of countries has led to the widespread abandoning of monetary targeting.

Inflation targeting avoids the problem of an unstable relationship between the goal and the intermediate target by focussing directly on the final goal. It also is easily understood by the public, and, in practice, has been associated with a significant increase in the transparency and accountability of monetary policy. However, a disadvantage of inflation targeting is the difficulty of directly controlling inflation. Moreover, the long and variable lags in monetary policy and the absence of a simple rule may make it difficult for the public to monitor the performance of the central bank in a timely manner.

Finally, the 'just do it' strategy of maintaining low and stable inflation can be used to describe the monetary-policy strategy of the US Federal Reserve in recent years. No explicit strategy is articulated, but it is similar to inflation targeting in its forward-looking behaviour. It has generally been successful but the paper argues that it might be overly dependent on particular individuals and therefore may not be a successful long-term strategy for monetary policy.

The Debate on Alternatives for Monetary Policy in Australia

Malcolm Edey

This paper reviews the arguments for and against various monetary-policy frameworks for Australia. Four broad possibilities are considered: quantity-setting systems based on the control of a monetary aggregate; final-targeting systems with an interest-rate instrument; exchange-rate or commodity standards, and a *laissez-faire* approach.

Three criteria are used to assess the relative merits of the different systems. First, does the system provide an anchor for inflation in the long run? Second, does the system have desirable short-run stabilisation properties? Third, does the system provide appropriate discipline on the monetary-policy decision-making process?

Most variants of the first three systems meet the first of these criteria.

The stabilisation properties of the different systems vary with the type of shocks that hit the economy. The prevalence of money-demand shocks and terms-of-trade shocks in Australia means that systems based on monetary aggregates or a fixed exchange rate would likely generate quite large business cycles. The argument against a fixed exchange rate is strengthened by the weak or negative correlation between terms-of-trade shocks in Australia and those in any country to which Australia might potentially peg its exchange rate.

Exchange-rate and monetary targets have the benefit of simplicity and transparency, but may constrain the discretion of policy-makers in an undesirable way. An inflation target can be regarded as 'constrained discretion' where a realistic balance is struck between simplicity and the ability to respond flexibly to shocks. By allowing policy to respond to all available information – and not just to the monetary aggregates – an inflation target allows discretion at the level of interpreting information, but subject to the constraint that the goal is achieved.

The paper also examines monetary-policy frameworks in other countries. The most obvious distinction between the various frameworks adopted by the industrial countries is that between the exchange-rate-pegging countries in Europe and the inflation-targeting countries. Amongst the inflation-targeting countries, the main difference is in the degree of inflation variability that the different approaches tolerate.

The paper concludes that theory, empirical evidence and international experience all argue in favour of a final-targeting system such as the inflation-targeting approach adopted in Australia. Such a system strikes a reasonable balance between a rigid rule and complete discretion.

Designing Inflation Targets

Andrew G. Haldane

This paper discusses three aspects of the design of inflation targets: the appropriate mean rate of inflation; the horizon of the inflation target, and the effects of increased central bank transparency.

There is broad consensus that standard measures of consumer price inflation overestimate actual inflation; typical estimates of the size of the bias are around 1 per cent a year. Abstracting from the issue of bias, an assessment of the appropriate rate of inflation depends on the welfare costs of operating at an inflation rate different from first-best and the disinflationary costs of moving to first-best.

The empirical evidence suggests that very high rates of inflation lower the growth rate of output. However, for countries with single-digit inflation rates, inflation appears to reduce the *level*, rather than the *growth rate* of GDP. Typical estimates of the sacrifice ratio suggest that the present value of the gains from lowering inflation from current levels to complete price stability exceeds the costs of doing so. However, the paper cautions that current estimates of the sacrifice ratio are derived from a period of moderate, not zero, inflation. A number of factors suggest that at zero inflation the sacrifice ratio may be higher. The first is that zero inflation implies that the real interest rate must be non-negative, and there may be times when real rates should be at or below zero. The second is that rigidities in the labour market may prevent falls in nominal wages, reducing real-wage flexibility. The third is that the fall in output required to move to complete price stability may have costly hysteretic effects on unemployment.

In assessing how forward looking monetary policy needs to be, two issues are relevant. The first is the length of the transmission lags between policy and its effect on output and prices. If policy-makers underestimate the transmission lag, monetary policy may generate cycles of its own. The paper also notes that as the inflation rate falls, the lags of monetary policy may become even longer. The second issue is the extent to which the authorities are prepared to trade off increased variability of output for reduced variability of inflation. If, after a shock, the central bank wishes to quickly return inflation to target, the cost may be greater variability in output.

The move to inflation targeting has seen an increase in the transparency of monetary policy. One aspect of this is the publication of forecasts for inflation. This ought to enhance credibility, as it allows the public to monitor the central bank's feedback rule. Empirical work for the United Kingdom indicates that the publication of the Inflation Report has helped reduce inflation expectations and reduced the volatility of the term structure of interest rates.

The Evolution of Monetary Policy: From Money Targets to Inflation Targets

Stephen Grenville

This paper traces the evolution of Australian monetary policy over the past decade or so. In particular, it examines how the monetary-policy framework has changed over this period and the reasons for the changes.

The paper discusses four phases in the evolution of Australian monetary policy: the end of monetary aggregates; the 'check-list' period in which policy was attempting to simply 'hold the line'; the period of rapidly rising asset prices; and the period of falling and low inflation. Each phase is discussed in terms of the degree of discretion that policy-makers had, the Bank's view of the transmission mechanism, and the broader macroeconomic context within which monetary policy was operating.

In explaining why Australia did not make more progress in reducing inflation in the 1980s, the paper argues that inflation reduction was seen as less important than remedying some of the structural imbalances that existed at the time. In addition, there was a general unwillingness to accept the loss of output involved in getting inflation down.

By the late 1980s there was growing concern that high inflation was having adverse effects on the economy. As a result, monetary policy became increasingly focused on reducing inflation. The unexpected depth of the early-1990s recession locked in lower inflation outcomes by reducing the community's inflation expectations. The adoption of an inflation target in 1993 has also helped in this regard.

The current framework has a clear specific final objective, with no intermediate objective or operational rule. The transmission mechanism is via output to inflation, although the exchange rate and price expectations also have central roles. Monetary policy acts as a 'stand-alone' instrument, directed principally at achieving price stability. Enhanced transparency and independence are also important elements in the current monetary-policy framework.

Which Monetary-policy Regime for Australia?

Warwick McKibbin

This paper examines the lessons for Australian monetary policy of the large volume of work undertaken on monetary-policy regimes by the Brookings Institution. The primary conclusion is that no simple monetary-policy rule dominates for all types of shocks or for all structures of the economy. The choice of policy regime depends upon a number of trade-offs between time consistency and credibility issues on the one hand, and the types of shocks that are expected, and one's assessment of how the economy actually works, on the other.

Given the nature of the Australian economy and the type of shocks that occur, monetary and exchange-rate targets are dominated by other policy frameworks. The current policy framework of 'targeting inflation over the cycle' is close to a rule from the class of Bryant-Hooper-Mann rules (also known as Taylor rules) that the Brookings project found to dominate other simple rules. These rules have short-term interest rates responding to deviations of inflation from target and output from potential.

The paper notes that there may be some advantage in the Reserve Bank of Australia being more explicit about how much it will adjust interest rates when inflation and output are away from their target values. It also notes that sticking to any simple rule at all costs will probably be suboptimal. On occasions, large shocks will occur which may require a re-assessment of the appropriate 'rule' for implementing monetary policy. The necessary changes will only be able to be made quickly if the central bank and others continue to improve their understanding of the Australian economy and its place in the global economy.

The Welfare Effects of Alternative Choices of Instruments and Targets for Macroeconomic Stabilisation Policy

John Quiggin

Over recent decades monetary policy has played an increasingly important role in macroeconomic stabilisation policy, while the role of fiscal policy has declined. This paper questions the desirability of this change, arguing that while monetary policy might stabilise aggregate activity, it does so at the cost of adding to the variability of individuals' consumption.

Macroeconomic policies should be concerned with maximising society's welfare. From a microeconomic perspective this means stabilising individuals' consumption, not macroeconomic aggregates. While monetary and fiscal policy may be able to achieve the same degree of macroeconomic stabilisation, they can have quite different effects on individual welfare.

Monetary policy influences the economy by changing the real interest rate, i.e. the relative price of consumption today compared to consumption tomorrow. While variation in this relative price through time might stabilise aggregate demand it can reduce individual welfare by making individual consumption more, not less, volatile. In contrast, fiscal policy operating through changes in tax rates can simultaneously stabilise individual consumption and aggregate demand.

While the use of fiscal policy for stabilisation purposes was common in the 1950s and 1960s, it would only be feasible in the present environment if the political obstacles to increases in tax rates were removed. Given the costs involved in changing tax rates, a reasonable strategy would be to allow one tax cut in a given contraction, with any further stimulus delivered through more frequent adjustments in government expenditure. The microeconomic analysis in the paper suggests that if such an option is unavailable, policy-makers should be extremely cautious about using monetary policy as a substitute.

The Australian Government's Current Approach to Monetary Policy: An Evaluation

Peter J. Stemp

This paper argues that the Reserve Bank of Australia (RBA) should have a single objective for monetary policy focused on a legislated inflation target. The case for this approach rests on three broad arguments. First, finetuning the business cycle is problematic given the difficulties of forecasting economic activity, and the long and variable lags of monetary policy. Second, inflation imposes costs upon the economy and inevitably is followed by a period of costly disinflation. Third, if monetary policy is concerned directly with employment, the authorities might target an outcome that is too high leading to rising inflation, but ultimately to no gain in employment.

In evaluating the RBA's approach to monetary policy, an index of independence and accountability is calculated. The index shows a substantial improvement in independence and accountability for the RBA between June 1987 and June 1997, although on all criteria used, the Reserve Bank of New Zealand and the Bank of England rank as high, or higher than the RBA.

The paper contains a number of proposals for the operation of monetary policy in Australia. Inflation should be the sole objective of monetary policy and the current inflation objective should be clarified so that it is clearer whether or not the objective is being met. There should be clearly defined review procedures if the specified target is not met, although there should also be an appropriate override clause in the case of a significant supply shock. Monetary-policy decisions should be delegated to an individual, or group of experts, who should be clearly independent of government. Finally, if policy decisions are taken by a group of experts, rather than an individual, minutes of the meetings of that group should be published.

Financial-asset Prices and Monetary Policy: Theory and Evidence

Frank Smets

This paper examines the appropriate response of monetary policy to changes in financial-asset prices. It argues that in an inflation-target regime, the basic principle should be that policy reacts to financial-asset prices if they affect forecasts of inflation.

A structural model is developed to show that changes in asset prices can affect expected inflation in two ways. The first is that a change in asset prices can directly affect aggregate demand. For example, rising asset prices increase wealth and the value of collateral for new loans. As a result, aggregate demand is likely to increase, and this might add to inflationary pressures. Second, even if changes in asset prices have no direct impact on aggregate demand, they may contain useful information about current and future economic conditions. For instance, a rise in stock prices might indicate a favourable supply shock and, all else constant, reduced inflationary pressures.

The paper also discusses the advantages and disadvantages of monetary conditions indices (MCI). It argues that while using an MCI as an operational target might be useful in terms of practicality and transparency, it does have a number of disadvantages. The concept of an MCI depends on a simple view of the transmission mechanism which may not be a good approximation to the actual working of the economy. Also, if asset-price movements occur in response to changing fundamentals, they need not be offset by changes in interest rates.

The paper's empirical assessment of the monetary-policy responses to asset prices in Australia and Canada, suggests that the Bank of Canada systematically responds to exchange-rate changes while the Reserve Bank of Australia does not. This is explained by the different types of shocks that affect each country. In Australia, terms-of-trade movements are a principal source of shocks to the exchange rate; the central bank does not attempt to offset these since changes in the exchange rate dampen the effects of the terms-of-trade shocks. In contrast, in Canada, nominal shocks to the exchange rate are more common; since these have an unambiguous effect on inflation, the central bank responds to them by changing interest rates.

Evaluating Simple Monetary-policy Rules for Australia

Gordon de Brouwer and James O'Regan

In pursuing the objectives of low inflation and the maximum rate of sustainable economic growth, most central banks use an overnight interest rate as their instrument of monetary policy. This paper examines various simple rules that might be used to determine the appropriate level of this interest rate.

These rules specify an interest-rate reaction function for the central bank in terms of a small number of variables, such as current or future output and inflation. Seven different policy rules are compared in terms of the outcomes on output and inflation variability. These include rules in which policy reacts to deviations of the price level and inflation from target values and rules which target the *level* and *growth rate* of nominal income. Also examined is a Taylor rule, in which interest rates respond to the weighted-average deviation of output from potential and inflation from target. To compare the various rules, a simple but data-consistent model of the economy is simulated using shocks representative of those that have hit the Australian economy in recent history.

The paper finds that the Taylor rule is the most efficient; that is, for any given degree of output variability, it minimises the variability of the inflation rate. Moreover, if the only objective of policy is to minimise the variability of inflation, policy should still respond to swings in the business cycle. This result arises because the variability of inflation is determined, in part, by the variability of output; reducing the variability of output reduces the variability of inflation.

The paper also examines the effect of changing the reaction coefficients on output and inflation in the Taylor rule. It finds that moving the interest rate by a larger amount in response to deviations of output from potential reduces the variability in both output and inflation up to some point, but excessively activist monetary policy can increase variability. The trade-off between output and inflation variability is convex: at relatively high levels of inflation variability, the costs to output stabilisation of reducing the variability in inflation are small, but they increase as inflation variability declines.

A forward-looking policy rule improves efficiency, relative to a simple backward-looking rule. In this respect, the inclusion in the policy rule of any variable with information about the future movements in output or inflation will improve efficiency. Greater credibility of an inflation target is also shown to reduce output and inflation variability.

The Smoothing of Official Interest Rates

Philip Lowe and Luci Ellis

Central banks tend to smooth changes in official interest rates. This involves changing interest rates relatively infrequently; moving interest rates in a sequence of steps in the same direction; and keeping rates unchanged for a relatively long time before reversing direction. This paper examines the reasons for, and the effects of, the practice of interest-rate smoothing.

The paper uses an empirical model of the Australian economy, where the forward-looking central bank aims at minimising expected deviations of inflation from target and output from potential. The effect of interest-rate smoothing is examined by adding a cost of interest-rate changes to the central bank's loss function and then varying that cost. The primary result is that a moderate degree of smoothing need not add appreciably to the variability of inflation and output. The main explanation for this result is that the lags involved with monetary policy mean that the current level of activity is influenced by the entire path of interest rates over the previous couple of years; making that path more volatile, but without changing the average interest rate very much, has little effect on output and inflation variability. However, the results suggest that while interest-rate smoothing has little effect on standard measures of output and inflation variability, it does lead to considerably longer cycles in both output and inflation.

One justification for interest-rate smoothing discussed in the paper is that larger and more frequent changes in interest rates might adversely affect the monetary-transmission mechanism; variable-rate debt would become less important and the announcement effects of monetary-policy changes would probably be weakened. Such changes would themselves likely reduce the desirability of large changes in interest rates. Although evidence of non-linearities is hard to find, the paper presents some evidence that changes in interest rates have a non-linear effect on consumer sentiment.

Another explanation of interest-rate smoothing discussed in the paper is that policy-makers are uncertain about the future state of the economy and view frequent changes in the direction of interest rates as costly. To a large extent these costs arise from the adverse impact that frequent interest-rate reversals would have on the ability of the central bank to justify its actions to the public. By moving in small steps, the possibility of frequent reversals is reduced and the monetary authorities can more clearly explain their policy actions. This is important for monetary-policy transparency and accountability.

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