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THE EXCHANGE RATE, INTERNATIONAL TRADE AND THE BALANCE OF PAYMENTS

Economic Group
Reserve Bank of Australia

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Introduction

Adrian Blundell-Wignall

Australia's economic relations with the rest of the world have undergone profound change over the past decade. The floating of the exchange rate opened goods markets to greater international competition and Australia's pattern of international trade changed considerably. Concomitantly, increasing integration into world financial markets saw Australia drawing more heavily on foreign capital. The papers in this Volume aim to increase our understanding of the implications of this process of internationalisation.

1. The Historical Context

In the past 15 years, two broad developments in the world economy have been particularly significant for Australia: financial market liberalisation and the emergence of the newly industrialising countries in Asia. From the late 1970s, financial liberalisation (and, in particular, the removal of capital controls) made financial markets increasingly globalised. At times, these developments were associated with speculative capital flows that undermined attempts to reconcile managed exchange rates with domestic macroeconomic objectives. At the end of 1983, against the background of more general moves to deregulate the financial system, the Australian dollar was floated.

Australia is a small commodity exporting country, subject to significant terms of trade shocks driven by the world commodity price cycle. Once the currency was floated, the nominal exchange rate was able to respond more rapidly to these external shocks, helping to cushion the domestic economy from the inflationary and deflationary pressures to which they gave rise. For example, falls in the terms of trade have been associated with real depreciation which has reduced the negative income effects of the terms of trade decline on exporters and has added a stabilising stimulatory influence to the domestic economy. While movements in the currency have been largely driven by commodity prices, it is widely felt that the depreciation in the mid-1980s went beyond that justified by fundamentals. While the real exchange rate recovered in the second half of the 1980s and fell again in the early 1990s, in line with the behaviour of the terms of trade, the overall trend in the past two decades has been one of real depreciation.

This downward trend in the real exchange rate occurred at a time when Australia also began to cumulate significantly larger external deficits, so that foreign debt was rising as a share of income. This too can be linked to the globalisation of world capital markets. The greater degree of integration of Australia into world financial markets meant that it became easier to attract capital from the rest of the world to finance investment independently of the level of national saving. There were two major investment booms in the 1980s associated with high real exchange rates and current account deteriorations. The first occurred around the time of the second oil price rise in the late 1970s/early 1980s, and resulted largely from improved prospects for the energy and minerals sectors. The second was associated with the asset price boom later in the decade. Both episodes were accompanied by a build-up in Australia's foreign liabilities and were followed by a world recession and falling commodity prices.

During the 1980s, the second major development in the world economy with strong implications for Australia was the rapid development of the newly-industrialising countries in the Asian region. South Korea, Taiwan, Hong Kong and Singapore set the pace, growing very quickly through export-oriented growth. Indonesia, Malaysia, China and Thailand also recorded high rates of growth. This meant that Australia now had the fastest growing region of the world on its doorstep. It also affected Australia's own policies toward competition, moving them away from inward-looking tariff protection, towards more outward-looking policies conducive to exports.

The combination of significantly reduced protection, the sharp downward movement of the exchange rate in the mid-1980s and the increasing industrialisation of the Asian region have been associated with major changes in the structure of Australia's trade. Both imports and exports have risen significantly as a share of GDP, and a much greater proportion of Australia's trade is now oriented towards the Asia-Pacific region.

Developments in other OECD countries have also been eventful. The rise of the US dollar in the early 1980s and the emergence of a large United States' current account deficit focused attention on exchange rate determination and the process of external adjustment. As the US dollar rose continuously through the first half of the 1980s, it was persistently trading at a discount in forward exchange markets, raising questions about the efficiency of the market. When the currency finally declined, the long lag before the current account responded left many wondering whether the relationships between relative prices and the external account had been significantly weakened by structural change.

While Australia moved to floating rates during the 1980s, European countries were on the opposite track, moving progressively towards fixed exchange rates. While political considerations were an important motivation, there was also a strong emphasis on the perceived economic benefits. It was argued that in the transitional phases, the Exchange Rate Mechanism (ERM) would help to bring about a convergence of inflation within Europe towards low German rates. By accepting the credible policies of the German Bundesbank, other European countries would be able to minimise the costs of disinflation. It was also argued that there would be strong microeconomic gains for trade and industry brought about by reducing - and eventually eliminating - exchange rate variability.

In the event, the European economies experienced a major real shock. The reunification of Germany saw the need for substantial 'catch-up' investment in the East, and large budget deficits resulted from the need to provide public infrastructure investment and to support the incomes of dislocated workers. Incremental saving had to be attracted towards Germany, and diverted away from other countries. This shift of resources required Germany's current account to move from significant surplus to deficit. To bring this about, while preventing excessive demand from spilling over into inflation, required both upward pressure on German real interest rates and an appreciation of the real value of deutschemark. With nominal exchange rates fixed, these adjustments could only be brought about by higher inflation in Germany, or by deflation elsewhere. Given Germany's commitment to low inflation and the rigidity of European labour markets, financial markets eventually perceived that this scenario would be too costly for most members of the ERM in terms of output and employment losses. One by one, the commitment of various European governments to the ERM was put to the test by speculators, with the result that by the middle of 1993 a number of significant realignments had occurred.

2. The Analytical and Policy Issues

The experiences of a range of countries raise a number of important analytical issues which are addressed in the papers in this Volume:

- Do nominal exchange rate changes cause persistent real exchange rate changes?
- Do foreign exchange markets operate efficiently?
- What impact do exchange rate changes have on the volume of a nation's exports and imports?
- What determines patterns of international trade?

The answers to a number of important policy questions turn on these issues. Perhaps the most important of these is the question of the exchange rate regime itself. Recent historical episodes in Australia and abroad illustrate only too well the need for flexible nominal exchange rates in the face of real shocks in a world where goods prices are sticky. On the other hand, fixing to a low-inflation currency, in the absence of real shocks, is a useful monetary rule, and may help to avoid misalignments caused by misguided exchange market speculation. Whether exchange rates should be fixed or floating depends partly on the nature of the macroeconomic objectives of policy, the flexibility of a nation's goods and labour markets, the types of shocks a country is likely to experience, and the extent of the microeconomic gains that might be associated with a common currency area. What is relevant for one country in these respects may be inappropriate for another.

If a floating rate is adopted, an important policy issue is the degree to which the authorities can influence the real exchange rate. If prices are perfectly flexible, then monetary policy has no impact on the real exchange rate. In contrast, if prices are slow to adjust, then policy may be able to influence the real rate over an extended period of time. A related policy issue concerns whether sterilised foreign exchange market intervention is a useful tool for influencing the behaviour of the exchange rate. Recent arguments favouring intervention emphasise its role as a signalling device to market participants in circumstances where speculation is driving currencies independently of market fundamentals.

A third set of issues concerns tariffs and other forms of industry assistance. The immediate impact of tariff cuts is to expose domestic industries to greater competition from imports. This may require a lower exchange rate if the trade balance deteriorates in the short run. On the other hand, tariffs act as a tax on exports, particularly for countries like Australia that import much of their capital equipment. Furthermore, increased competitive pressures may bring about dynamic gains and a greater outward-looking export orientation in the domestic economy. Long-run outcomes of competition policy may differ significantly from the short-run effects of such policies.

A fourth issue concerns whether or not policies to promote regional trading 'blocs' - the APEC grouping in Australia's case - are likely to enhance export performance. This will depend on the relative importance of a range of factors, such as resource endowments, political ties and income levels, which affect regional trade flows independently of the overall level of the real exchange rate in individual countries.

Finally, there is the issue of the sustainable level of foreign debt. Borrowing to undertake investment that yields high returns generates increased income and hence the capacity to service the debt. In contrast, if the investment returns are poor, the debt servicing may well require a significant real depreciation. There are also issues concerning the externalities imposed on new borrowers by the fact that there is already a large stock of outstanding Australian debt. Some assessment of the risk and costs of a sharp reduction of capital inflow is also necessary.

3. The Papers

The 'scene-setting' paper by Paul Krugman focuses on some of the major analytical and policy themes of the Conference. He gives his own broad overview of these issues, touches on some of the experiences of OECD countries in illustrating them, and comments on the problem of choosing an appropriate exchange rate regime.

The papers by Blundell-Wignall, Fahrer and Heath; Bullock, Grenville and Heenan; and John Pitchford, all deal with the Australian experience. The first of these deals with major influences that drive the Australian dollar, focusing in particular on its major cycles and its overall trend in the past two decades. It attempts to sort out which fundamental factors are most important in driving the equilibrium level of the real exchange rate. It also examines the evidence on the impact of inefficient speculation on major swings in the currency. The paper by Bullock, Grenville and Heenan examines how the exchange rate has interacted with other factors determining Australia’s imports and exports, including the moves to reduce effective rates of industry assistance in Australia and the rapid industrialisation of the East and South-East Asian economies. It outlines the significant structural changes in trade that have occurred since the middle of the 1980s, and assesses the relative importance of the factors which promoted them. Both papers touch on the issue of whether the real exchange rate and trade performance are evolving in ways that will permit foreign liabilities to be stabilised as a share of GDP. The paper by John Pitchford provides an assessment of Australian policies towards the exchange rate during the 1980s and 1990s. The paper also provides a framework for identifying which exchange rate regime is likely to be most suitable for achieving macroeconomic goals in Australia.

An alternative perspective based on the experience of other OECD countries is provided by Mike Artis. The emphasis in his paper is on the experiences of countries which target the exchange rate. This includes both ‘weak form’ targeting, such as the Plaza Accord mechanisms, and the ‘strong form’ target zones implemented within Europe. An analysis of the causes and consequences for policy of the recent breakdown of the ERM is a primary focus of this paper.

Jeffrey Frankel takes up the issue of whether there is a tendency for special regional factors to cause ‘blocs’ of countries to trade more with each other than is ‘normal’ in bilateral trading relationships throughout the world economy. He examines most well-known country groupings and, of particular interest from Australia’s perspective, he provides some direct evidence about whether the APEC grouping is a ‘natural’ trade bloc.

Recent Thinking About Exchange Rate Determination and Policy

Paul Krugman

There is a certain irony in the title of the paper that I was asked to write for this Conference. While there has, of course, been a lot of recent work on exchange rate determination, this work has had little impact even on sophisticated policy analysis. Indeed, it is striking that policy discussion has been based on an underlying model of exchange rate determination that has changed little since the mid-1970s. The workhorse model of policy analysis remains the Mundell-Fleming approach, modified mainly to allow for some expected regression of the exchange rate towards a long-run 'normal' level.

Consider, for example, the way in which most commentators discuss the exit of the United Kingdom from the exchange rate mechanism of the European Monetary System (EMS). We say that the purpose of the exit was to allow the Bank of England to cut interest rates; that this cut in rates inevitably led to a fall in the pound sterling against the deutschemark (DM); and that the combination of more competitive UK exports and the investment effects of the lower interest rates have allowed the United Kingdom to begin an economic recovery even while the rest of Europe continues to slump. What is the underlying model? Clearly, it is IS-LM with high capital mobility plus regressive expectations on the exchange rate, right out of an undergraduate textbook (say, to take an arbitrary example, Krugman and Obstfeld (1991)).

Why isn't there a more up-to-date canonical model of exchange rate determination? It is not for the want of trying. Indeed, there was a 'heroic age' of exchange rate theory from the mid-1970s to the early 1980s. During that era there were major competing schools of exchange rate theory (Dornbusch's overshooting model, the monetary models of Frenkel and Mussa, the portfolio models of Kouri and Branson) that attracted both efforts at theoretical extension and a considerable amount of empirical work. By about 1979, one would have described exchange rate economics as a field dominated by innovation, and one in which ideas were rapidly changing.

Unfortunately, that heroic age ended when empirical work succeeded in refuting not one or two but *all* of the contending theoretical approaches. From my point of view, the two key papers were Hansen and Hodrick (1980) and Meese and Rogoff (1983). The Hansen and Hodrick paper was the first of what was to become a host of papers refuting the proposition that forward premia are efficient, unbiased, or even halfway reasonable forecasts of subsequent changes in exchange rates. I'll go into the reasons why that result was so devastating below, but for now, let me simply note that the assumption of rational expectations was central to all of the new models of exchange rates. Without financial market efficiency, one was back in the old-fashioned world of macroeconomic models with *ad hoc* assumptions about expectations, a world that young exchange rate theorists thought they had put behind them.

The Meese and Rogoff paper stepped back from the efforts of empirical modellers to show that their preferred approach to the exchange rate did a better job than the others, and to ask whether any of the approaches did well enough to warrant consideration. There is still controversy over the philosophical basis of their test, which compared out-of-sample forecasts using the actual values of explanatory variables with a random walk. However, the paper highlighted the extremely poor performance of all models to such an extent that it became difficult to present another set of weak regression results without embarrassment.

The theory of exchange rate determination has never recovered from the empirical debacle of the early 1980s. While there has been considerable work, both on theoretical models and on empirical testing of propositions about exchange rates, I think that it is not unfair to say that for the most part international monetary economists have given up, at least for now, on the idea of trying to develop models of the exchange rate that are both theoretically interesting and empirically defensible. Quantitative policy analysts must have something to determine exchange rates in their empirical models, so they either have an exchange rate equation that more or less fits the data or simply impose some mechanism, but they make little pretence that they have solved the riddle of exchange rates. Theorists work with models in which the exchange rate is determined by certain fundamentals, but there is little effort to confront these models with evidence.

And yet, serious and useful work on exchange rates goes on. Instead of trying to find a working model of the complete process of exchange rate determination, however, this research tends to break off questions that are pieces of the puzzle. In the remainder of the paper I discuss three such questions that seem to me to be of crucial importance: the speculative efficiency of the foreign exchange market, the real effects of nominal exchange rate changes, and the role of real exchange rates in the trade balance.

On each of these questions I follow the same format. I pose the question and ask why it is important, then summarise what I take to be the current state of the evidence. This is followed by a description of some popular 'rationalisations' - that is, claims that the evidence does not show what it appears to. Finally, I discuss some recent concepts that have given the controversy a new lease on life.

1. Is the Foreign Exchange Market Speculatively Efficient?

1.1 Why it Matters

The speculative efficiency hypothesis - the view that the market takes into account the available information and does not make systematic mistakes - is a powerful idea. Indeed, it is so powerful that economists are extremely reluctant to abandon it even in the face of adverse evidence. This is true in finance and in macroeconomics but, above all, it is true in the economics of exchange rate determination, where the question of whether or not markets are speculatively efficient is critical to both theory and policy.

The reason why speculative efficiency is so crucial to theory sounds somewhat discreditable, but it should not. Without rational expectations, it is difficult to do much in the way of theory at all. In exchange rate models from overshooting to smooth pasting, the assumption of speculative efficiency is crucial to tying down the behaviour of asset markets. In the Dornbusch overshooting model, for example, one imposes *ad hoc* but plausible assumptions about price behaviour and money demand; the interesting results occur when one shows that given this assumed behaviour, the *rational* response of the exchange market is to produce overshooting, with all of its implied real exchange rate volatility. If one does not assume rationality, by contrast, the behaviour of the exchange market is as much imposed by the theorist as anything else: the magician essentially pulls out of the hat the same rabbit the audience has seen him stuff in a few minutes earlier.

As I have already indicated, this sounds like a spurious reason to want to believe in speculative efficiency, but I think that it has considerable justification. Physicists tend to prefer hypotheses about nature that constrain their theories rather than leave a large number of free parameters; a preference that has tended over time to steer them in the right direction. Why shouldn’t economists show the same kind of preference?

On a more practical level, the question of whether markets are speculatively efficient is crucial to the debate over exchange rate regimes. The practical man’s argument against floating exchange rates, from Ragnar Nurkse to George Soros, has always been that they are subject to destabilising speculation - that markets get carried away in one direction or another, giving rise to excessive and presumably costly variation in exchange rates. One of the most effective counter-arguments is the claim, originally made by Milton Friedman, that markets don’t work that way, and that rational speculators will try to burst bubbles rather than create them. While there has been some confusion over the Friedman hypothesis, both from high theory (the possibility in some models of rational bubbles) and more prosaic concerns (how do we define stabilising speculation?), his basic argument stands: the kind of irrational herding behaviour that opponents of floating exchange rates fear, should be ruled out by speculative efficiency.

It would, then, be both an easier world to model and a more comfortable world to live in if exchange markets were speculatively efficient. What is the evidence?

1.2 The Basic Evidence

The simplest form of the speculative efficiency hypothesis assumes both efficiency and risk-neutrality, so that the forward premium is the best available predictor of the subsequent change in the exchange rate. Since investors are not risk-neutral, one would not be surprised if the test were failed in a technical sense. The actual failure is, however, such a blowout that it is very difficult to rescue the hypothesis in any other form.

I will not try to survey all of this enormous literature; the survey by Froot and Thaler (1990) covers much of the ground. Basically, it turns out that for exchange rates in which the US dollar ($US) is one of the currencies, not only is the forward premium not an efficient predictor of the subsequent change in the exchange rate, its correlation with that subsequent change is actually perverse. In terms of the basic regression:

$$\Delta s = \alpha + \beta f + u \tag{1}$$

where we ought to find $\alpha = 0$ and $\beta = 1$. In fact, we typically find $\beta < 0$. That is, the forecast errors are very strongly negatively correlated with the forward premium itself. For other currency pairs, the results are not quite so striking but, in terms of the formal criterion - that no information available to investors at the time they sign a contract should be correlated with the forecast error - the results remain devastating.

It is tempting to argue that this test proves little, since we know that investors are not risk-neutral. In fact, however, before the tests were first performed, people did think that β would come out at least close to 1, and when some early regressions were misinterpreted as showing that this was true, they were claimed as evidence in favour of speculative efficiency. Moreover, there is substantial evidence that risk aversion alone cannot explain away the results. Expected exchange rate changes from surveys look much more like the forward premia than like the expected actual outcome given available information. To explain the perverse correlations one needs large and shifting risk premia, yet there is no plausible explanation of such shifts.

The most favourable thing that one could possibly say is that the data give no positive support to the idea of speculative efficiency. Most people would view things even less favourably: the assumption of efficiency is something that must be maintained in the face of seemingly unfavourable evidence. In my view, the situation is even worse: there is no plausible way to reconcile the assumption of speculative efficiency with the data.

Unfortunately, that is such an uncomfortable conclusion from the point of view of both modelling strategy and policy prescription that even after a decade of negative results theorists are still looking for a way out.

1.3 Rationalisations

Leaving aside the possibility of large, shifting risk premia, I would identify two ways in which serious efforts have been made to rationalise the failure of simple efficiency tests.

The first is the ‘peso problem’. This problem takes its name from the futures market in the Mexican peso during the years before the 1977 devaluation, which put the peso at a consistent discount. As a number of people have pointed out, any test of the efficiency of that market before 1977 would have concluded that it was inefficient, since the futures price of a peso consistently mispredicted the actual price, which itself had very little variance. Yet, that discount was the result of a belief by investors that there was some probability of a large devaluation, a belief that turned out to be justified.

In general, the peso problem may be defined as the presence of potential large events, whose possibility affects behaviour significantly even though they occur rarely. Thus one might have 60 months of observations, which seems like a large sample; but it is quite possible that throughout this period there is a varying but real chance of a 100 per cent devaluation over the next month, producing a large capital gain to holders of foreign currency. If the devaluation does not happen to materialise during the sample period, the market appears inefficient.

From a statistical point of view, the peso problem is simply that shocks may not be normal; they may have very fat tails. As a result, our usual statistical tests may be misleading.

It is worth noting that stories that attempt to explain exchange rate volatility by invoking such exotic things as rational bubbles can confront the failure of the efficiency tests only by bringing in particular versions of the peso problem: in the rational bubbles case, the efficiency test may appear to fail because of the potential large exchange rate change when a bubble bursts.

Leaving aside such stories, however, the natural way to confront the peso problem is to ask what large event the markets might have been worried about. In some cases there is a natural event of this kind: in the case of the German hyperinflation, studied by Krasker (1980), stabilisation provided the obvious ‘peso’ event. In the case of ‘Southern cone’ stabilisations, studied by Kaminsky (1982), the prospect of eventual collapse of the crawling peg regimes plays a similar role. However, for the industrial country experiences since 1973, peso problems seem hard to rationalise given the absence of probable abrupt shifts in regime.

Furthermore, the apparent bias in forward rates was so large during the 1980s that either the mysterious potential shock must have been unreasonably large, or it must have been perceived as fairly likely; in that case, the actual experience, that the shock never materialised, is a highly unlikely draw and we are again in the position of finding apparent inefficiency in the market.

While it is hard to argue definitively against the possibility of something that might have happened but did not, on the whole, the ‘peso problem’ explanation of apparent inefficiency is not convincing for recent exchange rate experience.

The other main way to make sense of the apparent irrationality of exchange markets is to argue that investors have been engaged in a process of learning about the structure of the world in which they live. If investors initially do not know the parameters of the economy, and must base their expectations on a model that is continually updated in the light of experience, it might be possible to look back over the data and find consistently biased expectations even though everyone was in fact doing the best he or she could given the available information. On this view, the standard tests for efficiency would apply only to a long-run equilibrium situation in which agents have had an arbitrarily long time to revise their expectation-forming mechanisms; in the real world, one would expect to fail the tests.

This is a highly reasonable argument and has been elaborated by Lewis (1989). The problem with it is that it does not justify the use of rational expectations models, since a world in expectational disequilibrium may behave very differently from the ‘ergodic’ models favoured by theorists. Indeed, there is no guarantee that this ergodic world emerges even in the long run. Perhaps, beliefs and the actual behaviour of exchange rates drive each other in endless circles (or strange attractors!). In other words, the learning/disequilibrium hypothesis may save the idea of investor rationality, but only by making that idea much less useful as a help in understanding the world.

In summary, while there are sophisticated ways to rationalise the apparent failure of exchange markets to meet efficiency criteria, they either lack plausibility or create as much trouble as they solve.

1.4 The Return of Efficiency: Target Zones

In spite of the disastrous failure of the speculative efficiency hypothesis when tested directly, in the late 1980s and early 1990s that hypothesis was once again fashionable in theoretical models. The ‘smooth pasting’ literature originally developed to analyse target zones could be criticised on many grounds, but one central problem was that it presumed the same risk-neutral speculative efficiency that the data seemed to reject. The reason for this assumption was, of course, its power to constrain the theory: with speculative efficiency one could derive a pleasingly elegant and initially surprising solution, without it the theory would be so unconstrained as to be uninteresting.

Given what we know about the empirical evidence on exchange markets generally, it is not surprising that the target zone model has fared badly in the face of the data. (See Svensson (1992) for a useful survey.) Interestingly, however, most of the proposed solutions have involved rational behaviour by investors given more complex processes; here, as elsewhere, we have difficulty in facing up to the implications of the apparent irrationality of the financial markets.

2. Do Nominal Exchange Rates Have Real Effects?

2.1 Why it Matters

Since the early 1970s, macroeconomics, in general, has been divided into two schools variously known as new classical and new Keynesian, fresh water and salt water, equilibrium and disequilibrium. The core disagreement between the two schools is over the flexibility of nominal prices. In Keynesian macroeconomics, of course, sluggish price adjustment is crucial to the story of why demand shocks affect the level of output. The new classical attack on Keynesian ideas asserts that prices cannot be sticky because that would represent irrational behaviour and that business cycles must, therefore, have another explanation.

The debate over the real effects of nominal exchange rate changes must be seen in the context of this broader dispute. Can a nominal devaluation lower the relative prices of the devaluing country's goods and/or labour? If so, this is of direct importance for the choice of exchange rate regime, because flexible exchange rates can then be a useful way to ease the process of adjustment to a variety of shocks. It is also, however, of considerable importance to the general macroeconomic debate: if the nominal exchange rate can affect the real exchange rate, then nominal variables may be presumed to have real effects in general. If, on the other hand, we are convinced that 'the exchange rate is the relative price of two monies, not of two goods' (Mussa 1979), and that exchange rate changes are normally matched by an offsetting combination of inflation in the depreciating country and/or deflation in the appreciation country, we also reinforce the case for new classical macroeconomics in general.

2.2 The Basic Evidence

The evidence on the real effects of nominal exchange rate changes is, at first sight, overwhelming: for industrial countries, especially since 1980, nominal exchange rates have been reflected in nearly one-for-one changes in the relative prices of goods and labour.

The $US is the most obvious example: from 1980 to 1985 its trade-weighted nominal exchange rate rose a logarithmic 49 per cent, its real rate by 44 per cent; then, from 1985 to 1990, the nominal rate fell 47 per cent, and the real rate fell 43 per cent. The $US experience is not, however, unique. To take the most recent example, the exchange rate adjustments that took place within Europe following the EMS crisis of 1992 were not, to any visible extent, offset by inflation in the depreciating countries or deflation in the countries that remained pegged to the DM; thus, these nominal exchange rate changes appeared to have very nearly one-for-one impacts on real exchange rates.

The overwhelming evidence, then, is that depreciation and appreciation are *not* reflected in corresponding inflation or deflation. Indeed, the evidence is so strong and straightforward that it can be regarded as 'Exhibit A' in the case for Keynesian macroeconomics and against the new classical view.

2.3 Rationalisations

Classical macroeconomics is extremely attractive, for the same reasons that the hypothesis of speculative efficiency is attractive: a world of clearing markets and rational agents is much more satisfactory from the point of view of the theorist who wants definite answers than a world in which one must make *ad hoc* assumptions like sluggishly adjusting prices. Thus classical macroeconomists have been reluctant to accept even the seemingly 'in-your-face' truth of the proposition that nominal exchange rate changes produce nearly equal changes in relative prices.

There is essentially only one way to argue with this evidence: to claim that the causal relationship actually runs the other way: that is, real shocks cause real exchange rates to change and these real shocks dominate the movements in nominal rates as well.

There is no question that real shocks occur and that they do move real exchange rates. Most notably, changes in the prices of oil and other raw materials have clearly played an important role in the movements of the exchange rates both of raw materials exporting nations and to some extent of highly import-dependent nations like Japan. One can also argue that changes in fiscal policy (like the emergence of US deficits under Ronald Reagan or German deficits after reunification) are, in effect, real shocks as well. The question is whether such real shocks can explain away the striking correlation between nominal and real exchange rates. The answer is almost surely no, for at least three reasons.

Firstly, while a reverse causation from real shocks to nominal exchange rates can explain a correlation between nominal and real exchange rates, the actual correlation is not a modest one - it is virtually perfect, with a coefficient of almost unity. This is just too much to explain unless one is willing to suppose that there are virtually no exchange rate changes that are *not* the result of real shocks, a view that is difficult to defend.

Secondly, the timing of exchange rate changes - closely matched to political events and seemingly unrelated to real shocks - is hard to reconcile with the reverse causation story. To take the most conspicuous recent example, what was the real shock that abruptly reduced the equilibrium relative price of UK goods and services by 10 per cent during the week following September 16th, 1992? (Should George Soros be considered an exogenous real variable?) The same questions arise when one considers the fall in the $US after the Plaza Accord.

Thirdly, it is difficult to reconcile a ‘real shocks’ story of real exchange rates with the observed changes in behaviour across exchange rate regimes. It is a glaringly obvious fact that real exchange rates have been much more volatile since 1973 than before, and that the adoption of the Exchange Rate Mechanism (ERM) of the EMS was associated with a sharp reduction in the volatility of intra-European exchange rates. It is implausible to argue that the nature of real shocks changed dramatically right on cue as the regime changed.

It may be worth pointing out one serious diversion in the discussion of the evidence on the relationship between nominal and real exchange rates: the issue of an alleged unit root in the real exchange rate. In the exchange rate discussion, as in other parts of macroeconomics, initial tests that seemed to fail to reject the hypothesis of a unit root in the real exchange rate were taken by some economist as evidence of the predominance of real shocks. The argument went like this: models that depend on short-run price stickiness, like the Dornbusch overshooting model, exhibit mean reversion in the real exchange rate, whereas a real shock could be permanent. Thus, the absence of evidence for mean reversion is treated as evidence for real rather than nominal shocks.

At this point I think that the wrongness of this argument is generally appreciated, but it may be worth re-emphasising. Firstly, while some real shocks could lead to permanent changes in the real exchange rate, many should not. Indeed, the idea that relative prices should follow a random walk even in a flexible price world seems more like a knee-jerk carryover from asset-pricing theory than a carefully thought-out proposition.[1] Secondly, a point emphasised by Jeffrey Frankel among

1. I have been puzzled by the importance attached by so many economists to unit root findings, often in the face of what seems like obvious evidence that there is, in fact, a tendency to return to a long-run trend. For example, in some studies a unit root is found in US real GDP. But the US unemployment rate shows a clear, unambiguous tendency to return towards the mean; and Okun’s Law, the relationship between changes in unemployment and output growth, is one of the most solid empirical relationships in economic analysis. Why ignore this evidence from the labour market, which seems so obviously to validate the conventional trend-and-cycle view of growth?

others, if mean reversion is slow (as it will be if prices adjust slowly) it will normally take very long time series to reject the hypothesis of a random walk; ironically, the further the economy is from flexible prices, the longer the time series that is necessary. Finally, when sufficiently long time series are used, one *does* find the mean reversion one expects from sticky-price models.

In summary, the evidence on the real effects of nominal exchange rate changes is about as clear as anything in economics: nominal depreciation produces a sustained reduction in the relative price of the depreciating country's goods, services and labour. If that evidence sits uncomfortably with influential macroeconomic doctrines, so be it: it is the doctrines that need changing, because the evidence stands.

2.4 The Return of Price Flexibility: Credibility

Even though there is overwhelming evidence that nominal exchange rates have real effects, there is an influential policy doctrine that urges countries to act as if any depreciation will lead to an immediate offsetting rise in prices. This is the doctrine of credibility, which argues that wages and prices are largely determined by expectations of future inflation and that a fixed nominal exchange rate can be a peg on which to hang a credible commitment to future price stability. The credibility doctrine is most influential among European policy makers who use it to justify the sacrifices needed to remain within or (for non-members) 'shadow' the ERM; but it is also influential in stabilising developing countries such as Mexico and Argentina.

Policy makers who believe in the credibility doctrine argue that any devaluation of their currencies will fail to produce the desired gain in competitiveness because it will simply lead to a burst of inflation. This sounds like the classical view that nominal variables cannot have real effects. The chain of argument is, however, somewhat different: it is not argued that nominal variables are inherently neutral in a market system, but rather that wage and price-setters, who may have considerable market power, will respond to the depreciation by increasing their demands. The conclusion, however, is the same: depreciation simply doesn't 'work' in real terms.

The doctrine of credibility is widely held, but seems to be based more on anecdotes and selective interpretation of history than on careful examination of the evidence. For example, in Sweden, it is widely noted that the effects of the 1982 devaluation were wiped out by inflation after a few years. Yet, it is not often observed that the inflationary boom of the mid-1980s was largely due to a mishandled deregulation of the banking system, not the devaluation.

In any case, recent events seem to suggest that the credibility doctrine was, at the very least, oversold. It was widely asserted, for example, that any depreciation of the pound would lead only to an explosion of inflation; given the experience since Black Wednesday, this fear looks irrational. In general, the emergence of a policy consensus during the late 1980s, that nothing is lost by fixing exchange rates, seems to be an example of how a conventional wisdom can take hold based on little or no evidence.

3. Do Real Exchange Rates Matter For Trade Flows?

3.1 Why They Matter

The idea that a weaker $US will reduce the US trade deficit, or that a stronger yen will reduce Japan's surplus, seems straightforward. Yet it is an idea that receives startlingly hostile attacks from both the Right and the Left.

During the 1980s most of the attacks came from the Right. Why would the *Wall Street Journal*, for example, feel that it was important to refute the idea that a lower $US would spur exports? Presumably because any suggestion that currency depreciation does something useful threatened their case for a return to the gold standard or some simulation thereof. Similarly, more moderate monetary conservatives in Europe were unwilling to acknowledge that exchange rates play any useful role in trade adjustment because that amounts to a potential argument against the European Monetary Union.

The characteristic conservative argument against any role for exchange rates is essentially to point to the famous identity $S-I=X-M$. While there is a naive view that this identity somehow allows savings-investment balances to translate into trade balances without any intervening real variables (what John Williamson has called the doctrine of immaculate transfer) the more sophisticated view holds that markets for goods and services are sufficiently well integrated that a change in the national composition of world demand requires hardly any change in relative prices.

At present, however, the more important critics of the idea that the exchange rate affects the trade balance are on the Left: advocates of 'managed trade', especially in the United States, are unwilling to accept the idea that overall trade imbalances can be corrected without direct imposition of quantitative restrictions. Indeed, an assertion of the ineffectiveness of the exchange rate is crucial to demands by the United States, at the time of writing, that Japan accept numerical targets not only for a number of particular imports but for its current account as a whole.

These critics from the Left essentially have the same view as the 'elasticity pessimists' of the early post-war period: the responses of trade flows to prices are too small to be helpful, indeed, small enough that the Marshall-Lerner condition may not be satisfied. These alleged small trade responses are blamed both on market imperfections and on what is perceived as a world in which trade is increasingly managed.

So the proposition that exchange rate depreciation spurs exports and limits imports bothers a wide range of opinion across the political spectrum.

3.2 The Basic Evidence

The best evidence in favour of the role of exchange rates comes from the United States, where since the early 1970s, depreciations have consistently been followed by an improved trade performance and appreciations by worsened performance.

Consider the $US cycle of the 1980s. The $US hit a trough in 1980, a peak in 1985, then fell rapidly. All empirical studies suggest a substantial lag in exchange rate effects; the picture for the 1980s looks best with a two-year lag. And the numbers are very striking. From 1982 to 1987, US real exports of goods and services rose at an annual rate of only 4.1 per cent, while imports rose at an annual rate of 10.2 per cent. From 1987 to 1991, exports rose at an annual rate of 9.8 per cent while imports went up by only 2.5 per cent annually. It is difficult to think of any explanation of such a radical change in trade performance other than the fact that the $US rose for the first half of the decade and fell for the second.

Robert Lawrence once pointed out that the $US cycle of the 1980s played out almost like a controlled experiment on the effects of exchange rate fluctuations. Initially, the $US soared in a real appreciation which, in magnitude, has few precedents; then it fell to roughly its starting position. The result has been to allow much tighter fitting of standard trade equations and also, seemingly, to confirm their usefulness: while predictions have not been perfect, exchange rates seem to play a conventional role in determining trade flows.

But as in the case of our previous question, yes is an answer that many people are unwilling to accept.

3.3 Rationalisations

Those who remain unconvinced of the effectiveness of exchange rates in affecting trade generally make their case by pointing to experiences other than that of the United States. For the conservative critics, the case in point is trade adjustment within Europe; while for the critics from the Left, it is Japan's persistent surplus.

For Europeans who think that exchange rates do not matter, the case in point has been the shift in current account balances since 1989. Since reunification, they point out, Germany has moved from a large surplus to a large deficit *vis-à-vis* its European partners even though it has remained under a fixed exchange rate regime, with only small differences in inflation rates. Doesn't this show that changes in savings-investment balances can be translated into changes in trade balances without the exchange rate as a transmission mechanism?

The short answer is yes, it does - but only because changes in real output took place instead. The effect of German reunification was a fiscal-led boom in West Germany even while high interest rates squeezed demand elsewhere. If European markets had been very well integrated, the increased German demand would have been spread evenly around Europe. In fact, from 1989 to 1991 the West German unemployment rate fell sharply while the rate in the rest of Europe rose, and West German industrial production rose 9 per cent while production fell in the rest of Europe. The German economy is very open, relying heavily on industrial goods produced elsewhere in Europe, especially in the Low Countries, so that changes in demand fall more on imports than is the case in, say, the United States; thereby, the German boom was more effective at turning a current account surplus into a deficit than a comparable boom would have been in the United States or Japan. But nothing in that experience suggests that at constant rates of unemployment, a reduction in Germany's $S - I$ could have been translated into a corresponding change in her $X - M$ without a substantial real appreciation.

On the whole, the attempts to use European experience to debunk the apparent role of exchange rates in trade balance determination look increasingly unconvincing. My guess is that they will look even less convincing a year from now, when the effects of the depreciation of the pound have had time to work themselves through the pipeline.

Perhaps surprisingly, the neo-structuralists who point to the Japanese experience are somewhat harder to answer. The raw facts look like this: in 1985, there were about 240 yen to the $US, and Japan had a current account surplus that peaked in 1987 at 4 per cent of GDP. In 1992, the yen averaged 125 to the $US, yet Japan was once again running a current account surplus of more than 3 per cent of GDP. Doesn't this show that at least in the case of Japan, exchange rates cannot move the trade balance?

I do not think that Japanese trade is really insensitive to the exchange rate, but the defence is fairly complicated - exculpatory factors, rather than a one-sentence answer. The factors include the following: lower inflation in Japan than in the United States, so that the real yen has not appreciated as much as the nominal; a long-term upward trend in the equilibrium real yen, due to rapid technological progress concentrated in tradeable sectors; and a massive favourable shift in Japan's terms of trade, due to falling real prices of raw materials. Equations fitted to Japanese manufacturing trade show price elasticities comparable to those for US trade, a fact that leads me to conclude that it is these special factors rather than an absolute lack of exchange rate response that explains the persistence of Japan's surplus. Still, in this case, we do not have the kind of overwhelming, simple evidence that we have in many of the other issues discussed in this paper.

Perhaps the important point to remember, however, is that if there is any question about the impact of exchange rates on trade, it applies only to Japanese trade - and in spite of some US paranoia, Japan is only a small part of the world trade picture. Broadly speaking, the evidence is still that exchange rates do work in the adjustment process. Indeed, the experience of the 1980s makes that evidence stronger than ever before.

4. Implications For Policy

4.1 Does Exchange Rate Theory Give Any Policy Guidance?

It is notoriously difficult to translate exchange rate models into policy prescriptions. Like all plausible monetary models, exchange rate models generally lack a clear microeconomic foundation, making it impossible to do any rigorous welfare economics. Nor is it as easy to assign plausible criteria for ranking outcomes as it is in domestic macroeconomics, where we have little trouble concluding that everyone would prefer output to be high and stable.

Suppose, for example, that it had turned out that Dornbusch's overshooting model fitted the data quite well. Should one have concluded from this that floating exchange rates are a bad thing, because they tend to be inherently very volatile? Or should we have concluded that the observed volatility shouldn't worry us because it may be driven by fully rational behaviour? At this point the answer is moot, because the model turns out not to be validated by the evidence; but the question helps illustrate why it is hard to go from conclusions about exchange rate determination to conclusions about policy.

Nonetheless, there is a framework that is widely used to discuss the welfare economics of exchange rate policy, namely the optimum currency area discussion. So it is worth asking how the current state of thinking about exchange rate determination has a bearing on that framework.

4.2 Optimum Currency Areas

The optimum currency area theory essentially views the choice of exchange regime as a trade-off between macroeconomic flexibility and microeconomic efficiency. If exchange rates are flexible, then nations that for some reason have managed to get their wages and prices out of line need not suffer extended recessions in order to work them down; they can simply devalue or allow their currencies to depreciate. That was the argument Keynes made in 'The economic consequences of Mr Churchill'; it is the same as the argument that prevailed when Norman Lamont pulled the United Kingdom out of the ERM.

On the other hand, flexible exchange rates expose nations to the microeconomic costs imposed by unstable units of account, costs that are that much greater if currencies are subject to irrational, destabilising speculation. Concern about these microeconomic costs, and worries about destabilising speculation, underlay both the creation of the Bretton Woods system and the creation of the EMS.

So what can we say about this trade-off? Unfortunately, the evidence on exchange rates seems to cut both ways.

There was a time when many economists, both monetarist and Keynesian, accepted Milton Friedman's argument that flexible exchange rates would work smoothly, because rational speculators would act to stabilise rather than destabilise exchange rates. In the light of the evidence, however, Friedman's argument does not seem very reassuring: the traditional concern about irrational, destabilising speculation seems as relevant as ever.

On the other hand, until very recently, many economists (and policy makers) would have denied the usefulness of exchange rate flexibility, on the grounds either that nominal realignments do not produce real realignments, or that real realignments play no role in the adjustment process. Here again, however, the evidence seems to suggest that the traditional concerns remain as valid as ever.

In brief, flexible exchange rates are useful but unreliable; a fixed exchange rate regime may buy stability at the price of a lack of adjustment.

4.3 Exotic Proposals

One surprising aspect of recent thinking about exchange rate policy has been the re-emergence of what we might call exotic proposals for exchange regimes; proposals that try to reconcile the conflicting claims of fixed and flexible rates by adding other policy instruments, such as some form of capital controls.

The apparent justification for such schemes should be clear. Suppose that you are convinced that the foreign exchange market is unreliable, subject to irrational speculative bubbles. Then you may be unwilling to allow exchange rates to float freely, preferring at any given time to peg the exchange rate. Yet a permanently fixed exchange rate means abandoning the help that exchange rate flexibility can provide in adjustment. A seemingly useful compromise, then, is an adjustable peg: an exchange rate that is normally fixed, but adjusted when it seems clear that a change in relative prices is necessary.

There is, however, a major problem with such an adjustable peg system in a world of capital mobility: it is subject to massive speculative attacks whenever the market suspects that a realignment is in prospect. So what do you do? Economists have repeatedly come up with the same answer, which has now been revived in a more sophisticated form by Eichengreen and Wyplosz (1993): capital controls that discourage such speculative attacks.

It is astonishing, in a way, that such proposals are now resurfacing. During the 1980s, most countries developed a strong commitment to 'clean' foreign exchange policies: currencies were to be fully convertible, with the maintenance of any target exchange rate a job essentially for monetary policy; capital flows were a microeconomic issue and were not to be meddled with for macroeconomic purposes. Only a few years ago, the complicated schemes of the Bretton Woods era, with their capital export taxes, deposit requirements, and so on, seemed antique and foolish. What we have now discovered, however, is that the problematic trade-offs that motivated these schemes are still there.

My personal gut feeling - I cannot really call it a judgement - is that even sophisticated forms of capital controls are a mistake, except in crisis; that the microeconomic costs of such controls tend to grow over time and/or their effectiveness tends to be eroded. However, this may be more an aesthetic judgement, a preference for clean policies and a strict separation between macro and microeconomics, than a reasoned policy conclusion.

So let me conclude on a somewhat dispiriting note: recent thinking about exchange rate determination has taught us a great deal about how the world works, but has given us remarkably little guidance for policy. We are much better at explaining and quantifying the dilemmas of exchange rate policy than we were 20 or so years ago, but the dilemmas themselves remain much the same.

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Discussion

1. Michael Mussa

It is a pleasure once again to comment on an interesting and insightful paper by Paul Krugman. Based on the disappointing results of numerous empirical tests of models of exchange rate behaviour, Paul Krugman reaches a rather gloomy assessment of recent developments in exchange rate theory - which might be paraphrased by the old line, 'We have both new and good models of exchange rate behaviour, but unfortunately what is new is not good and what is good is not new'. More specifically, in terms of practical implications for economic policy, Krugman finds that there has been little relevant theoretical advance from the Mundell-Fleming model of three decades ago.

I agree with much, but not quite all, of what Krugman says in his paper. To begin, let me note that there should be no embarrassment from the fact that the Mundell-Fleming model continues to exert significant influence over our thinking about macroeconomic policy in open economies. I say this not only because my former thesis adviser Bob Mundell remains a good friend, or even because the work of Mundell and Fleming was done three decades ago in the Research Department of the International Monetary Fund. Rather, I see it as a mark of the maturity of macroeconomics as a practical discipline relevant to real world policy issues that the main outlines of our thinking about how the macroeconomy works do not shift with every intellectual fad that happens to grab hold of the academic journals. Nevertheless, there are I believe a few things that we have learned from the past 20 years of intellectual efforts that are relevant to a practical understanding of open economy macroeconomic policies in a world of floating exchange rates and a high degree of international capital mobility. I shall endeavour to make this point while commenting on the main subjects discussed in Krugman's paper.

1.1 Foreign Exchange Market Efficiency

As Paul Krugman properly emphasises, extensive empirical research utilising data of the past 20 years has revealed two anomalies that represent considerable embarrassments to most theoretical models of exchange rate behaviour. Firstly, it is difficult to find any economic model that consistently performs better than a naive random walk in predicting the behaviour of exchange rates. Secondly, contrary to the assumption in most modern models of exchange rate behaviour, the forward premium on a currency is not an unbiased predictor of the change in the spot value of the currency. Indeed, for exchange rates against the US dollar, the forward premium does help to predict the change in the spot exchange rate, but with the wrong sign.[1]

These empirical results clearly raise important questions and doubts about most recent models of exchange rate behaviour. Nevertheless, I would assert that recent theorising about the behaviour of exchange rates has made at least one important advance in extending the theoretical framework of Mundell and Fleming. This is the general idea that exchange rates need to be viewed as 'asset prices', in the sense that today's exchange rate reflects the market's current expectations of some discounted sum of economic fundamentals that will influence the foreign exchange market in the present and in future periods.[2] As with the prices of other assets traded in highly organised markets (such as common stocks), when something happens that changes market expectations about present and future economic fundamentals thought to be important for the exchange rate, the exchange rate reacts immediately to this 'news'.

The theory of the exchange rate as an 'asset price' is most easily developed and is usually expounded in the context of a model that assumes that economic agents are fully rational, have a complete and common understanding of the structure of the economic system and the stochastic behaviour of its fundamentals, and operate in fully efficient financial markets. However, as I discussed at some length in my Graham Lecture, Mussa (1990), these theoretical assumptions are not essential either to the general idea of the exchange rate as an 'asset price' or to at least three of the key implications of this general idea:

- the largely random character of exchange rate fluctuations under floating exchange rate regimes is explained by the prevalence of 'news' in inducing most exchange rate changes;
- the tendency for nominal and real exchange rates to move together under a floating rate regime is explained by the contrast between the behaviour of nominal exchange rates as randomly fluctuating asset prices and the behaviour of national price levels as relatively sluggishly adjusting variables; and
- with respect to the influence of economic policies on exchange rates, what matters is not simply what policies governments pursue today, but also to an important extent, the policies they are expected to pursue in the future.

1. I first saw this result in a working paper written by John Bilson which was later published in the *Journal of Business* and was written at about the same time as the more widely cited and excellent paper by Hansen and Hodrick (1980). Much subsequent research, see Froot and Thaler (1990), has confirmed the basic result and shown that it is not dependent on a particular time period.
2. For a concise exposition of the concept of the exchange rate as an 'asset price', see Frenkel and Mussa (1980); for a more extended discussion, see Frenkel (1981), Frenkel and Mussa (1985), or Mussa (1982).

This last implication of the 'asset price' approach is, in my judgement, absolutely vital for understanding the influence of economic policies on exchange rates. However, it is not an insight that may be gleaned from the Mundell-Fleming model or most other earlier theoretical work on exchange rates; and its importance is not limited to floating exchange rate regimes. For example, in European exchange market crises of the past year, markets were clearly reacting not only to increases in interest rates used to defend existing parities, but also to assessments of whether these interest rate increases were durable and credible for economies experiencing recessions and, in many cases, significant problems in their financial sectors. In formal empirical analyses of exchange rate behaviour, it is difficult to isolate and estimate these effects of expectations about future economic policies, but there is no doubt of their powerful influences in the markets in which foreign exchange rates are actually determined.

1.2 Nominal and Real Exchange Rates

As noted earlier, I agree with Krugman that shorter-term movements in nominal exchange rates tend to induce similar movements in real exchange rates. Indeed, this phenomenon has been a major theme in my research since the mid-1970s. Nevertheless, I would still assert that 'the exchange rate is the relative price of two monies, not the relative price of two goods'. This definitionally true proposition does not mean - and in my thinking has never meant - that movements in nominal exchange rates exert no influence on the relative price of national outputs. Quite the contrary, understanding that the nominal exchange rate is the relative price of two monies is the key to understanding why and in what circumstances nominal exchange rates will exert an important influence on real exchange rates (i.e., on the relative prices of the national outputs of different countries).

Specifically, for countries with low to moderate inflation rates, the nominal price of domestic output in terms of national money is a relatively slow-moving variable under both pegged and floating exchange rate regimes. Under a pegged exchange rate regime, when the relative price of two national monies is changed by an official parity adjustment, there tends to be a roughly equivalent immediate effect on the real exchange rate. Under a floating exchange rate regime, as previously noted, the relative price of two national monies is an 'asset price' that tends to react randomly and often quite significantly to new information. With national price levels adjusting relatively sluggishly, fluctuations in the nominal exchange rate tend to produce sympathetic fluctuations in the real exchange rate.

This being said, it is relevant to emphasise two important caveats to the proposition that nominal exchange rate changes tend to induce roughly equivalent changes in real exchange rates. Firstly, the theory of purchasing power parity should not be carelessly discarded as at least *part* of the explanation of the behaviour of nominal exchange rates. In the long run, the cumulative differential movement in national price levels between two countries can be substantial even for countries that typically maintain relatively low annual inflation rates. In the long run for such countries, there is a general tendency for changes in nominal exchange rates to offset differential movements in national price levels. Also, for two countries with wide disparities in their national inflation rates, purchasing power parity can be relevant in the relatively short run. In particular, for a hyperinflating country (in comparison with a country that maintains relative price stability), even when there are significant changes in the real exchange rate, the depreciation of the nominal exchange rate tends to parallel the upsurge in the domestic nominal price level.

Secondly, changes in real economic conditions can exert an important influence on equilibrium levels of real exchange rates which may or may not be reflected in nominal exchange rates. Some of the papers at this Conference remind us of this point in the case of Australia, where changes in the world market prices of important export commodities appear to exert a measurable influence on the real exchange rate. Another example is the persistent real appreciation of the Japanese yen *vis-à-vis* the US dollar during the past four decades. During the 1950s and 1960s, this real appreciation was accomplished through the inflation differential between Japan and the United States, without any change in the nominal exchange rate. During the floating rate period, the real exchange rate has fluctuated more erratically, along with short-term movements in the nominal exchange rate, but the long-term trend toward real appreciation of the yen has been sustained. Thus, the real economic forces that underlie the trend real appreciation of the yen are able to exert themselves, through one mechanism or another, regardless of the nature of the nominal exchange rate regime.

1.3 Exchange Rate and Trade Flows

On the substantive issue of whether real exchange rates influence trade flows, again, I am in broad agreement with Krugman that, when ‘other things’ are held constant, real appreciation of a country’s currency tends to worsen its trade balance. As he emphasises, this is what happened to the United States during the 1980s, when the strong real appreciation of the US dollar during the first half of the decade was clearly an important factor contributing (with a lag) to the deterioration of the United States’ trade and current accounts.[3] Subsequently, the downward correction in the real foreign exchange value of the US dollar contributed importantly to the improvement in the United States’ trade and current accounts.

3. See Feldman (1982) for an assessment of the US dollar’s impact on the United States’ foreign trade.

It should be emphasised, however, that the relationship between the trade balance and the real exchange rate is not always this simple, especially when 'other things' are not being held constant. Recall that during the 1950s and 1960s, when the United States typically ran a current account surplus, the US dollar was relatively strong in real terms. In contrast, for most of the 1970s and 1980s, the US dollar was relatively weak in real terms, but the United States was, on average, running a current account deficit. Thus, the long-term relationship between the real strength of the US dollar and the United States' current account over the past decade looks quite different from the shorter-term experience of the 1980s.

To rationalise this apparent inconsistency, it is essential to recognise that forces other than relative international cost competitiveness influenced the trade balance. During the 1950s and 1960s, the United States generally had a desired excess of national saving over national investment, and this was presumably reflected both in the relatively strong currency and in the United States' current account surplus. During the past two decades, desired national saving has declined relative to desired investment in the United States, and this appears to have contributed to the combination of a weak US dollar and a current account deficit.

1.4 Exchange Rate Theory and Policy

As Krugman emphasises, 'It is notoriously difficult to translate exchange rate models into policy prescriptions'. Nevertheless, there are some issues on which modern theories of exchange rate behaviour are useful and relevant. In particular, as he argues, 'There is ... a major problem with ... an adjustable peg system in a world of capital mobility: it is subject to speculative attacks whenever the market suspects that a realignment is in prospect'. As noted before, the modern theory of exchange rates as 'asset prices' is essential to a proper analytical understanding of this very important problem. Specifically, we need a theory that links the exchange rate that markets are prepared to endorse today to expectations of the policies that governments will be able to sustain in the future. In my judgement, the development of such theoretical models of exchange rates, whatever their empirical limitations, has been a critically important intellectual advance that we have made during the past two decades.

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2. General Discussion

The general discussion of Krugman's paper focused on three issues:

- the relationship between real and nominal exchange rate movements;
- the links between the current account and the exchange rate in Japan; and
- proposals to reintroduce capital controls.

With regard to the first issue, there were several objections to the proposition that nominal exchange rate changes were the primary source of real exchange rate changes. Any shock that affected the nominal exchange rate would initially show up as a real exchange rate change, as goods prices are sticky in the short run. Over a period long enough to incorporate the lagged impact of the exchange rate on prices, however, this correlation might disappear.

The extent to which nominal exchange rate changes would be reflected in sustained effects on real exchange rates depends primarily on whether shocks are real or nominal in origin. It also depends on the structure of economies (the share of imported goods in consumption), and the price elasticities of supply and demand for traded and non-traded goods. The correlation between the nominal and real exchange rate would be higher for real shocks associated with substantial induced changes in the nominal exchange rate, as has often been the case for terms of trade changes in Australia. The correlation should ultimately be lower for nominal shocks, particularly in the presence of high and variable inflation. In this context, it was noted that the countries with a high nominal-real exchange rate correlation have typically been industrial countries with relatively low inflation rates.

It was also observed that the 'peso problem' phenomenon could influence the observed correlation between nominal and real exchange rates. Expected future changes in policy, for example, could influence the current exchange rate. There were, however, some cautionary comments about blaming everything on the peso problem.

The second area of discussion centred on Japan and whether its exchange rate played the usual role in external adjustment. Some participants pointed out that, in real terms, there was a structural upward trend in both the yen and Japan's external performance. Exchange rate movements affected outcomes around this trend. However, whether or not the latest rise in the yen and the current account surplus reflects a continuation of this structural trend depends very much on how one views the current business cycle in Japan. A major recession would improve the current account temporarily, but not in a structural sense. Here it was noted that problems arise in interpreting the available Japanese data. Recently, the unemployment rate has hardly changed, which indicates that there is no recession. However, if the output gap is considered, the recession in Japan looks deeper than it is in the United States. Relative expenditure levels in Japan compared with the rest of the world should also be considered in any analysis of this issue.

There was a general feeling that it would be best to examine the current account-exchange rate issue for Japan in a medium to long-term framework. Short-term movements in the yen do not appear to affect trade, but medium to long-term movements do alter current account outcomes. It was also suggested that there may be non-linearities and/or discontinuities in the relationship between exchange rates and the trade balance with the sharp rise of the yen in the mid-1980s, which did not eliminate Japan's current account surplus. This might have happened if the structural component of Japan's current account surplus rose at the time.

Finally, the possibility of reintroducing capital controls and transactions taxes to reduce excessive exchange rate volatility in the world economy was raised. However, this 'sand in the wheels' suggestion received little support. It was argued that it was difficult to distinguish between current and capital transactions and that capital controls could easily get 'sand' into the wheels of commerce, thus creating more problems and inefficiencies than the controls were originally meant to solve.

Major Influences on the Australian Dollar Exchange Rate

Adrian Blundell-Wignall
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1. Introduction

In December 1983, Australia abandoned its management of the exchange rate, ushering in a period of floating rates which has continued until the present. This decision to float the Australian dollar ($A) lagged behind that of the major countries, which ceased their commitment to fixed parities in March 1973. Over the course of the decade to the end of 1983, Australia moved through several transitional exchange rate regimes, each more flexible than its predecessor. However, none proved satisfactory from the perspective of conducting monetary policy in a world environment characterised by the increasing globalisation of financial markets and major swings in both inflation and economic activity. Speculative capital flows periodically undermined attempts to reconcile objectives for the exchange rate and macroeconomic stability. The decision to float was taken with monetary policy considerations in mind, but against the background of more general moves to deregulate the financial system.

Since then there has been considerable debate in Australia about the causes of swings in the $A, particularly during 1985 and 1986. Strongly held views about the role of speculators, the influence of Australia's cumulating current account deficits, sharp swings in Australia's terms of trade and the impact of monetary policy have been central to the debate. In the mid-1980s, the exchange rate depreciated as the terms of trade declined and the current account deficit rose. Some argued, however, that the exchange rate went further than could be justified by 'fundamentals', adding a fillip to inflation. During the 1990s, the exchange rate has again declined as interest rates have been steadily reduced and the terms of trade have fallen. The subject of whether the causes of this depreciation are nominal (with adverse consequences for inflation) or real (contributing to external adjustment), is again creating dilemmas for policy makers. To assess such issues requires some knowledge of the relative importance of the various influences on the $A exchange rate.

This paper reviews Australia's experience with managed exchange rates during the 1970s and early 1980s and with floating exchange rates in the past 10 years. It examines the broad characteristics of fluctuations in the $A, often comparing these with the behaviour of exchange rates in other countries. In this process, various hypotheses about factors that influence the $A are examined and tested with quantitative techniques. Section 2 reviews the historical experience since the early 1970s. Section 3 sets out some of the major elements of exchange rate economics and comments both on international empirical evidence and the extent to which it is relevant to the $A. Empirical estimates of a long-run equilibrium model for the real $A exchange rate are discussed in Section 4 and some attempt is made to relate these to earlier findings about the broad behavioural characteristics of the $A. Some concluding remarks are offered in Section 5.

2. The Historical Background

From the early 1970s until the late 1980s Australia's inflation rate was higher than that of most other OECD countries. This is shown in the steadily rising relative price line for Australia versus a weighted average of other countries in Figure 1 and for Australia versus the United States in Figure 2. This inflation differential was associated with long-run nominal exchange rate depreciation - both against the trade-weighted basket of currencies (Figure 1) and the US dollar ($US) (Figure 2). Over the longer run, there has also been some depreciation of the real exchange rates (nominal rates deflated by relative prices) shown in both figures. Thus, not all of the nominal depreciation which has occurred in the past two decades has been eroded through higher inflation. Similar trends are also broadly confirmed for the real bilateral rates against the yen and the deutschemark (DM) shown in Figure 3.

Figure 1: Exchange Rates
(December 1983=100)

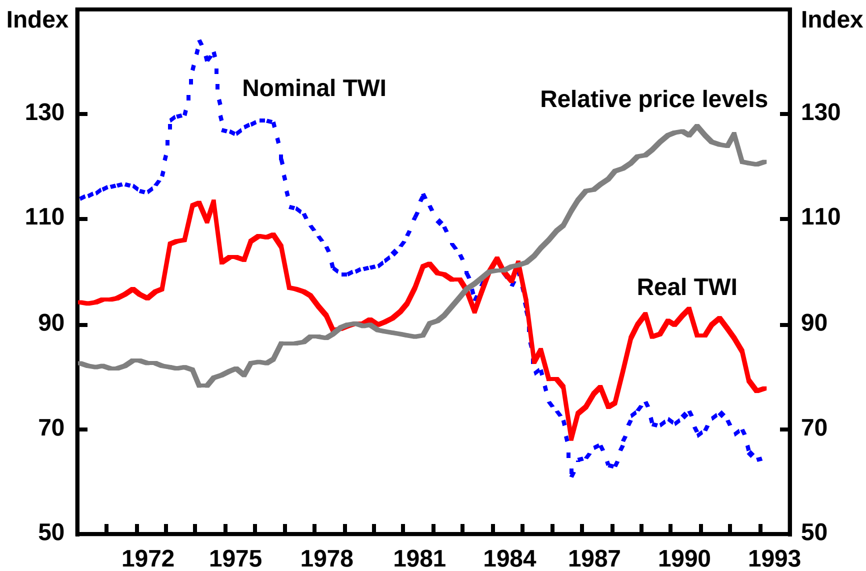


Figure 2: Exchange Rates
(December 1983=100)

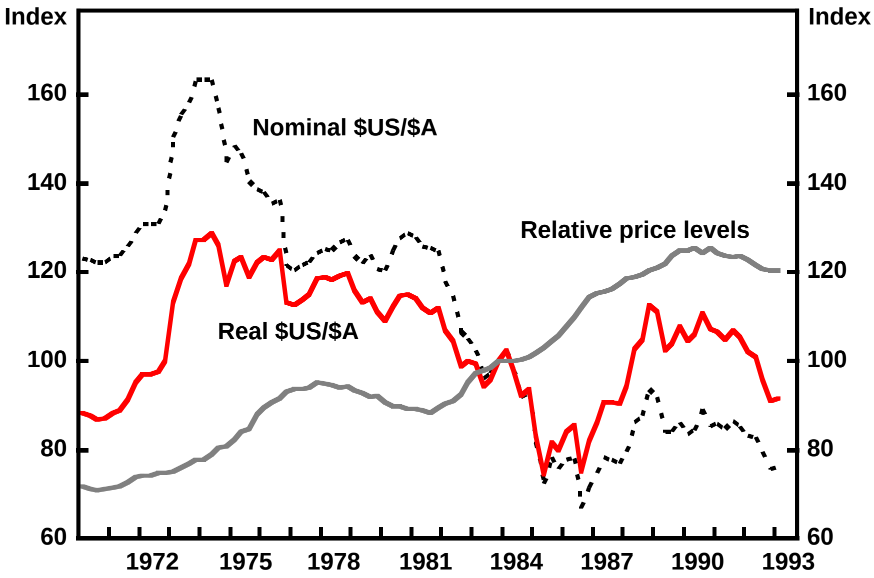
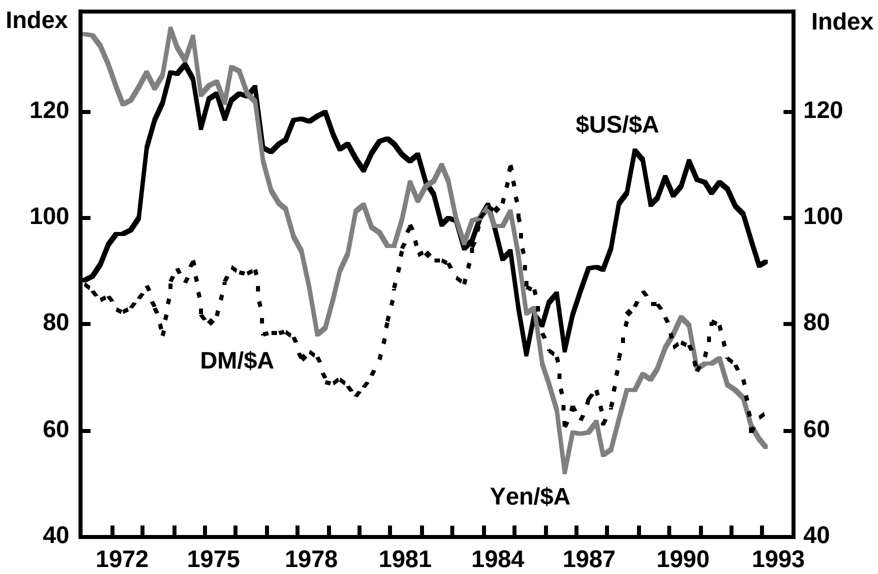


Figure 3: Real Exchange Rates
(December 1983=100)



Around these longer-run trends both nominal and real exchange rates have been subject to quite major fluctuations. These fluctuations reflect a number of factors, including major swings in the terms of trade. While its exports have become more diversified recently, Australia is still predominantly a commodity exporting country. Commodity prices are highly volatile, and are driven primarily by the strength or weakness of the world economy, represented by OECD industrial production (Figure 4). Peaks and troughs of the world commodity price cycle shown in Figure 4 are highly correlated with Australia's terms of trade, shown in Figure 5. Since the early 1970s, movements in the terms of trade as large as 45 per cent have occurred in the space of a couple of years, although movements of 10 to 25 per cent have been more common since the early 1980s. The apparent impact of these large real external shocks on the real exchange rate is clear from Figure 5. Other factors, however, must be important as well, since there are often short-to-medium run divergences in the movements of the real exchange rate from those in the terms of trade. Moreover, since the mid-1980s, there appears to have been a sustained downward movement in the real trade-weighted index (TWI) relative to the terms of trade. Subsequent discussion helps to draw out what some of these additional factors appear to have been during particular episodes.

Since 1970 there have been six broad phases in the behaviour of the nominal and real exchange rates that deserve special consideration:

- 1970-1973, when the $A appreciated in nominal and real terms in the face of a rising terms of trade;

Figure 4: World Commodity Prices and OECD Industrial Production
(12-month-ended percentage change)

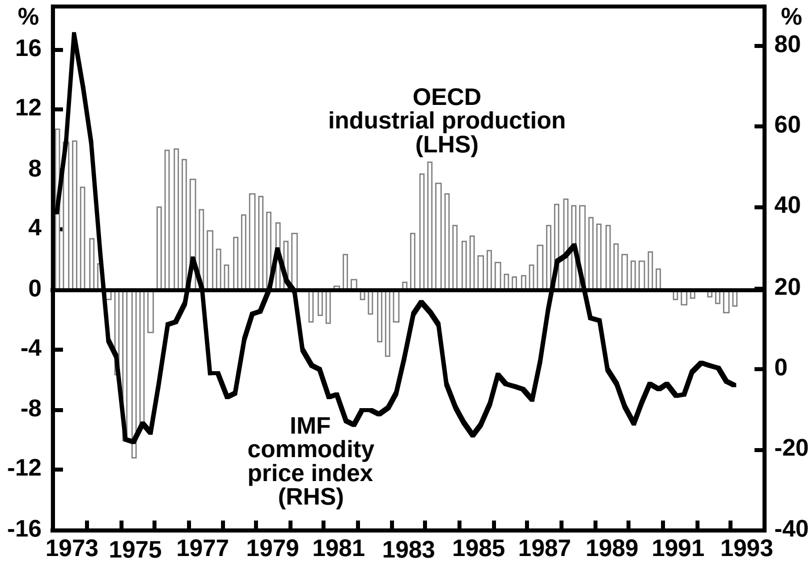
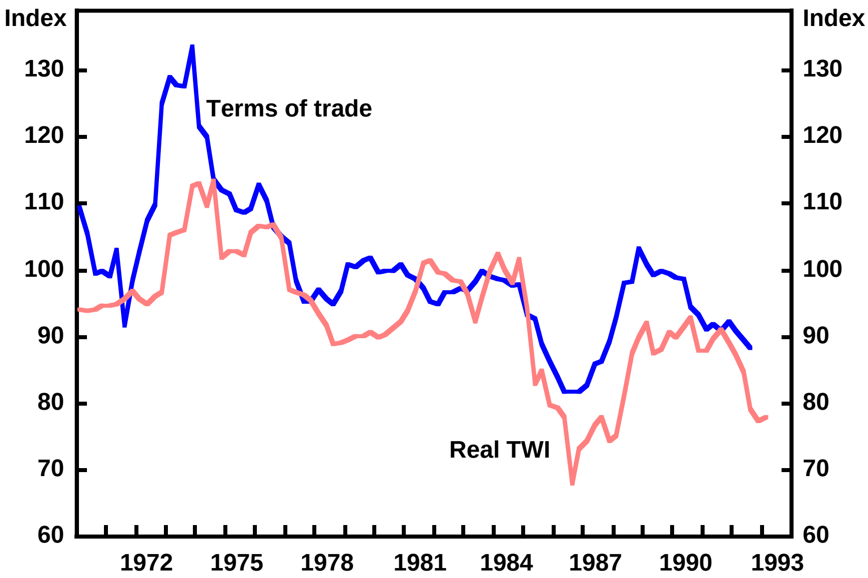


Figure 5: Real TWI and Terms of Trade
(December 1983=100)



- 1974-1976, when the $A depreciated as the terms of trade declined;
- 1980-1983, when the nominal and real TWI appreciated with no apparent upward movement in the terms of trade;
- 1985-1986, when depreciation crises under floating rates appeared excessive in relation to the terms of trade decline at the time;
- 1987-1989, when the $A appreciated as the terms of trade rose; and
- 1990-1993, when $A depreciation in the face of a declining terms of trade appeared to be somewhat delayed and relatively orderly.

Each of these periods is discussed in turn.

2.1 Managed Exchange Rates

The various managed exchange rate regimes prior to December 1983 were accompanied by capital controls and widespread regulations in the domestic financial system.

2.1.1 The world commodity price boom of the early 1970s

Under the system of fixed exchange rates established at the Bretton Woods Conference in 1944, the $A was pegged to the pound sterling. This system came under extreme pressure during the early 1970s, when current account imbalances suggested fundamental disequilibria among major OECD countries. This led to substantial changes to international monetary arrangements during the course of

1971 and, towards the end of the year, the $A was revalued and pegged to the $US instead of the pound. However, attempts to bolster the Bretton Woods system quickly proved to be inadequate. The $US was devalued in December 1971 and February 1973, with the decision by major countries to float finally being made in March 1973.

Australia did not follow suit and at first tried to maintain its peg to the $US. However, as Australia's terms of trade rose sharply with the world commodity price boom of the early 1970s, a number of changes in the parity between the $A and the $US occurred. The sharp rise in the terms of trade led to a positive real income transfer equivalent to between 4 and 5 per cent of gross domestic product (GDP) between 1972 and 1974, exacerbating inflationary pressures which, with fixed exchange rates and increasing international reserves, were imported from abroad. The $A was revalued three times, though not sufficiently to avoid a marked acceleration of inflation.

2.1.2 Terms of trade weakness and depreciation 1974-1978

Dissatisfaction with the $US as an anchor currency during the early 1970s began to arise largely because it was being subjected to continuous downward pressure. In 1973, the $A depreciated in real terms against the yen and the deutschemark (Figure 3), in spite of the underlying strength of the economy. Economic circumstances changed in 1974 when the terms of trade began to decline, falling by about 24 per cent between early 1974 and the middle of 1975, and the $A was devalued 12 per cent against gold and the $US in September 1974. At the same time it was decided to unhitch the currency from the fortunes of the $US in favour of fixing the exchange rate against a basket of currencies. Under this arrangement, the external value of the $A was varied to offset movements of other currencies against the $US.

This regime, too, proved unsatisfactory when the terms of trade were subject to renewed downward pressure from 1976. The fixed nominal exchange rate and relatively high domestic inflation soon led to the perception that the $A had become overvalued. This, in turn, caused a marked fall-off in private capital inflow to finance the current account. Speculation about devaluation caused investors to delay bringing funds to Australia, anticipating that assets would soon be cheaper. Foreign exchange reserves began to fall precipitously and the Government devalued the $A by 17.5 per cent in November 1976. At the same time, the perception of the need for greater flexibility in exchange rate management led to the abandonment of the system of fixing against a basket of currencies in favour of a crawling peg against the $US. Under this new regime a small group of officials (the so-called 'troika') kept movements of the TWI under review, adjusting it via the daily peg against the $US.

2.1.3 The crawling peg and effective appreciation in the early 1980s

Tight monetary policy in some OECD countries, notably the United States and Germany, and rising world energy prices led to a marked weakening of OECD economic activity during the early 1980s (Figure 4). However, Australia is relatively rich in energy resources and through this period the terms of trade held up comparatively well. Indeed, there was a sense of euphoria about prospects for the energy and minerals sectors following the second major OPEC oil price rise, which led to an investment boom in 1981. This boom saw the current account deficit widen to nearly 6 per cent of GDP (Figure 6). Inflation was already high at around 10 per cent and demand pressures threatened to drive it further out of line with developments in other countries. Monetary policy was tightened in 1981 and 1982, and real interest differentials at the short and long end moved in Australia's favour, particularly against countries other than the United States (Figures 7 and 8). This combination of circumstances saw the $A more or less hold ground against the soaring $US and appreciate sharply against the yen and the deutschemark. As a result, the TWI rose in early 1981 and, given Australia's relatively high inflation rate, this appreciation was sustained in real terms, even in the face of some subsequent nominal depreciations, until the middle of the 1980s.

The euphoria surrounding the minerals boom proved to be misplaced. On the one hand, the OECD area entered a major recession in the early 1980s, so there was not a lot of demand for Australia's minerals and energy. On the other hand, the large wage claims that had been agreed to in anticipation of major increases in

Figure 6: Measures of External Imbalance

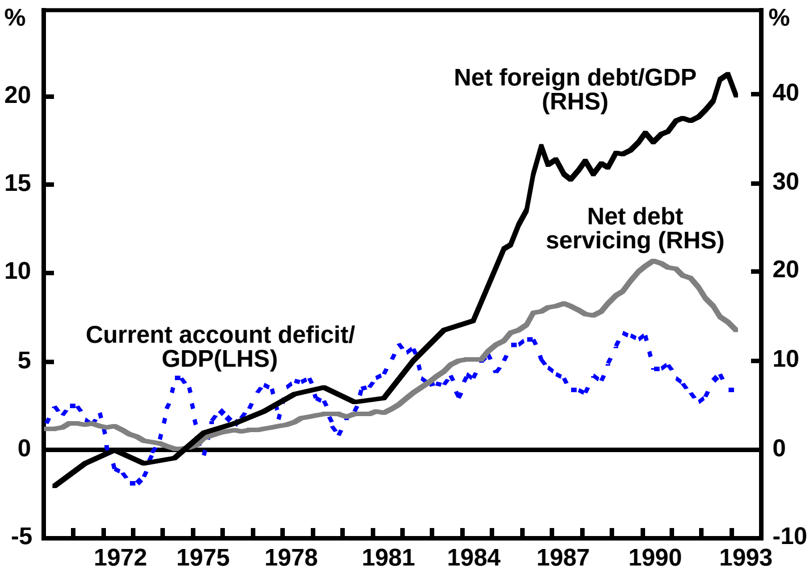


Figure 7: Real Short-term Interest Differentials
(Australian rate less foreign rate)

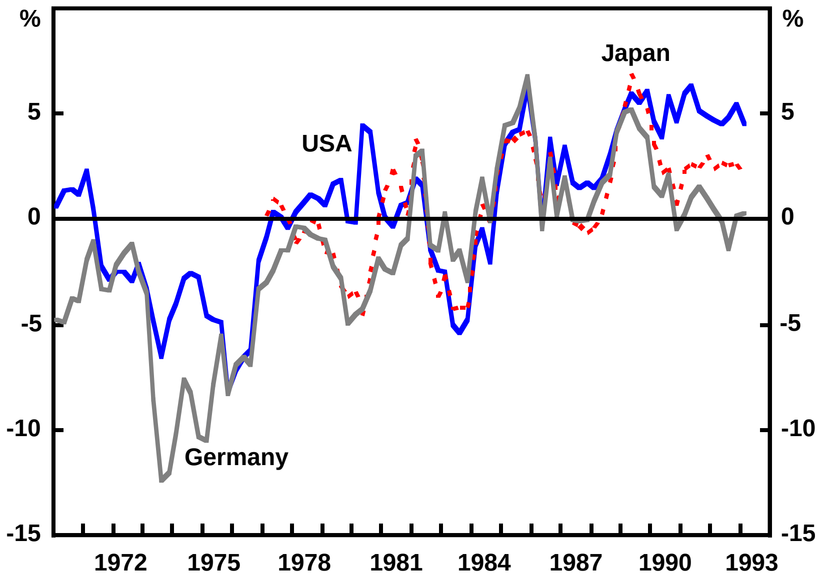
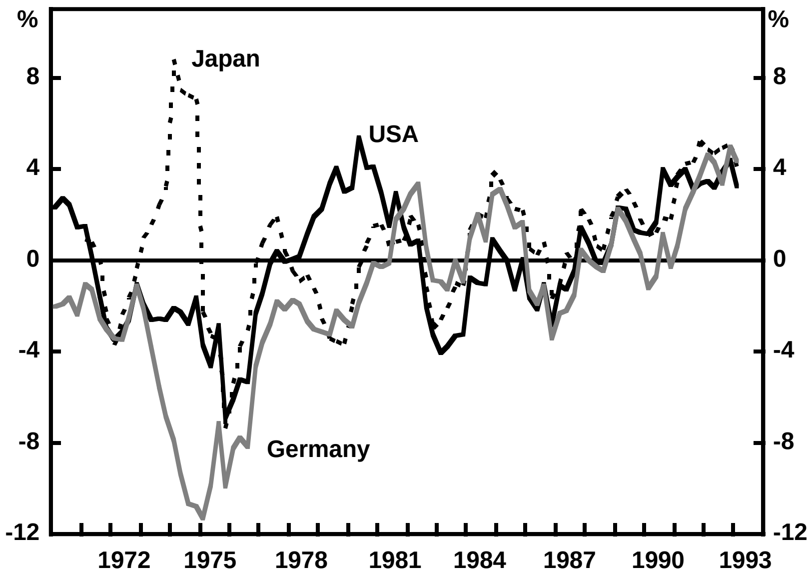


Figure 8: Real Long-term Interest Differentials
(Australian rate less foreign rate)



production proved to be excessive and generated inflationary pressures. These circumstances led to a perception that the exchange rate had become overvalued in early 1983. This, together with great uncertainty about the future policies of the incoming Government, led to intense speculation and heavy capital outflow, in spite of the presence of exchange controls designed specifically to inhibit such linkages.[1] Eventually, the exchange rate was devalued by 10 per cent in the first half of the year. This was followed by heavy capital inflow in the second half of 1983, apparently in anticipation of an appreciation of the crawling peg, as confidence in the policies of the new Government began to grow. Effective monetary policy required these inflows to be offset. While the authorities could have tried to deal with such flows through direct controls, these were seen as being out of keeping with the desire to reduce distortions in financial markets. Another option was to float the dollar. When the $A was floated on 12 December, foreign exchange controls were dismantled virtually overnight.

2.2 Floating Exchange Rates

The move to a floating rate regime was expected to improve the efficiency of the financial system, consistent with broader financial deregulation at the time, while giving the authorities greater control over domestic monetary policy. This was expected to be associated with a rise in the volatility of exchange rates, compared with the various pegs and crawling pegs which preceded it. Before discussing the depreciation crises of the mid-1980s which did see volatility rise to an historically high level, it is worth placing this issue in perspective. To this end, Figures 9, 10 and 11 show measures of the moving average of monthly volatility measures for a number of bilateral and trade-weighted exchange rates.[2] Prior to the float, the volatility of the $US/$A exchange rate and the TWI were broadly similar to those of some other major exchange rates, while $A volatility against non-US currencies was always relatively high. This picture was little changed during the first year of the float.

During the mid-1980s, however, there were some changes to these volatility patterns:

- $US/$A volatility rose;
- $A volatility against third currencies rose to even higher levels; and
- the volatility of the TWI rose from being similar to that of most other major currencies to being above them.

1. Australia was becoming more integrated with world financial markets by the beginning of the 1980s and this, together with the development of hedging facilities, served to heighten sensitivity of capital flows to developments at home and abroad.

2. These are calculated as the Schwert (1989) index of volatility and show the standard deviation of the monthly percentage change in the exchange rate.

Figure 9: Exchange Rate Volatility
(standard deviation of monthly log changes)

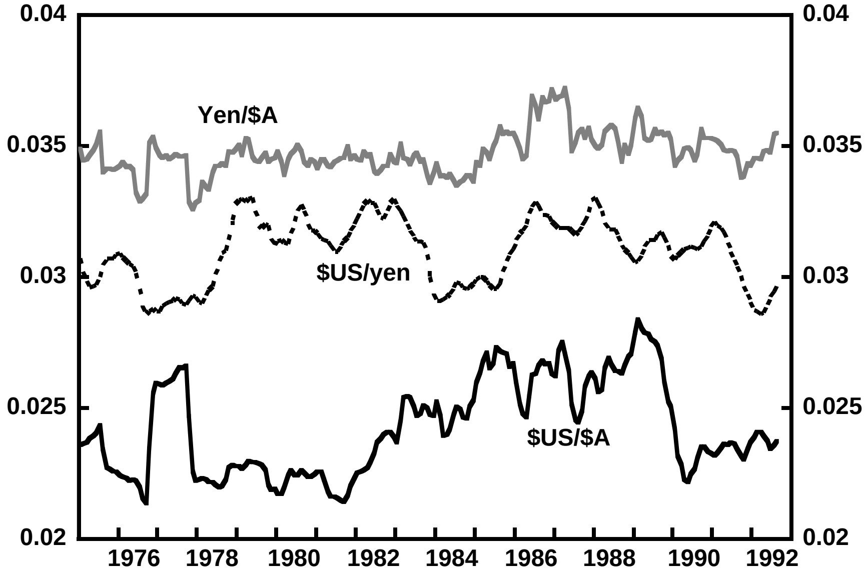


Figure 10: Exchange Rate Volatility
(standard deviation of monthly log changes)

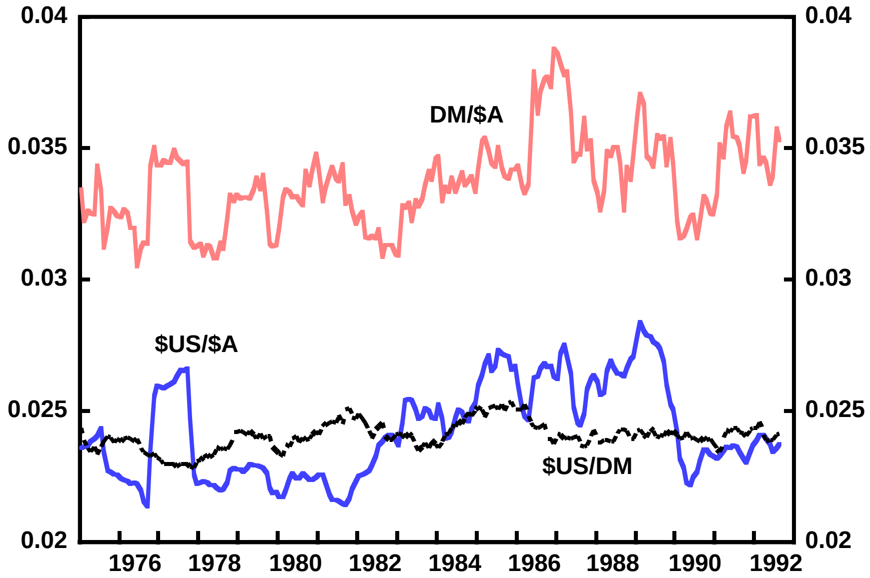
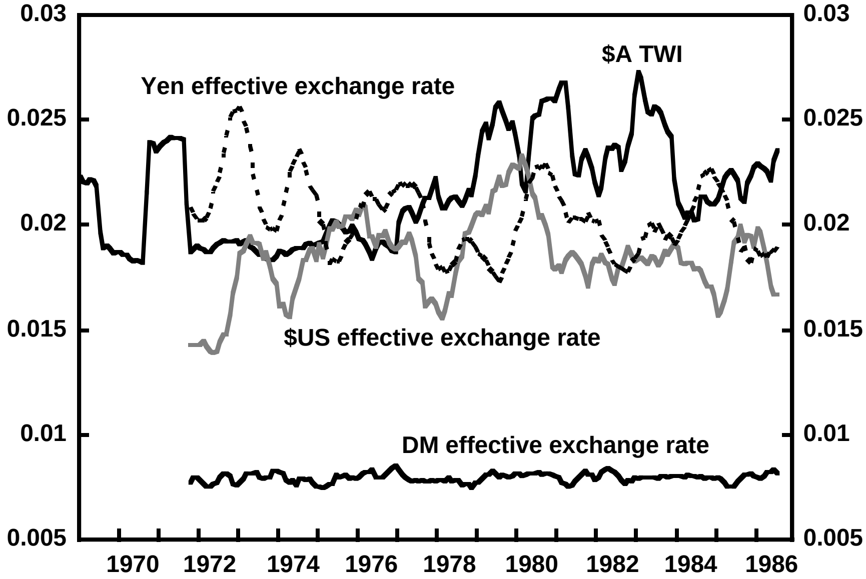


Figure 11: Exchange Rate Volatility
(standard deviation of monthly log changes)



Subsequently, in the late 1980s and the early 1990s, $A volatility declined across-the-board. In this latter period it is fair to say that the $A has been no more volatile than any of the major currencies. Nor is it much more volatile, on average, than it was during the period of managed exchange rates. The relatively high level of volatility in the mid-1980s appears more related to events specific to that period, than to the advent of floating exchange rates as such.

2.2.1 Floating rate crises in 1985 and 1986

The sharp rise in $A volatility in the mid-1980s was associated with major sustained changes in the exchange rate level. From January to the end of April 1985 the $A depreciated by over 20 per cent against both the $US and the TWI. While relative stability in these exchange rates was regained for a time and the $A actually appreciated until July, this was followed by further depreciation which gathered pace in the middle of 1986. The $A fell 17 per cent from May to the end of August 1986. Overall, the TWI depreciated by more than one-third from its level at the end of 1984, to its lowest point at the end of July 1986. The causes of these large downward adjustments appear to have involved both nominal (monetary) and real factors, as well as significant changes in market psychology.

There were four potentially important and interrelated factors that appear to have influenced exchange rate developments from the beginning of 1985. The first was that the exchange rate had become overvalued in the early 1980s, and this had not been corrected by early 1985. Moreover, at that time, commodity prices began to weaken, leading to a 13 per cent decline in the terms of trade in 1985 and 1986. This caused an increase in the current account deficit. These circumstances required real exchange rate depreciation in an underlying equilibrium sense. Correction to overvaluation in circumstances where the equilibrium rate itself is declining was bound to require large nominal and real depreciation. However, judging by the abnormal level of exchange rate volatility in these years and the extent to which domestic inflation rose subsequently, there are grounds to believe that other factors also drove the exchange rate lower.

The second factor concerns the outlook for inflation, which may have been particularly important in the timing of the February 1985 phase of the depreciation. In late January 1985, the authorities ceased the practice of announcing projections for the M3 monetary aggregate. In one sense this decision was understandable, since financial deregulation under way at the time rendered the traditional monetary aggregates increasingly difficult to interpret. The M3 target, however, was not replaced by any clear alternative focus for inflation expectations. Moreover, cash rates fell at first as the Reserve Bank had difficulty in mopping up the excess cash in the system caused by a public sector strike, which affected the processing of tax payments. The unofficial 'cash rate' fell to a low of 5.5 per cent on 6 February, rising to a peak of 13.25 per cent on 13 February. In an environment where some Federal ministers were calling for a continued commitment to full wage indexation, these developments contributed to the feeling of increased uncertainty about the future path of inflation.

Against this background, the Reserve Bank began to tighten monetary policy. By March 1985, unofficial cash rates had been pushed up to around 15 per cent, some two percentage points higher than their late January level. While the exchange rate had stabilised at its lower level for a time, it fell again in November, possibly triggered by further adverse balance of payments news and higher-than-expected money supply growth. The Bank became a strong buyer of Australian dollars at this time, and cash rates were raised sharply again. These actions served to reverse most of the November depreciation, eventually permitting some easing of cash rates. Relative to other countries, however, overall monetary policy was significantly tightened throughout 1985. Three-month real interest rate differentials favouring the $A rose to between 4 and 7 percentage points against other major countries by late 1985 (Figure 7).

The third factor influencing exchange rate movements in the mid-1980s was a marked increase in the perceived riskiness of investing in Australia as a consequence of the sharp rise in external debt. This was particularly important in the second major bout of depreciation in 1986. While Australia had experienced terms of trade and balance of payments fluctuations before, the sustained and rapid rise in foreign debt was a new and troubling phenomenon. Net debt as a share of GDP had risen from around 5 per cent of GDP at the beginning of the 1980s to about 14 per cent in 1984, as the current account imbalances of the early 1980s began to cumulate.[3] Partly driven by exchange rate valuation effects, this leaped to around 25 per cent by the end of 1985 and to over 34 per cent in 1986.[4] On 14 May 1986, the Treasurer made his often-quoted 'banana republic' remarks, and the problem of external debt and its links with underlying structural imbalances in the economy was emphasised much more in policy discussions. The spectre was raised of Australia not being able to grow quickly enough to meet its net foreign interest payments without pushing the level of debt even higher as a share of GDP. The credit worthiness of Australian debt was downgraded by ratings agencies and the $A slid from around 72 US cents in mid-May to about 60 US cents by the end of July. Negative sentiment and exchange rates around these low levels persisted throughout most of August.

The fourth factor affecting the exchange rate during the mid-1980s was the presence of destabilising speculative cycles, evidence for which is reported in the empirical results below. In the absence of a firm anchor for monetary policy, and given concerns about the terms of trade, the balance of payments and external indebtedness, the market appeared to lack a clear idea of how far the exchange rate had to fall. In this environment, rumours triggered disproportionate movements in the $A. In 1985, the MX missile crisis helped to trigger the early depreciation of the $A. In the lead-up to July 1986 (which saw the low point for the $A) several factors appeared to contribute to further falls in the currency driven by speculative runs. These included the announcement (subsequently withdrawn) that exemptions to withholding tax were to be abolished, rumours that the Treasurer had resigned and talk of Japanese sales of Australian bonds. *Ex ante* pressures over very short horizons were enormous by any standards. Exchange rate movements of 2 to 3 per cent during the course of a single day occurred on several occasions during the mid-1980s.

During the 1986 episode, the Reserve Bank increasingly used the twin tools of buying Australian dollars and tightening monetary policy. Cash rates were pushed up sharply from the 9 per cent to the 13 per cent range in the first half of May, to around 15 per cent towards the end of the month. Rates were then allowed to drift down for a time, before being pushed up to around 17 per cent by the end of

3. These were caused first by the 1981 investment boom and subsequently by the marked decline in public saving. See Edey and Britten-Jones (1990) and Tease (1990).

4. Since much of Australia's debt at the time was denominated in foreign currency, a good part of this leap was due to valuation effects of the exchange rate depreciation. In the empirical work below these effects are excluded when modelling the exchange rate, by use of the cumulated current account balance.

August. To a very large extent these activist policies reflected the view that while fundamentals required downward adjustment of the $A, adverse market psychology risked pushing it too far, with potentially adverse consequences for price and wage inflation.[5]

2.2.2 Terms of trade and exchange rate strength 1987-1989

The driving force influencing the currency in 1987 and 1988 was the strength of world demand, which pushed commodity prices up by around 49 per cent from July 1986 to their peak in January 1989. Between late 1986 and the first quarter of 1989 Australia's terms of trade rose by over 26 per cent, exerting substantial upward pressure on the nominal and real exchange rates.[6]

The almost continuous rise of the $A in 1987 and 1988 occurred in spite of considerable changes in the overall stance of monetary policy. Policy was at first eased through 1987, with cash rates falling substantially.[7] Falling interest rates and the rising terms of trade stimulated economic activity, particularly in the second half of the year. By 1988 the economy was booming. Business confidence and investment were strong, and the current account actually improved in 1987 and the first half of 1988, as national saving rose through the highly successful efforts of the public sector to curb its borrowing. However, policy makers became concerned about the sustainability of the boom, particularly in light of rapid asset price inflation. By April 1988, monetary policy began to tighten.

Similar concerns about the strength of demand in the US economy also saw interest rates being 'snugged' upwards. However, the stronger tightening in Australia saw short-term interest differentials move sharply in favour of the $A (Figure 7). This reinforced the favourable impact of the terms of trade on the currency during most of 1988. From its low point of around 60 US cents in mid-1986, the $A rose by some 49 per cent to around 89 US cents in January 1989. Over this same period, the TWI rose by 35 per cent and for most of this period the Reserve Bank was a net purchaser of foreign exchange.

Tight monetary policy persisted through 1989. However, the final surge of investment through the course of the year, much of it speculative, could not be financed from national saving. While the public sector accounts remained in sound shape, corporate borrowing continued to be associated with further declines

5. See Macfarlane and Tease (1989).

6. However, this was not without a final bout of nervousness in January 1987, when a realignment in the European Monetary System occurred, which was successfully countered with very strong purchases of Australian dollars and temporarily higher interest rates.

7. Contrary to popular perception, almost all of the easing of cash rates, from 18 per cent in January to just above 10 per cent by the end of the year, occurred prior to the stock market crash in October 1987.

in private sector saving. The current account had begun to deteriorate again in late 1988 and this gathered momentum through 1989. In response to these developments and aggressive sales of Australian dollars by the Bank, there was a downward adjustment in the exchange rate in February, in spite of favourable interest rate differentials and the strong terms of trade.

2.2.3 Declining terms of trade and firm monetary policy in the 1990s

By the beginning of the 1990s monetary policy was also tight in most other countries that had experienced asset price inflation in the late 1980s (the Anglo-Saxon countries, Japan and a number of Scandinavian countries). For quite different reasons interest rates were also rising in Europe. German unification required a major transfer of resources within Europe to finance investment in and income support transfers to the East. At the same time, with nominal exchange rates constrained by the European Monetary System (EMS), high German interest rates were imposed on other European countries. If nominal exchange rates could not adjust, the required adjustment in real exchange rates had to be generated by even faster deflation of Germany's main trading partners. This configuration of developments in the world economy was strongly biased towards deflation and OECD industrial production slowed. Commodity prices fell from early 1990, exerting strong downward pressure on the terms of trade - circumstances which have persisted more or less until the present.

These external circumstances are similar to those of the mid-1980s, yet exchange rate outcomes during the 1990s bear little resemblance to the chaotic episodes of that period:

- after declining somewhat in early 1990, the currency strengthened later in the year, when Gulf War factors were influencing world exchange markets, peaking in September at around 83 US cents with a TWI of 62;
- the $A then depreciated about 5 to 6 per cent over the following half year before strengthening again to 80 US cents with a TWI of 61 in September 1991; and
- from September 1991 to May 1993 the $A depreciated by about 15 per cent against the $US and 18 per cent against the trade-weighted basket. In this period intervention was aimed at preventing excessively rapid declines and, at times, there were short periods of upward pressure on the exchange rate.

Compared with other periods of terms of trade decline, the exchange rate depreciation was noticeably delayed. When the depreciation did come, it was much more orderly than in the mid-1980s.

The main reason for this seems to be the relative absence of the three factors other than the terms of trade that played such important roles during the mid-1980s, i.e. concerns about inflation and monetary policy, the perceived unsustainability of the leap in foreign debt, and bandwagon speculative cycles. With regard to the first of these, it is clear that the inflation concerns of the mid-1980s have been greatly reduced. While cash rates have been steadily lowered from the high levels necessary to puncture the asset price boom and related spending of the late 1980s, most easings have been broadly conditional on declining inflationary expectations. Real interest rates have remained significantly positive. Short-term real interest differentials have remained high *vis-à-vis* the United States, positive against Japan and negative only in relation to Germany, where monetary policy has been very tight. Long-term real interest differentials have continued to rise in favour of the $A *vis-à-vis* all major currencies for much of the early 1990s.

The fact that Australian long-term bonds rates have appeared high in relation to inflation has caused domestic and foreign buyers to purchase them in anticipation of capital gains. This has provided considerable support for the currency. Bond yields have in fact fallen from around 13.5 per cent in 1990 to 7.5 per cent in 1993.

The second favourable contrast with the mid-1980s is that the 1990s have been much less associated with concerns about unsustainable growth in foreign debt. Indeed, through a remarkable growth in exports, the goods and services balance has been in surplus for a good part of the 1990s and the current account deficit has mostly been less than 4 per cent of GDP. Furthermore, the net servicing cost of the foreign debt as a percentage of exports of goods and services has been falling during the 1990s, mainly because of lower interest rates. While foreign debt has continued to grow as a share of GDP, there have been no major leaps in indebtedness comparable with that in the mid-1980s.

The third contrast with the mid-1980s is that the depreciation has been relatively orderly and destabilising speculative cycles have not dominated exchange rate outcomes. There are a number of reasons for this. Firstly, such cycles are not independent of the broader environment in which they occur. In this respect, low inflation and the very clear direction of monetary policy have been particularly helpful. Secondly, the increased depth and maturity of the foreign exchange market may be a factor. Finally, foreign exchange market intervention may have had some success in promoting orderly market conditions.

3. Stylised Facts About Exchange Rates and the Long-Run Equilibrium

The above discussion has sought to place major movements in the $A exchange rate in their historical perspective. In so doing, it has focused on factors thought to be important in influencing the currency in each particular episode. Amongst the many influences discussed, five seemed to be of particular importance:

- Australia's terms of trade;
- net foreign indebtedness;
- domestic investment booms that could not be financed adequately out of domestic saving;
- real interest differentials; and
- speculative factors not based on any 'fundamentals'.

But how do these factors fit in with the economics of exchange rates? Do they lend themselves to a more formal modelling of the $A? In this respect, it is worth stating from the outset that attempts to model month-to-month, or quarter-to-quarter, changes in exchange rates have failed quite badly. The out-of-sample forecasting performance of structural exchange rate models has typically been inferior to the predictions of a simple random walk model.[8] One reason often cited for this is that these models are typically based on the assumption of market efficiency, which may not apply. Indeed, international research has repeatedly questioned whether foreign exchange markets fit into the efficient markets paradigm. Since this issue is so important in forming an overall strategy on how empirical statements about exchange rates might be made, it is worth mentioning it from the outset.

3.1 Exchange Market Efficiency

The concept of 'efficiency', as it applies to financial markets, has a narrow and precise interpretation: that market participants should not be able to derive excess returns by systematically exploiting available information. Arbitrage eliminates such opportunities, so that all of the information available at any point in time is reflected in the price of the asset in question.

3.1.1 Uncovered interest parity: inefficiency and risk premia

Provided 'political' risk arising from regulations etc. does not exist so that covered interest parity (CIP) holds, and provided participants in the foreign exchange market are neutral with respect to other country-specific risks, then efficiency in the sense described above implies that expected returns on comparable assets should be equalised. If this were not the case, expected excess returns would be available. Thus, if the interest rate in country A exceeds that in B, this must be matched by an exactly offsetting expected depreciation of currency A against currency B, and uncovered interest parity (UIP) is said to hold:

$$\underbrace{\underbrace{i_t^* - i_t = fp_t}_{CIP} = \Delta s_t^e}_{UIP} \tag{1}$$

8. See Meese and Rogoff (1983, 1988). These findings have been repeated frequently in the literature.

The first part of this expression is CIP in which the interest differential $i_t^* - i_t$ equals the forward premium fp_t. This should equal the expected appreciation of the nominal exchange rate Δs_t^e, where s_t is the logarithm of the nominal exchange rate (foreign currency per unit of domestic currency) and e denotes expectations. Therefore, UIP also implies that the forward price of foreign exchange should equal the expected future spot price.[9]

Intuitively, the reason for this should be quite clear. A deviation of the forward rate from the expected future spot rate should be eliminated by market participants seeking profits. If the $US/$A forward rate for payment one period ahead is higher than participants think the $US/$A spot rate will be, then opportunities exist to profit by selling the $A forward and buying $A back on the spot market in one period's time, when the forward contract expires. This process will drive the forward rate down towards equality with the expected future spot rate. If efficiency and risk neutrality prevail, then the forward market for foreign exchange should provide all of the information on expected future spot rates. In econometric terms, the forward rate should be an unbiased predictor of the future spot rate, i.e. there should be no systematic errors in market participants forecasts of the future spot rate.

Tests of efficiency and risk neutrality, however, have been generally rejected in the literature: the forward rate *is* a biased predictor of the future spot rate.[10] Figure 12 shows the three-month forward premium between the $A and the $US, as well as the difference between the logarithms of the current and three-month ahead spot rates. It is clear from the figure that forward rates have not proved to be efficient predictors of future spot rates in the foreign exchange market. The $A has continually stood at a discount to the $US since 1985. During this period there have been episodes of persistent appreciations, for example, in 1986/87 and 1987/88. There have also been episodes of persistent depreciations well in excess of the forward discount, for example, in 1985 and 1988/89. Formal tests of UIP set out in Appendix B confirm its rejection on Australian post-float data. The forward rate is a biased predictor of the future spot rate.

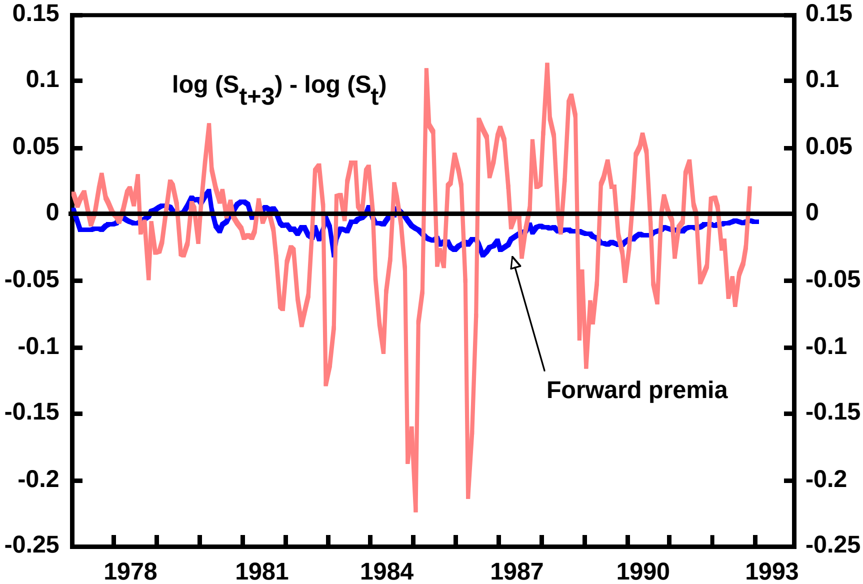
3.1.2 'Political' and country-specific risk

The assumption of risk neutrality is essential if the forward price of foreign exchange is to equal the expected future spot rate. If this assumption is violated, the forward price reflects not only the expected future spot rate, but will also

9. Since $fp_t = f_{t,t+1} - s_t$ and $\Delta s_t^e = s_{t,t+1}^e - s_t$, where $f_{t,t+1}$ is the forward price of foreign exchange contracted in period t for payment in period $t+1$.

10. See Levich (1985), Hodrick (1987) and Froot (1990) for detailed surveys of these and other efficiency tests of the foreign exchange market. Previous Australian studies include Tease (1986) and Smith and Gruen (1989).

Figure 12: Three-Month Forward Premia and Exchange Rate Appreciation



include premia for risk involved in currency speculation. These premia drive a wedge between the expected future spot rate and the forward rate:

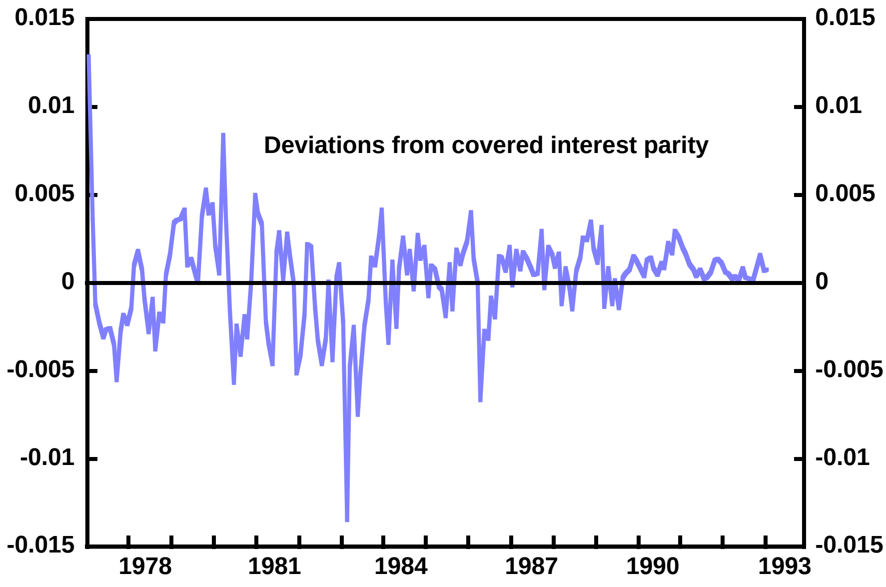
$$fp_t - prp_t - rp_t = \Delta s_t^e \qquad (2)$$

where prp_t is a 'political' risk premium deriving from regulations and rp_t is a risk premium on foreign-currency-denominated assets. Expected appreciation is equal to the forward premium less the (time-varying) risk premia on foreign currency assets. Equivalently, the logarithm of the forward price of foreign exchange $f_{t,t+1}$, contracted in period t for delivery in one period's time, exceeds the logarithm of the expected future spot rate $s^e_{t,\,t+1}$ by the sum of 'political' and country risk premia. This has led some to speculate that UIP may fail, not because of any market inefficiency, but because of the presence of these time-varying risk premia.

The first condition to check when interpreting UIP is whether or not the foreign exchange market is free of regulations and controls that distort prices, regardless of how market participants behave. A straightforward test for the absence of 'political' risk premia in exchange rates is a test for CIP. Except for minor transactions costs, the hedged yield on comparable domestic and foreign assets should be equal. That is, the difference between the spot and forward exchange rates between two currencies should equal the interest differential between the two relevant countries. Figure 13 shows deviations from covered interest parity from 1980 to the present for the $US/$A rate. Prior to 1984, such differentials were often large. Subsequently, they have declined to small values which arise from transactions costs and measurement error (except for the 1986 withholding tax episode). Formal tests set out in Appendix B confirm that since 1984, CIP holds for the Australian dollar.[11]

Since 'political' risk is excluded, the next thing to check is whether a time-varying country risk can explain the bias in the forward rate as a predictor of the future spot rate. This is more difficult, because the bias may be due either to systematic expectational errors or to a time-varying risk premium, and neither is directly observable. Froot and Frankel (1989) attempt to disentangle this ambiguity by making use of a variety of sources of survey data on exchange rate expectations. Given fp_t and survey-based measures of Δs_t^e in equation (2), the risk premium is directly (though imperfectly) measurable. This enables the authors to decompose the bias in the forward rate as a predictor of the future spot rate into that due to the presence of the risk premium and that due to systematic prediction errors. They find that the 'lion's share' of the bias is explained by expectational errors.

Figure 13: Deviations from Covered Interest Parity



11. See the OECD study by Blundell-Wignall and Browne (1991) for tests of covered interest parity for some of the major OECD countries.

Survey data for Australia are collected by the firm MMS International. Formal tests in Appendix B confirm that the MMS-measured risk premium is responsible for essentially none of the $A forward rate bias. These measures are, however, only as good as the expectations survey. In particular, it is difficult to believe that responses to the MMS survey questions about expected future spot rates are (or indeed can be) independent of the forward rate. No systematic risk appears to have emerged in the 1980s according to the MMS measure, which fluctuates around zero. Nevertheless, it is not implausible that the rapid growth in net foreign liabilities as a share of GDP during the 1980s has led to world investors demanding a higher expected return on $A assets than on foreign assets.

In summary, it does seem reasonable to take very seriously the proposition that failures of UIP may be the result of divergences from market efficiency and that systematic forecast errors imply the presence of information which, if systematically exploited, would enable abnormal returns to be made.

3.1.3 Inefficiencies and the role of feedback traders

One of the most plausible explanations for inefficiencies offered in recent years is that ‘noise’ and ‘feedback’ traders play an important role in foreign exchange markets - traders whose demand for assets is based on the history of past returns, rather than expectations about fundamentals. This idea has been offered to explain the empirical regularities that exchange rates are positively autocorrelated over short horizons (recent past increases will be correlated with current increases) and negatively autocorrelated over longer horizons (the cumulation of rises over a long enough period will predict falls in the exchange rate).[12] Cutler, Poterba and Summers (1990a) found these patterns in the excess returns for such a wide range of asset markets and countries that they concluded they are an inherent feature of the speculative process, rather than the result of risk premia associated with specific country and asset market features. They offer a model to explain these phenomena with different groups of speculators: those which are fundamentals-based and efficient; those which base their demands on fundamentals observed with a lag; and feedback traders.[13] Because ‘news’ about fundamentals is incorporated into prices with a lag, speculators following feedback rules make profits while increasing the variability of the asset prices, even though fundamentals eventually assert themselves. Autocorrelation patterns of excess returns for the $US/$A exchange rate set out in Appendix B are consistent with the findings of Cutler, Poterba and Summers (1990a).

12. See Frankel and Froot (1987) and Cutler, Poterba and Summers (1990a).
13. See Cutler, Poterba and Summers (1990b).

3.2 Empirical Modelling Based on Longer-Run Tendencies

As mentioned earlier, structural time series models, to date, have failed to explain short-run movements in exchange rates adequately. This is likely to be explained, at least in part, by the inherent difficulty of incorporating inefficient speculation mechanisms into these models. An alternative strategy is to be relatively less ambitious and focus on what can be said about longer-run or equilibrium tendencies of the real exchange rate resulting from the behaviour of economic fundamentals. The actual real exchange rate may deviate from the equilibrium level for a variety of reasons. Monetary policy influences the nominal exchange rate in the short run and, since goods prices at home and abroad adjust only slowly, the real exchange may be influenced temporarily. Similarly, feedback traders may drive exchange rates away from fundamentals over short horizons. In all of these cases, however, fundamentals should assert themselves in the longer run. Provided the theory of real exchange rate behaviour in equilibrium can be specified, empirical techniques (cointegration and error-correction methodology) enable such relationships to be identified from time series data. Shorter-run exchange rate behaviour that is not explained by fundamentals can then be examined separately - for example, to see whether the exchange rate displays evidence of the presence of feedback traders, or of the effects of short-run monetary policy changes that lead to the Dornbusch (1976) form of overshooting, and so forth.

With regard to empirical modelling, this strategy requires that the long-run equilibrium determinants of the $A be specified. From the historical discussion in Section 2, the apparent importance of the terms of trade, external indebtedness and *ex ante* savings-investment imbalances in explaining broad real exchange rate trends, suggests a clear role for balance of payments theories about the equilibrium value of the currency. The following section attempts to sketch out a broad and greatly simplified outline of this approach to real exchange rate determination, in an attempt to motivate the subsequent empirical approach.

3.2.1 The balance of payments and the equilibrium real exchange rate

The long-run equilibrium real exchange rate at any point in time should be that which is consistent with a country maintaining a sustainable current account balance.[14] A reasonably precise statement of the balance of payments identity of one country against another, or one country against the rest of the world, is:

$$\Delta a = b + \rho a_{-1} \tag{3}$$

14. This does not imply purchasing power parity, for reasons elaborated later.

where a is net foreign assets as a share of wealth, b is the trade surplus as a share of wealth, and ρ is the average interest rate on net foreign assets minus the growth rate of wealth, that is assumed to be constant. The trade balance (as a share of wealth), following Frenkel and Mussa (1985), is assumed to be given by:

$$b = \gamma[z - q] \tag{4}$$

where $q = s + p - p^*$ is the logarithm of the real exchange rate, p is the logarithm of the domestic price level and p^* the logarithm of the foreign price level. The variable z summarises exogenous real factors that affect domestic and foreign excess demand for domestic goods.

The current account surplus defined by equations (3) and (4) must be willingly held in portfolios. The desired rate of accumulation of net foreign assets by domestic residents adjusts the stock of net foreign assets to the desired stock, which is in turn adjusted for the risk premium on foreign currency assets:

$$\Delta a = a^d + \beta(r^* - r - \Delta q^e) - a_{-1} \tag{5}$$

where a^d is a variable reflecting the desired stock of net foreign assets in the absence of any risk premium, r is the real interest rate with a maturity equal to the observation interval, and Δq^e is the expected change in the real exchange rate over that interval. The coefficient β reflects the responsiveness of desired net foreign assets to variations in risk premia. This relationship implies the uncovered interest parity condition in real terms, with a risk premium equal to $(1/\beta)(a - a^d)$.

This simple framework provides the basis for analysing the equilibrium level of the real exchange rate. In the long run, equilibrium net foreign assets should be stabilised as a share of wealth $(\Delta a = 0)$, and the real exchange rate is expected to be constant $(\Delta q^e = 0)$. Letting a bar denote the currently expected equilibrium level of a variable, this implies that the equilibrium trade surplus $\bar{b}$ equals ρ multiplied by the equilibrium level of net foreign liabilities $-\bar{a}$:

$$\bar{b} = \gamma(\bar{z} - \bar{q}) = -\rho\bar{a} \tag{6}$$

It also implies that:

$$\bar{a} - \bar{a}^d = \beta(\bar{r}^* - r) = -\beta\overline{rp} \tag{7}$$

Equilibrium net foreign assets differ from their desired level in the absence of risk by the risk premium multiplied by a coefficient related to risk aversion.

Combining these last two expressions yields an equilibrium relationship between the real exchange rate, factors influencing domestic and foreign excess demand for domestic goods, and the level of net foreign assets:

$$\bar{q} = \bar{z} + \frac{\rho}{\gamma}\bar{a} = \bar{z} + \frac{\rho}{\gamma}[a^d + \beta\overline{rp}] \tag{8}$$

In Frenkel and Mussa (1985), $\bar{z}$ and $\bar{a}$ at any point in time will come to depend on the expected future paths of z and a. If they evolve as random walks, however, the theoretical model is greatly simplified. The best forecasts of future values of z and a are their current levels. That is, the equilibrium value of the real exchange rate comes to depend on the current levels of the variables in z, and the current level of a. Two further points are worth noting. Firstly, if the explanatory variables are not stationary in their levels, then neither is the equilibrium value of the real exchange rate unless the z's form a cointegrating relationship. Secondly, in this case, the model would meet the requirements for using cointegration and error-correction methods in its empirical application.

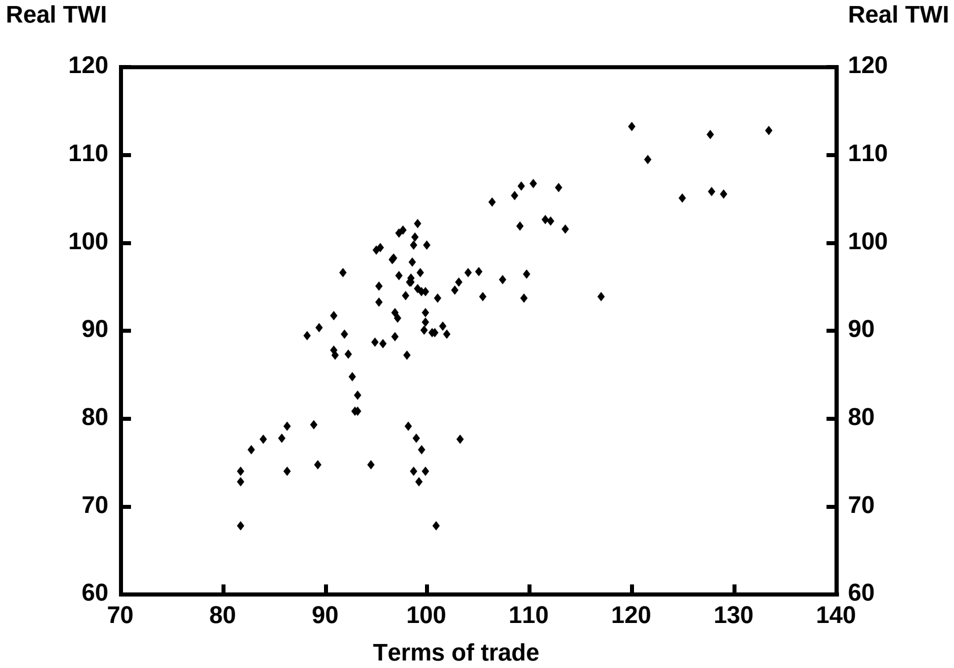
3.2.2 Terms of trade and investment shocks

The intuition behind the z variables in equation (8) is relatively straightforward. Factors that create current and expected future excess demand for domestic goods require exchange rate adjustment to ensure equilibrium. If, for example, these factors led to decreased demand for domestic goods by foreigners, the trade balance would deteriorate. Given the level of net foreign assets (or liabilities) and net interest flows, this would be inconsistent with balance of payments equilibrium without exchange rate depreciation to raise foreign demand. Following the 'dependent economy' traded and non-traded goods framework, domestic excess demand for traded goods in Australia would, for the balance of payments equilibrium to be maintained, require exchange rate depreciation. Domestic excess demand for non-traded goods, on the other hand, would require the exchange rate to appreciate to switch demand towards traded goods.

For a commodity-exporting country like Australia, the terms of trade are particularly important in influencing current domestic and foreign excess demand for domestic goods. A rise in the terms of trade reflects strong demand for Australian commodities by the rest of the world. Such a relative price shift, if it is perceived to be permanent, implies a permanent real income transfer to Australia from the rest of the world. This increases domestic demand for both traded and non-traded goods, and at a time when foreign demand is already strong. In the absence of a rise in the exchange rate, the relative price shift also causes domestic producers to switch towards exporting commodities. The exchange rate rises to offset these tendencies, switching demand towards imports of foreign goods. These mechanisms are set out more formally in Blundell-Wignall and Gregory (1990).

Figure 14 shows a scatter plot of Australia's terms of trade and the real TWI, in order to give a visual impression of longer-run tendencies in the data. Even though other possible influences on the real exchange rate are not held constant, the relationship is quite striking: there is a clear positive relationship between the

Figure 14: Terms of Trade and Real TWI



terms of trade and the real exchange rate, as predicted by the equilibrium balance of payments theory.

The other important factor related to excess demand referred to in Section 2 was the apparent importance of *ex ante* investment demand shocks. Such a shock was prominent in 1981, when euphoria over prospects for the minerals and energy sectors drove up investment demand, longer-term real interest rates compared with the rest of the world and the real exchange rate.[15] Similar pressures emerged during the investment boom of the late 1980s. How does this fit in with long-run exchange rate determination from a theoretical perspective?

An *ex ante* permanent rise in investment demand is an important component of $\bar{z}$, since it reflects not current, but expected future excess demand for domestic products from home and abroad. The marginal productivity of capital rises, but actual capital accumulation must be financed out of saving. The additional saving can be generated by reduced domestic consumption, or by attracting incremental saving from the rest of the world. Shifting saving from the rest of the world requires a deterioration in the balance of trade in the current period, in order to generate an even better trade performance later on. This intertemporal aspect of the relationship

15. This mechanism is discussed in Gregory (1976).

between *ex ante* investment demand and expected future excess demand (from home and abroad) for domestic products is a potentially important aspect of real exchange rate and long-term real interest rate dynamics.[16]

In theory, an *ex ante* rise in investment demand in the presence of perfectly integrated and flexible goods markets would lead to only *ex ante* pressure on the real interest rate. The real exchange rate would appreciate, and foreign saving would be diverted immediately, through trade flows, to ensure *ex post* real interest rates were equalised between countries. However, while it is reasonable to suppose that financial markets are fully integrated, in the sense that CIP holds, goods markets are not so well integrated. Trade flows adjust only sluggishly in response to relative price signals to reallocate world savings in a manner that equalises the marginal productivity of capital between countries. This process can take many years or, in the case of developing or transforming economies, possibly decades. This is consistent with the common empirical finding that there is no long-run tendency towards real interest rate parity.[17]

In the presence of sluggish trade flows, all of the incremental saving needed to finance the *ex ante* rise in investment cannot be obtained immediately from abroad: the domestic *ex ante* investment shock becomes 'bottled up'. The domestic real interest rate, therefore, rises relative to the foreign rate and persists at this higher level to:

- help crowd out domestic consumption by encouraging greater saving;
- crowd out some of the *ex ante* investment; and
- appreciate the real exchange rate to generate the required trade deficit.

The extent and persistence of these changes in relative prices depends on the length of time required for the trade balance to adjust to the new desired domestic saving versus investment imbalance.

It may be helpful to think of the recent topical example of this problem in the world economy - the need for massive 'catch-up' investment in eastern Germany. Informed estimates suggest this 'catch-up' will take 10 to 15 years. German real interest rates and the real exchange rate for the deutschemark need to be higher to

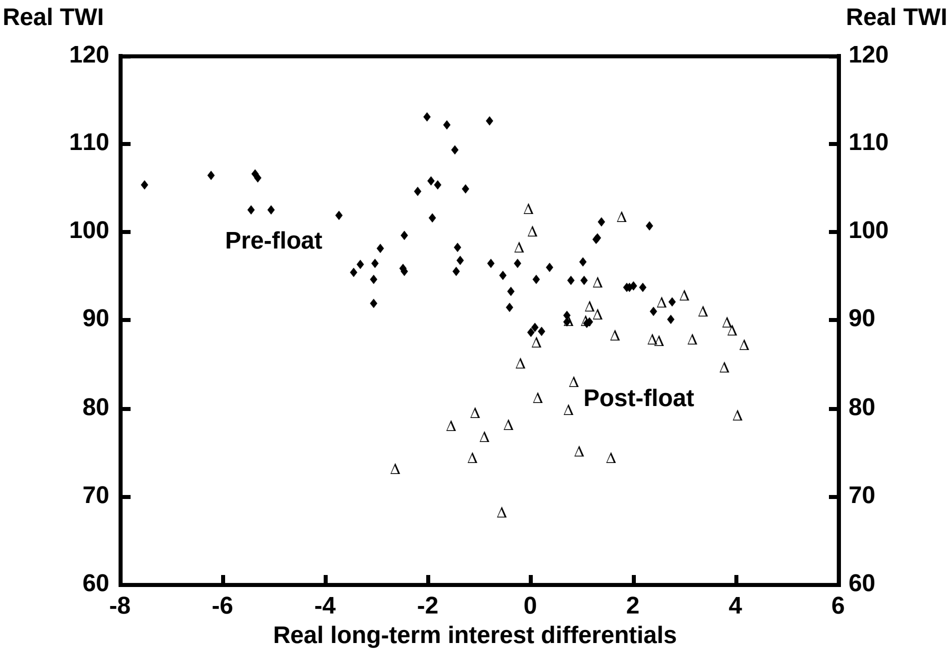
16. This relationship is often ignored in the interpetation of empirical exchange rate models, where the focus is usually on the response of the exchange rate to monetary shocks, e.g. as in the Dornbusch (1976) overshooting model. The interest rates relevant to monetary shocks are short-term rates that match the observation interval of the expected change in the exchange rate. Long-term real interest rates are not determined by monetary policy, but rather reflect the marginal productivity of capital and the marginal rate of substitution in consumption.

17. See Cumby and Mishkin (1986) and the OECD study by Blundell-Wignall and Browne (1991). Of course, in the very long run, marginal productivities of capital will be equalised. It is assumed that this process is so long that it can be ignored for the purpose of empirical investigation.

ensure real resources are diverted within Germany, and between Germany and the rest of the world, to meet this investment demand. The euphoria over the minerals sector in Australia in the early 1980s has already been mentioned as an example of this same sort of mechanism. Similarly, the Australian investment boom in the second half of the 1980s, at least partly in response to perceptions of improved opportunities for trade with the rest of the world in general, and Asia in particular, contributed to higher long-term real interest rates and the strength of the $A over this period. Australia had to attract saving from the rest of the world to finance the investment at the time, in anticipation of being able to repay this borrowing through greater productive potential and exports in the future.

Figure 15 shows a scatter plot of the long-term real interest differential favouring Australia and the real exchange rate. The overall relationship is not as strong as is the case for the terms of trade. One reason why the relationship is somewhat looser may be due to the distortions to real interest rates during the high-inflation period of the 1970s, when financial markets were slow to adapt because of regulations or inertia. Another, and possibly more important reason, is that capital controls may have partly broken the nexus between real interest differentials and the real exchange rate. If these distortions are excluded, so that only the post-1984 data are shown (the triangles in the figure), a clearer positive relationship emerges.

Figure 15: Real Long-Term Interest Differentials and Real TWI
(Australian interest rate less foreign rate, December 1983=100)

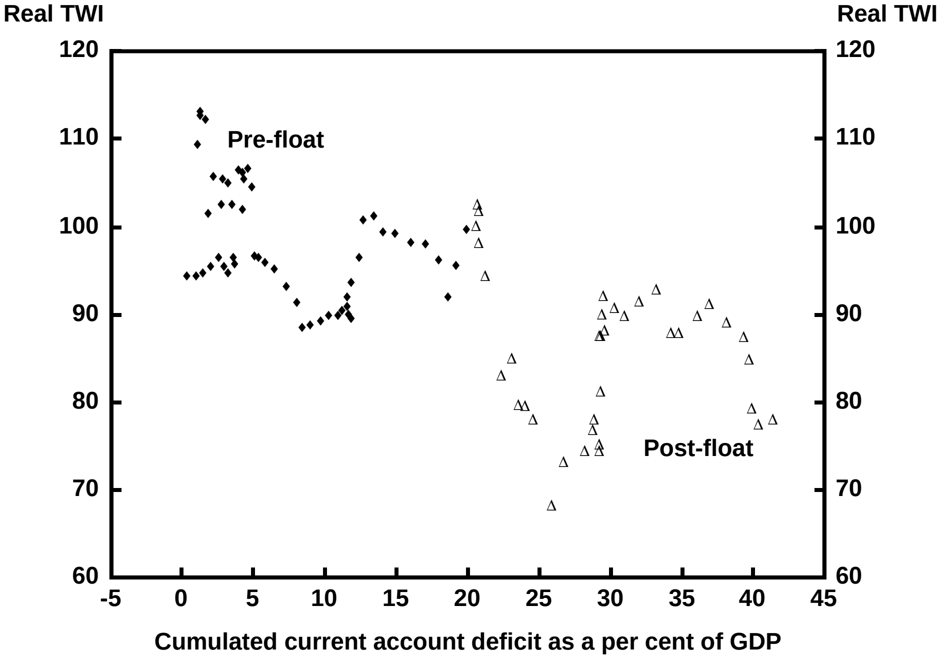


3.2.3 Net foreign assets

The intuition behind the net foreign assets term in equation (8), assuming the world interest rate exceeds the growth rate of wealth (ρ is positive), is as follows. From an initial position of equilibrium, a higher level of net foreign assets, given world interest rates, implies higher net interest income from the rest of the world. For a given trade balance this violates the requirement that net foreign assets stabilise as a share of wealth: the real exchange rate would need to appreciate. Conversely, if the level of net foreign assets fell to the point where, for example, net foreign liabilities emerged, this would increase debt servicing costs for the domestic economy. For a given trade balance, net foreign liabilities would begin to rise indefinitely as a share of wealth. The real exchange rate would need to depreciate to restore equilibrium.

Figure 16 shows a scatter plot of the level of net foreign liabilities (measured by the cumulated current account) as a share of GDP and the real TWI. There is a clear negative relationship between the real TWI and Australia's net foreign liabilities. In terms of the way the above theoretical model is specified, there would be a positive relationship between the real TWI and Australia's *negative* net foreign assets.

Figure 16: Net Foreign Liabilities and Real TWI



3.2.4 The implied empirical long-run (cointegrating) relationship

The above discussion suggests that the current equilibrium level of the real exchange rate depends on the currently expected levels of the terms of trade, the long-term real interest differential and the level of net foreign assets. All of these variables are assumed to contain a unit root, i.e. they are stationary in their differences. This relationship is assumed to be of the form:

$$q_t = \alpha_0 + \alpha_1 x_t + \alpha_2 [r_t - r^*_t] + \alpha_3 a_t + \varepsilon_t \qquad (9)$$

where all variables are sampled quarterly, x is the logarithm of the terms of trade, r is the long-term real interest rate, and a is the cumulated current account balance as a share of GDP. Where q refers to an effective or trade-weighted real exchange rate, r^* refers to a weighted average of foreign interest rates. It is worth noting that there is a potential ambiguity with regard to the sign on α_2. Whereas the exchange rate should be positively related to the real interest differential insofar as *ex ante* investment shocks are concerned, equation (8) suggests the exchange rate also responds positively to the long-run risk premium on foreign currency assets. If foreigners require domestic residents to hold more of their assets than domestic residents desire, then the foreign interest rate must be higher than the domestic rate in equilibrium. The higher level of net foreign assets implies more net interest income and the real exchange rate must be higher in long-run equilibrium.

4. The Empirical Findings

Each of the variables was pre-tested and found to possess a unit root (see Appendix B). The long-run coefficients in equation (8) were then estimated by the Phillips and Hansen (1990) procedure. The coefficient estimates and corrected t statistics are reported in Table 1 (see Appendix B for details). Cointegration between these variables was tested by examining the significance of the lagged residuals from the long-run equation in an error-correction model. The dependent variable is the change in the logarithm of the real exchange rate, and the regressors are the lagged residuals and current and three lagged innovations of the explanatory variables. A negative error-correction coefficient that is significantly different from zero according to a standard t test is taken as evidence that the variables are cointegrated. That is, the real exchange rate reverts to an equilibrium level depending on the terms of trade, the real interest differential and the ratio of net foreign assets to GDP.

Two sets of results are reported. The first is based on a long sample period, 1973Q2 to 1992Q3, which corresponds with the post-Bretton-Woods era. The second set of results is based on a shorter sample, 1984Q1 to 1992Q3, during which the $A was floating. During the latter period there were no foreign exchange and capital controls which, to the extent that they were binding previously, may have affected the links between capital flows, real interest differentials resulting from savings-investment imbalances and the degree to which net foreign liabilities were acquired. The removal of capital controls should have fewer direct implications for the terms of trade effect. The relative price and real income effects of a shift in the terms of trade work largely independently of capital controls.

4.1 Results for the TWI and $US/$A Real Exchange Rates

4.1.1 Fundamentals and the equilibrium real exchange rate

Results for the real TWI and the real bilateral $A rate against the $US are reported in Table 1. The main features of the results are as follows. Firstly, there appears to be a long-run or equilibrium relationship between the real exchange rate for the $A, the terms of trade, the long-term real interest differential and the level of net foreign liabilities as a share of GDP. Both for the real TWI and the real exchange rate against the US dollar, the error-correction coefficient is the correct sign and significantly different from zero. In the case of the long sample period, which covers both the managed and floating rate regimes, the coefficient implies that, following a random shock that drives the real TWI away from equilibrium, about two-thirds of the reversion back to equilibrium is completed in five to six quarters. Consistent with the idea that fully floating rates permit more rapid reversion to equilibrium following a shock, the error-correction coefficient for the shorter sample period is larger.

Secondly, and consistent with the earlier findings of Blundell-Wignall and Gregory (1990) and Gruen and Wilkinson (1991), the terms of trade has a powerful impact on the equilibrium level of the real exchange rate. For the TWI this coefficient is around 0.8. That is, if the terms of trade rise by 10 per cent, the equilibrium real exchange rate rises by 8 per cent. It could be argued that the causality runs from changes in the exchange rate to the terms of trade, because the pass-through of exchange rate changes is faster to the domestic price of imports than exports. To test this we estimate the model using a terms of trade variable which we know with absolute certainty to be exogenous: the ratio between the IMF commodity price index (in world prices) to a world price of manufactures. This obviously does not measure Australia's actual terms of trade as well as the ratio of the export to import price deflators. However, when used in the $US/$A regression, it leads to about the same coefficient (0.8) on the terms of trade as when the original measure is used (though it does not work as well for the TWI model).[18] This coefficient is slightly larger for the short sample period, though robust given

18. Moreover, the pass-through issue is not really relevant here because we have estimated a long-run equation, and the evidence is that the pass-through to export and import prices is complete in the long run. See Dwyer, Kent and Pease (1993).

the difference in the number of observations. The terms of trade effect on the real exchange rate does not seem to be sensitive to the presence or absence of capital controls. For the $US/$A real exchange rate, the coefficient is again of a similar

Table 1: Long-Run Coefficients and Error-Correction Results

Real Trade-Weighted Index

	1973Q2-1992Q3	1984Q1-1992Q3
Terms of Trade	0.781	0.885
	(4.689)	(4.781)
Real Long-Term Interest	-0.002	0.028
Differential (*vis-à-vis* average world rate)	(-0.251)	(2.707)
Net Foreign Assets (% of GDP)	0.257	0.979
(cumulated current account)	(1.716)	(3.822)
Error-Correction Coefficient (unrestricted)	-0.180	-0.726
	(-2.042)	(-2.069)
Error-Correction Coefficient (restricted)	-0.177	-0.721
	(-2.400)	(-3.927)

Real ($US/$A) Exchange Rate

	1973Q2-1992Q3	1984Q1-1992Q3
Terms of Trade	0.619	0.800
	(2.934)	(3.175)
Real Long-Term Interest	0.013	0.025
Differential (*vis-à-vis* USA)	(2.514)	(2.461)
Net Foreign Assets (% of GDP)	1.181	0.211
(less US net foreign assets as a % of GDP)	(3.772)	(0.364)
Error-Correction Coefficient (unrestricted)	-0.275	-0.989
	(-2.139)	(-1.467)
Error-Correction Coefficient (restricted)	-0.222	-0.360
	(-2.212)	(-1.918)

Note: Long-run coefficients are estimated with the Phillips and Hansen (1990) procedure. Error-correction coefficients are estimated with the log change in the real exchange rate as the dependent variable and the regressors are the lagged residuals of the Phillips-Hansen equation and the current and three lagged innovations of the explanatory variables. The t statistics are shown in parentheses. See Appendix B for more details. The restricted error-correction results exclude insignificant lagged innovation terms.

order of magnitude, though slightly smaller than for the TWI results.[19]

Thirdly, the real long-term interest rate differential over the full sample period is incorrectly signed for the real TWI, but correctly signed for the real exchange rate against the $US. This possibly reflects measurement problems for the weighted-average long-term real interest rate over the managed exchange rate period, particularly with the inclusion of the Japanese rate.[20] Over the shorter post-float sample period, however, the long-term real interest differential in the TWI model has the expected sign. The impact of this variable on the real exchange rate is much stronger in the post-float period, both for the TWI and the $US/$A models. In both cases a sustained 1.0 percentage point movement of the long-term real interest differential results in about a 2.5 per cent movement in the equilibrium real exchange rate.

Finally, net foreign assets as a share of GDP appear to have a strong effect on the real exchange rate. Over the full sample period, the coefficient of 0.26 suggests that a 10 per cent rise in the share of net foreign liabilities (as opposed to assets) would result in a 2.5 per cent fall in the equilibrium level of the real TWI exchange rate. The shorter sample period results suggest an even higher elasticity for this variable.[21]

Figure 17 shows the real TWI and its calculated equilibrium values. The broken line shows the equilibrium values of the real exchange rate calculated on post-1984Q1 data. Figure 18 shows the same calculations for the $US/$A real exchange rate. The equilibrium real exchange rate tracks the broad swings in the actual real exchange rate reasonably well in both cases, though there are sustained periods of deviation from fundamentals. There are also differences in the equilibrium calculations between the post-float and long-sample models, even though the broad movements are similar. This underlines the importance of not being too precise about the 'true' equilibrium level of the real exchange rate. Nevertheless, the results do provide some insights into past episodes of major movements in the real exchange rate.

19. The $US results should really also include the US terms of trade. This variable was found to be insignificant for the $US/$A model.

20. See Figure 8. The real long-term differential with Japan moves quite perversely relative to that with other countries prior to the early 1980s. Japan's relevance to Australia has probably grown significantly since the float, but was less important in the 1970s. Japanese long-term real interest rates were also more heavily influenced by administrative controls and were more prone to move inversely with inflation in earlier years.

21. For the $US/$A model, the size of the coefficients on net foreign assets variable over the two sample periods is the reverse of the case for the TWI. The results are not strictly comparable, however, since the variable refers to net foreign assets as a share of GDP in Australia, less those in the United States. Statistical tests revealed that the cumulated current account for the United States could not be excluded from the equation.

Figure 17: Actual and Equilibrium Real TWI
(December 1983=100)

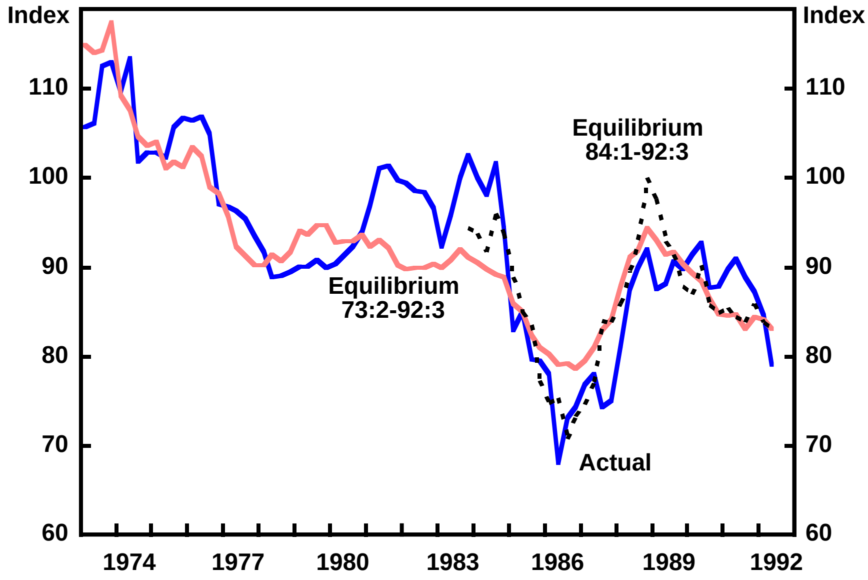
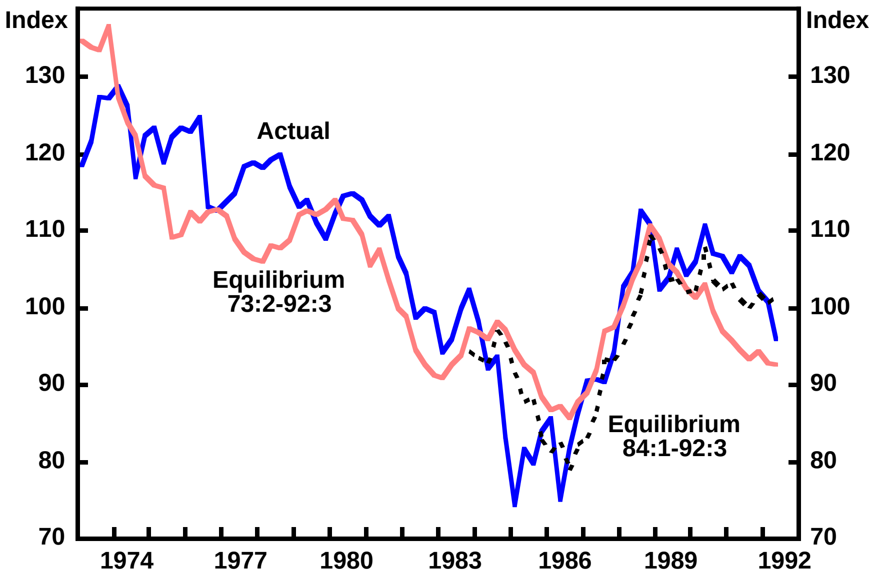


Figure 18: Actual and Equilibrium Real $US/$A
(December 1983=100)



4.1.2 The mid-1980s episode and more recent developments

Considering first the TWI, the results suggest that the real exchange rate was substantially overvalued in the first half of the 1980s, as a consequence of the minerals boom and its aftermath. In the first half of 1985, this overvaluation was finally corrected, but at the same time fundamentals began to deteriorate. The equilibrium real exchange rate defined by the long-sample model declined steadily by about 11 per cent from March 1985 to March 1987. Between March 1985 and September 1986 the actual real exchange rate depreciated by 28 per cent, about 11 per cent more than could be justified by fundamentals. While this gap subsequently narrowed, misalignment was persistent for most of the second half of the 1980s, even when fundamentals drove the real exchange rate upwards again. If the model based on the shorter sample period is used, overshooting is reduced to about 7 per cent for the September quarter and is not sustained beyond that time. In this case, the equilibrium real exchange rate declines by about 25 per cent from March 1985 to its trough in December 1986.

There are two reasons for the larger movement of the equilibrium rate based on the post-float data. Firstly, net foreign liabilities were rising quickly at the time and this has a larger relative weight than the TWI model based on the full sample period. Secondly, fiscal tightening and deteriorating private investment expectations were associated with a sharp fall in the long-term real interest differential favouring the $A. The real interest differential has the expected sign and is relatively large over the post-float period.

There is a very similar story for the $US/$A real exchange rate results. The model based on the long-sample period attributes more of the ultimate fall in the real exchange rate to unexplained residuals than does the model based on the shorter sample period. The main explanation for this appears to be the doubling of the weight attributed to real interest differentials in influencing the equilibrium real exchange rate and a slightly higher weight on the (declining) terms of trade.

It is interesting to note that the real $US/$A exchange rate was significantly undervalued compared to its equilibrium level in 1985 and again in 1986. This finding is robust between the long-sample and short-sample results. This 'double trough' is absent in the case of the real TWI, which was not undervalued until 1986.

All of the models do quite well in predicting the upswing in the real exchange rate in the second half of the 1980s, as the terms of trade recovered and real interest differentials began to move in Australia's favour. The strengthening of the real $US/$A rate at this time, when the $US was weakening against most major currencies, was closely in line with the estimated rise in the equilibrium real exchange rate. However, as other major currencies, such as the yen and the DM, also strengthened against the $US, the $A does not appear to have risen sufficiently against them to keep the real TWI in line with its rising equilibrium level (see the historical experience with these cross rates in Figure 3). In principle, this should have been relatively stimulatory for economic activity.

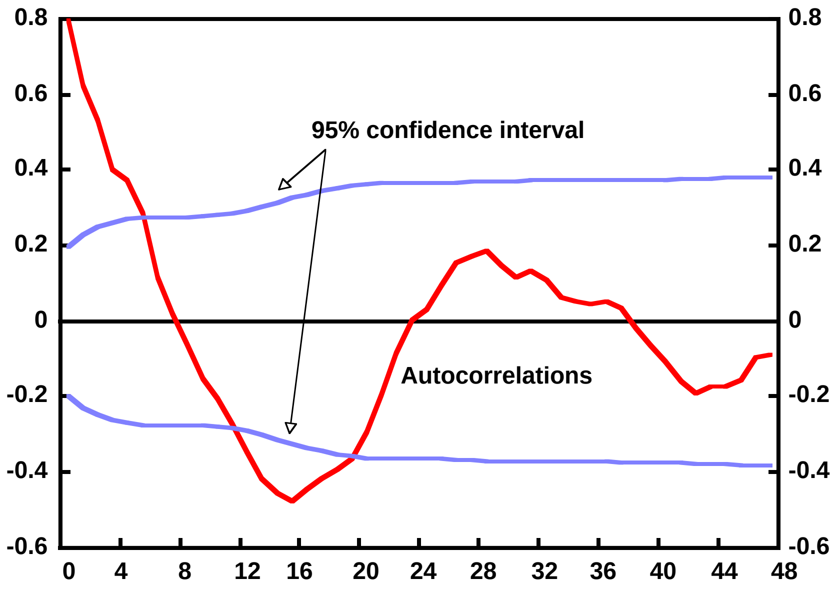
Consistent with the historical discussion in Section 2, both measures of the real exchange rate have declined more or less in line with their equilibrium levels during the 1990s. There has been no major overshooting along the lines that occurred during the mid-1980s. Indeed, until the depreciation from the middle of 1992, the real exchange rate appears to have remained above its equilibrium level for both the TWI and $US/$A real rates.

4.2 The Unexplained Residuals

The finding of a significant long-run (error-correcting) relationship between the real exchange rate, the terms of trade, net foreign assets and the long-term real interest differential, implies that the actual real exchange rate will always revert towards its equilibrium level following a ‘disturbance’. However, the statistical properties of these long-run errors are of some interest, because they may provide some insights into the nature of exchange rate dynamics.

Figure 19 shows the estimated autocorrelation function associated with these residuals for the real TWI model estimated on the long sample period. The 95 per cent confidence interval is also shown. There is evidence of strong positive autocorrelation over short horizons. Over longer horizons, the autocorrelation

Figure 19: Autocorrelations of Equilibrium Errors: Real TWI Model



function becomes negative. While the results are not shown in this paper, virtually identical autocorrelation patterns arise in the case of the real $US/$A exchange rate.

One reason why the real exchange rate might deviate from its long-run equilibrium level is the Dornbusch (1976) phenomenon of overshooting in response to monetary shocks. If monetary policy is tightened in Australia and markets are efficient in the sense set out in Section 3, the nominal exchange rate should immediately appreciate. If, however, the equilibrium level of the real exchange rate has not changed, monetary policy cannot permanently affect the level of the real exchange rate. The immediate nominal exchange rate appreciation is just sufficient to ensure that subsequent expected depreciation satisfies uncovered interest parity over the period in which goods prices are driven down relative to those abroad. The real exchange rate immediately appreciates, but subsequently depreciates as 'sticky' goods prices slowly adjust towards their equilibrium levels.

The reported autocorrelation results do not appear to be consistent with this form of Dornbusch overshooting, which would predict negative autocorrelation over short horizons, as monetary policy induced disturbances begin to 'dampen' with respect to fundamentals. The finding of positive autocorrelation over short horizons in response to any disturbance, and reversion later on, appears more consistent with the above-mentioned hypothesis that 'feedback' traders have extrapolative short-run expectations, reflecting the belief that new 'trends' persist, while basing longer-run expectations on fundamentals.

There are also a number of other possibilities. One concerns 'noise traders', who may irrationally perceive a random fluctuation in the exchange rate as a source of information about fundamentals on which they can profitably trade.[22] This would exacerbate the initial random movement if noise traders' beliefs were correlated, causing them to trade 'bullishly', while sophisticated *arbitrageurs* are not always present to drive them out of the market, i.e. by causing them on average to end up buying high and selling low. This market selection mechanism may be prevented from working efficiently because *arbitrageurs* are too risk averse to trade with a sufficiently long time horizon. Alternatively, it may take *arbitrageurs* time to work out that the disturbance is not based on fundamentals, i.e. they absorb information with a lag.

Another possibility is that market participants may simply not use all of the available information about fundamentals. For example, the estimation of the long-run coefficients in defining the equilibrium exchange rate allows for short-run dynamics of the explanatory variables. Consider the case of the terms of trade. There is evidence to suggest that this variable has a unit root, but it is not a random

22. See Black (1986).

walk. In particular, only a part of any given change in the terms of trade is likely to be permanent. If market participants assume that all of the change is permanent, one would observe cumulative deviations of the actual real exchange rate from the ‘correctly-calculated’ equilibrium, followed by reversion later on.

It is of course possible that the model is not properly specified and the inclusion of other variables might eliminate the observed patterns. However, it should be recalled that more formal tests of the null hypothesis of efficiency of the foreign exchange market referred to above were rejected in the case of the $A. Moreover, positive autocorrelation over short horizons and negative autocorrelation over longer horizons was also observed for excess returns data. These combined pieces of evidence are highly suggestive of the presence of informational inefficiencies in the market for the $A.

Here it is worth noting in passing that if inefficiencies are present, then sterilised foreign exchange market intervention may have some potential to influence exchange rate dynamics.

5. Concluding Remarks

The empirical research reported in this paper is subject to the usual caveats and certainly should not be oversold. Nevertheless, a few observations are worth making.

Firstly, there is at least some evidence in the Australian data to suggest that the real value of the $A tends towards a long-run equilibrium level influenced by the terms of trade, the long-run real interest differential and net foreign liabilities. These ‘fundamental’ factors appear to explain broad trends in the real exchange rate reasonably well. There is, however, evidence of persistent deviations from fundamentals in the short run.

Secondly, the empirical evidence supports an underlying economic model that views balance of payments equilibrium as a long-run intertemporal concept. Cycles in the terms of trade have a very powerful influence on Australia’s equilibrium real exchange rate. A rise in the terms of trade, for example, is immediately associated with *ex ante* foreign and domestic excess demand for domestic goods. This drives up the real exchange rate and helps to avoid inflation pressures that might otherwise build up. Nor does the higher real exchange rate have any serious adverse implications for net foreign assets and the balance of payments in the longer run, since the real income and substitution effects essentially offset each other.

The influences of the long-term real interest differential and net foreign liabilities on the real exchange rate, however, are somewhat more complicated. The cumulation of net foreign liabilities through time, other things being given, must reduce the equilibrium value of the real exchange rate. Put another way, the rising servicing burden associated with growing net foreign liabilities requires an improved trade balance to ensure sustainability in the longer run. If nothing else were happening, there would need to be a trend depreciation in the real exchange rate. On the other hand, an *ex ante* rise in investment demand which becomes ‘bottled up’ in the sense discussed above, requires the current account to deteriorate and net foreign liabilities to rise at first. The mechanism by which this occurs is a rise in the domestic long-term real interest rate and an appreciation of the real exchange rate. Provided the expected future excess demand for Australian products that stimulated the increased investment demand actually eventuates, foreign liabilities can be repaid without long-term depreciation. However, the empirical evidence reported in the paper suggests that rising net foreign liabilities have so far been associated with a trend decline in the equilibrium real exchange rate.

Nevertheless, from a policy perspective, it is worth emphasising that a rising real exchange rate and a deteriorating current account in the short run is not necessarily undesirable, provided it is associated with rising *ex ante* investment demand. In a low-inflation environment, sensible investment in productive capacity may well generate a high rate of return that will eventually pay for itself, regardless of past experiences.

Thirdly, formal tests of the null hypothesis of efficiency in the foreign exchange market were rejected on Australian data. Indeed, there is evidence to suggest that recent past increases in excess $A returns are positively correlated with current increases, whereas the cumulation of rises over a sufficiently long period of time eventually predicts falls in the returns. Similar patterns were observed in the persistence of deviations of the real exchange rate from its equilibrium level. Such deviations should not, in principle, display positive autocorrelation in the short run, which indicates the tendency for initial deviations to feed on each other in a cumulative manner. These patterns are more compatible with the presence of ‘feedback’ and ‘noise’ traders, possibly combined with lags and learning behaviour in absorbing information about fundamental and other factors driving exchange rates.

These informational inefficiencies create the risk of real exchange rate misalignments, with potentially damaging costs in terms of macroeconomic fluctuations and resource misallocation. Since expectations about future monetary and fiscal policies influence short-run exchange rate dynamics, well-explained policies oriented towards medium-term objectives that are understood by financial markets should help to minimise such costs.

Appendix A: Data

Nominal Bilateral Exchange Rates	All these series were obtained from the Reserve Bank of Australia, *Bulletin*, Table F9. They are end-of-month exchange rates which are averaged to achieve a quarterly series. All quarterly series were converted to indexes with December 1983 as the base quarter.
Real Bilateral Exchange Rates	These were created by multiplying the quarterly nominal rates by the quarterly relative Consumer Price Index with its base in December 1983.
Consumer Price Indexes	All CPI series were rebased to December 1983. The Australian CPI is the Medicare and Medibank adjusted analytical series available quarterly and obtained from a Reserve Bank database. Foreign CPI measures are available monthly and were averaged to obtain a quarterly series. These rates were obtained from the OECD database on Datastream.
Trade-Weighted Indexes	The nominal and real Australian TWI series were obtained from a Reserve Bank database. Effective exchange rates for the USA, Japan and Germany were obtained from the IMF database on Datastream.
Terms of Trade	For Australia, this series was obtained from a Reserve Bank database. Foreign terms of trade were calculated from import and export price indexes which were obtained from the IMF database on Datastream.
Nominal Interest Rates	All interest rates are period averages except those used in interest parity calculations and Japanese rates, which are end-of-period. Monthly observations were averaged to obtain quarterly series. The Australian rates were obtained from the *Bulletin* and the foreign rates were obtained from Datastream.

	The definitions are as follows. *Short rates:* Australia (3-month Treasury Bill); USA (3-month Treasury Bill); Japan (3-month Gensaki); and Germany (3-month FIBOR). *Long rates:* Australia (10-year government bonds); USA (10+ year government bonds); Japan (10-year government bonds); and Germany (7 to 15-year government bonds).
Real Interest Rates	These were calculated as: i_t-$(CPI_t/CPI_{t-4}$-$1)*100$, where i_t is the nominal interest rate.
Current Account Balance	All current account balances were seasonally adjusted and calculated as quarterly averages of monthly observations. The Australian balances were obtained from a Reserve Bank database; the foreign balances were obtained from Datastream.
GDP/GNP	Australian GDP is available quarterly and is seasonally adjusted. GNPs for the foreign economies were obtained from Datastream and are also seasonally adjusted.
Net Foreign Debt	This series was obtained from the *Bulletin*, Tables H7 and H8. It is available annually from 1976 until June 1986 and quarterly thereafter. Observations prior to 1976 were calculated by decumulating the stock of foreign debt with the flows of the current account balance.
Commodity Prices	This is the world commodity price index, obtained from the IMF database on Datastream.
OECD Industrial Production	This was obtained from the OECD database on Datastream.
Net Debt Servicing	This was calculated as net interest payments over total exports.
Expected Exchange Rates	These data were obtained from MMS

	International. It is the median response to the question: 'Where do you think the $US/$A will be in four weeks' time?'
Interest Parity Interest Rates	The Australian interest rate used was the weighted averages of the yields on 13-week Treasury notes at the last tender of the month (*Bulletin*, Table F1). The US interest rate was the end of month Treasury Bill Rate obtained from Datastream.
Spot and Forward Rates	These were obtained from a Reserve Bank database and were Friday 4.00 p.m. rates.

Appendix B: Time Series Properties of the Data

B.1 Measures of Volatility

The Schwert (1989) index is used to measure the volatility of monthly nominal exchange rates. This index is calculated in three steps. Firstly, the log difference of the exchange rate in question is regressed on twelve dummy variables and twelve lagged levels of itself. Secondly, the absolute values of the residuals from this regression are regressed on twelve monthly dummies and twelve lags of this new dependent variable. The index is the predicted value of the dependent variable, scaled by a constant. The index is an estimate of the monthly standard deviation of the percentage change in the exchange rate and shows how the volatility of this variable evolves over time.

B.2 Tests of Interest Parity and Speculative Efficiency

B.2.1 Covered interest parity

If foreign exchange markets are operating efficiently, then the returns over *k* periods on similar domestic and foreign assets should be equalised by arbitrage i.e. covered interest parity (CIP) will hold:

$$(1 + i)_t = \left[(1 + i^*)_t \frac{S_t}{F_{t,t+k}}\right] \tag{B1}$$

where i is the interest rate on the domestic asset, i^* is the interest rate on the foreign asset, S_t is the spot exchange rate (foreign currency per units of domestic currency, so an increase in S_t is an appreciation of the domestic currency) and $F_{t,t+k}$ is the forward exchange rate at time t for maturity k periods ahead. Equation (B1) assumes no transactions costs and no default or political risk (e.g. the imposition of capital controls) for either asset.

A linear approximation of equation (B1) can be found by taking logs of both sides:

$$(f_{t,t+k} - s_t) = (i^* - i)_t \tag{B2}$$

where $f_{t,t+k}$ and s_t are the logs of the forward rate and spot rate, respectively. Thus CIP is the condition that the forward premium, in each period is equal to the interest rate differential.

Covered interest parity is tested for by estimating the following regression equation:

$$(f_{t,t+3} - s_t) = a + b(i^* - i)_t + u_t \tag{B3}$$

where u_t is an independently and identically distributed random error. The test for CIP is that $\hat{a} = 0$ and $\hat{b} = 1$. This equation was estimated with the \$US/\$A exchange rate, the 13-week Treasury note rate for Australia and the three-month US Treasury bill rate, using monthly data over the period 1984M1 to 1993M3, with the following result:

$$\begin{gathered}(f_{t,t+3} - s_t) = \underset{(0.0004)}{0.0005} + \underset{(0.0264)}{0.9856}(i^* - i)_t \\ \bar{R}^2 = 0.96 \qquad No.\ obs = 111 \qquad \chi^2(\hat{a} = 0, \hat{b} = 1) = 9.36\end{gathered} \tag{B4}$$

where method of moments standard errors are in parentheses below the estimated coefficients.

Although $\hat{a}$ is close to zero and $\hat{b}$ is close to one, the standard errors are sufficiently small that on strict statistical grounds, CIP is rejected by the data: the joint test that $\hat{a} = 0$, $\hat{b} = 1$ is rejected at a significance level of less than 1 per cent. This rejection possibly reflects transactions costs or measurement error. In any case, the economic (as distinct from statistical) departure from CIP appears to be very small.

B.2.2 Uncovered interest parity

Under the hypothesis of uncovered interest parity the interest differential between a foreign and domestic asset each with k periods to maturity should be equal to the expected appreciation of the domestic currency over the k periods, provided agents in the foreign exchange market are risk neutral and so do not demand a premium on the foreign asset's return, which is subject to currency risk. UIP can thus be written as:

$$(i^* - i)_t = s^e_{t,t+k} - s_t \tag{B5}$$

where the right-hand side is the expectation, held at time t, of the percentage change in the exchange rate over the next k periods.

Under the assumption of rational expectations, the exchange rate expected in k periods time is equal to the exchange rate that is actually realised, plus a random error whose average value is zero:

$$s^e_{t,t+k} = s_{t+k} + v_{t+k} \tag{B6}$$

Assuming both rational expectations and risk neutrality, the test for UIP is that $\hat{a} = 0$ and $\hat{b} = 1$ in the regression equation:

$$s_{t+k} - s_t = a + b(i^* - i)_t + v_{t+k} \tag{B7}$$

where $k=3$, and which was estimated over the period 1984M1 to 1992M12 with the following results:

$$\begin{array}{lll} s_{t+3} - s_t = \underset{(0.0192)}{-0.0426} - \underset{(0.9772)}{2.3971}(i^* - i)_t & & \\ \bar{R}^2 = 0.06 \qquad \textit{No. obs} = 108 \qquad \chi^2(\hat{a} = 0, \hat{b} = 1) = 14.88 & & \end{array} \tag{B8}$$

As equation (B8) shows, the hypothesis of UIP is clearly rejected. Not only is the slope coefficient significantly different from one, it is not significantly different from minus one. This result is commonplace in the literature on testing for uncovered interest parity. No economic hypothesis has been rejected more decisively, over more time periods, and for more countries, than UIP (and its near equivalent, speculative efficiency).

Since equation (B7) embodies two assumptions, rational expectations and risk neutrality, it is difficult to determine which of these maintained hypotheses is being rejected when UIP is rejected.[23] Many researchers interpret rejection of UIP as evidence of a time-varying risk premium, while still maintaining the assumption of rational expectations. However, as the risk premium is then typically defined to be the deviation from UIP, this interpretation is merely a tautology.

B.2.3 Speculative efficiency

If covered interest parity is assumed to hold, uncovered interest parity can be rewritten as:

$$s_{t+k} - s_t = a + b(f_{t,t+k} - s_t) + v_{t+k} \tag{B9}$$

If $a=0$ and $b=1$, the forward premium is an unbiased predictor of the expected appreciation of the exchange rate, provided, once again, that agents hold rational expectations and are risk neutral. Equation (B9) was estimated over the period 1984M1 to 1992M12 with the following results:

$$\begin{array}{lll} s_{t+3} - s_t = \underset{(0.0192)}{-0.0357} - \underset{(0.9772)}{1.9285}(f_{t,t+3} - s_t) & & \\ \bar{R}^2 = 0.05 \qquad \textit{No. obs} = 108 \qquad \chi^2(\hat{a} = 0, \hat{b} = 1) = 7.02 & & \end{array} \tag{B10}$$

Since CIP holds, the estimated coefficients should be similar to those of the UIP regression, and this is indeed the case. The null hypothesis of speculative efficiency is rejected with significance levels of less than 3 per cent. Again, it is

23. Another possibility is the so-called 'peso problem': expectations are formed rationally *ex ante*, but the event that is rationally expected (the change in the exchange rate) is not observed *ex post* because the sample size is too small. This has the effect of making the test statistics not normally distributed, rendering invalid conventional methods of statistical inference.

difficult to determine whether this rejection is due to the failure of expectations to be formed rationally, the presence of a risk premium, or both.

Froot and Frankel (1989) observe that the contribution of each of these factors to the bias in the forward premium can be ascertained by using survey data on expected exchange rates. They note that the regression coefficient $\hat{b}$ in the regression of Δs_{t+k} on the forward premium can be written as:

$$\hat{b} = 1 - b_{re} - b_{rp} \tag{B11}$$

where

$$b_{re} = \frac{-\mathrm{cov}(\eta_{t+k}, fp_t)}{\mathrm{var}(fp_t)} \qquad b_{rp} = \frac{\mathrm{var}(rp_t) - \mathrm{cov}(\Delta s^e_{t+k}, rp_t)}{\mathrm{var}(fp_t)} \tag{B12}$$

η_{t+k} is the expectational error based on the survey data, fp_t is the forward premium and rp_t is the risk premium, defined as the expected appreciation of the exchange rate over k periods (also based on the survey data) minus the forward premium. The deviation of $\hat{b}$ from one can therefore be decomposed as that part due to systematic prediction errors (irrational expectations), as given by b_{re} and that part due to the existence of a risk premium, as given by b_{rp}.

Australian survey data on exchange rate expectations are compiled by the firm MMS International, who ask a sample of between 15 and 25 foreign exchange market traders what they expect the \$US/\$A exchange rate to be in one month's time. The following equation using one-month changes in the exchange rate is estimated:

$$\begin{gathered} s_{t+1} - s_t = \underset{(0.0085)}{-0.0165} - \underset{(1.5319)}{2.8649}(f_{t,t+1} - s_t) \\ \bar{R}^2 = 0.03 \qquad \mathit{No.\ obs} = 100 \qquad F(\hat{a} = 0, \hat{b} = 1) = 3.59 \end{gathered} \tag{B13}$$

The estimates of b_{re} and b_{rp} are 4.537 and -0.672, respectively. Like Froot and Frankel (1989), when one-month ahead survey data are used, all of the deviation from the null hypothesis is explained by expectational errors; indeed, risk premia do not explain a positive proportion of the bias in the forward premium.

B.2.4 Feedback trading

Table B1 below shows the average autocorrelations of the three-month excess returns from holding domestic securities (i.e. the domestic interest rate less the sum of the foreign interest rate and the appreciation of the exchange rate). It appears that the excess returns show some short-run positive autocorrelation, followed by negative autocorrelation. This evidence is consistent with the findings of Cutler, Poterba and Summers (1990a, 1990b), who find the same pattern for a variety of asset markets in the United States. They interpret this pattern as evidence for the existence of feedback traders, e.g. chartists, who impart short-run inefficiencies to the market returns. In the long run, asset prices reflect their fundamental determinants and this imparts negative autocorrelation to the excess returns.

Table B1: Average of Autocorrelations 1984M1-1992M12

Months	1-4	5-8	9-12	13-16	17-20
Average	0.589	0.199	-0.172	-0.424	-0.405

B.2.4 Unit root tests

For each of the variables used in the structural modelling, the null hypothesis of a unit root was tested for by estimating the following regression:

$$\Delta y_t = \alpha + \beta t + (\rho - 1)y_{t-1} + \sum_{i=1}^{m}\gamma_i \Delta y_{t-i} + \varepsilon_t \qquad \text{(B14)}$$

The Augmented Dickey-Fuller statistic was used to test the hypothesis that $(\rho-1)=0$, i.e. that there is a unit root in the data. The absence of a deterministic trend $(\beta=0)$ and of drift $(\alpha=0)$ was also tested for as a part of this process. This equation was estimated over the period 1969Q3 to 1992Q3, or the largest subperiod for which the data are available. The data are quarterly and m is initially set to four to eliminate autocorrelation in the errors. The results are shown in Table B2 below.

The null hypothesis that $\rho = 1$ could not be rejected for all series except the cumulated current account series. Statistically, these series appear to have an explosive root $(\rho > 1)$; however, in absolute terms, ρ is very close to 1 for these variables.

B.2.5 Structural models of real exchange rates

Since each of the variables used in the model contains a unit root, it is necessary to employ a modelling procedure that takes this into account and explores the possibility of cointegration between the variables in question. While the variables themselves are not stationary, a linear combination of them may be. Methods of cointegration have the advantage of modelling the equilibrium long-run relationship separately from the short-run dynamics. This allows the long-run 'fundamentals' to be isolated and discussed.

Table B2: Unit Root Tests

	$\rho - 1$
Log (Real TWI)	0.000
	(0.443)
Log ($US/$A)	-0.000
	(-0.288)
r_A-r^*_{world}	-0.106
	(-2.001)
r_A-r_{US}	-0.096
	(-1.981)
$(CAB/GDP)_A$	0.009
	(2.754)
$(CAB/GDP)_A$-$(CAB/GNP)_{US}$	0.004
	(1.130)
LOG (Terms of Trade$_A$)$^{(a)}$	-0.000
	(-0.204)

Notes: (a) 5 lags were required to eliminate autocorrelation.
(b) Test statistics are in parentheses.
(c) Critical values 1%: -2.60; 5%: -1.95; 10%: -1.61.
(d) All α and β estimates are not significantly different from zero.

The Phillips and Hansen (1990) method is used to estimate the parameters of the equilibrium real exchange rate equations. This method (unlike some others) yields standard t statistics, enabling inference about whether the estimated parameters are significantly different from zero. However, this technique does not, in itself, provide a test for cointegration. To do so, the lagged errors from the long-run relationship were included in an error-correction model and tested for their significance. A significant negative coefficient on the lagged errors implies that if the real exchange rate in a certain period exceeds its long-run equilibrium value, it will tend to depreciate in the next period, although the short-run dynamics of the real exchange rate will also be influenced by other factors. However, the error-correction property ensures that the real exchange rate eventually returns to its long-run equilibrium value.

To conserve degrees of freedom, especially when the model was estimated over the short sample period 1984Q1 to 1992Q3, insignificant lags were excluded from the final specification of the error-correction model.

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Discussion

1. Bob Gregory

This excellent paper by Blundell-Wignall, Fahrer and Heath presents a simple and important Australian story of exchange rate determination. The basic stripped-down story, presented here without the qualifications that they might like to make, is:

- changes in the terms of trade determine the real exchange rate (see Figure 5 in the paper);
- variation in the nominal exchange rate - rather than changes in the internal price level - is the mechanism which delivers the change in the real exchange rate[1] (see Figure 1); and
- the lag between terms of trade changes and nominal exchange rate changes is short, and the effects of terms of trade changes are large and consistent through time.

The evidence seems convincing and completely consistent with our memories of the 1970-73 and 1987-89 periods, when commodity prices were particularly high, and the 1985-86 period when commodity prices collapsed.

I refer to the terms of trade - real exchange rate - nominal exchange rate story as an Australian one because it fits well into our intellectual history (Wilson 1931; Swan 1960; Salter 1959; Gregory 1976). More importantly, it does not seem to fit well into the way other countries, and most members of the economics profession, see the determination of their exchange rates. Indeed, it is when the implications of this particularly Australian story is applied to other countries that a whole raft of interesting questions arise. I pose four sets of questions that occurred to me.

Firstly, across flexible exchange rate countries I do not think that it is true that exchange rate volatility maps strongly and noticeably into terms of trade volatility. For example, you would not hear a German say that the deutschemark is always stable because the terms of trade rarely change for Germany, or that the US dollar is unstable because the terms of trade vary so much for the United States. Economists in these countries talk about the importance of other things, usually interest rates and monetary policy. The monetary theory of the balance of payments and exchange rate (Mussa 1979), or the portfolio theories (Kouri (1976) and Branson and Henderson (1985)), do not seem to accommodate easily the

1. In addition there has been a minor trend shift of the relationship between the terms of trade and the real exchange rate, because foreign debt servicing has increased, and a minor displacement between the nominal and real exchange rate, as a result of faster inflation in Australia.

proposition that changes in the terms of trade are the major determinant of the exchange rate. What then is a proper theory of exchange rate movements? One which differs by country? This has not been the tradition in economics which seems to be searching for universal theories.

Therefore, the first important question can be posed as follows. If our terms of trade are so volatile and dominate real exchange rate movements, what has happened to the influence on the Australian exchange rate of the factors which determine real exchange rate volatility of other countries? Why have these factors not affected the Australian real exchange rate more and made less obvious the relationship between the terms of trade and the real exchange rate?[2]

Secondly, what is the role of monetary and fiscal policy in a Blundell-Wignall *et al*. world? Traditional theories of economies with flexible exchange rates have monetary and fiscal policy operating through exchange rate changes - monetary expansions leading to devaluations and fiscal expansions being ambiguous in effect. Given that the fit is so close between changes in the terms of trade and the real exchange rate (Figure 5), and between changes in the real and nominal exchange rate (Figure 1), does that mean there has been virtually no role for macroeconomic policy to stabilise economic activity in Australia? Again, if policy was important, surely the terms of trade changes would not fit exchange rate changes so closely unless the terms of trade were also determining policy!

Or should we argue that policy has been targeted to lead to a *de facto* fixed exchange rate *except* when it is changed by the terms of trade?

The puzzle of the missing influences on the exchange rate is addressed in a slightly different way by Krugman in his contribution to this Volume. He says:

> The question is whether such real shocks can explain away the striking correlation between nominal and real exchange rates. The answer is almost surely no, for at least three reasons.
>
> Firstly, while a reverse causation from real shocks to nominal exchange rates can explain a correlation between nominal and real rates, the actual correlation is not a modest one - it is virtually perfect, with a coefficient of almost unity. This is just too much to explain unless one is willing to suppose that there are virtually no exchange rate changes that are *not* the result of real shocks, *a view that is hard to defend* (my emphasis).

2. One answer, which would probably surprise us all, is that the terms of trade also matter for other countries and perhaps to a similar extent! For large countries, however, the causation probably works the other way and the change in the exchange rate leads to a change in the terms of trade. This arises from the differential effect of devaluations on export and import prices for a large country. This difference between large and small countries was the centre piece of Wilson's (1931) development of the Australian analysis of devaluations.

The contrast with Blundell-Wignall *et al*. is stark. Their paper describes instances when exchange rate changes occurred in Australia without terms of trade changes but a consideration of Figure 5 and Figure 1 quite clearly shows that these changes are relatively unimportant. How should we respond? Reject Krugman, at least as an explanation of Australian exchange rates! I am inclined to say yes but the puzzle remains. Why are the other factors that are alleged to dominate exchange rate movements in other countries not more important in Australia?

Thirdly, what is achieved in Australia by such large exchange rate swings in response to terms of trade changes which have always been temporary? What should be the role of policy? It has become commonplace in Australia to talk of real exchange rates as a mechanism to bring about resource flows across sectors. Currently, for example, most economic analysts are pleased that the real exchange rate is low because they believe that it is contributing to the diversification of Australia's export base and that more manufactured exports to Asia is a good thing. Very few people, for example, would believe that a sudden and large appreciation today, of say 30 per cent that will last three years, in response to a terms of trade boom would be a good thing. They would see the large change in the exchange rate as being disruptive in our move towards a new industry structure. Why then does not the financial market believe the same thing and produce nominal exchange rate changes that do not mirror changes in the terms of trade? Why does the nominal exchange rate respond so much? Should we have expected, on *a priori* grounds, a much smoother path for the nominal exchange rate? These issues invariably lead to the question as to whether or not the authorities should attempt to smooth exchange rate changes to reduce fluctuations in the manufacturing sector which is not as able to bear large fluctuations in prices as the mining and agricultural sectors are with their large sunk costs.

Fourthly, the discussion as to an appropriate role for policy is made more complex in the light of the recent argument that Reserve Bank policy should only target inflation. The Blundell-Wignall *et al*. analysis seems to suggest that the role of the nominal exchange rate is to bring about real exchange rate changes quickly and hence effect resource swings by signalling relative price changes generated by terms of trade swings. But if inflation control is the target, and there are non-symmetries in the response of the rate of change of prices to exchange rate changes, do we want the exchange rate to be so volatile? How should the concern for inflation and the need to shift resources be reflected in policy? Again I refer to the Krugman contribution. He says nominal exchange rate changes have real effects, he quotes the United States' trade outcomes in response to devaluations in the US dollar as a good thing, and seems to suggest using exchange rate policy for objectives other than price stability. But, once again, can we relate this to the view expressed in the Blundell-Wignall *et al*. paper that the nominal exchange rate is the creature of terms of trade shocks?

Finally, the Blundell-Wignall *et al*. paper is extremely rich in ideas and detail and the clear presentation of the story is a very stimulating one in helping us think further as to the appropriate role of the exchange rate in a small open economy subject to large shocks in the terms of trade. The paper is made all the more stimulating when it is placed alongside the other excellent contributions to this Volume.

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2. General Discussion

The discussion of the paper by Blundell-Wignall, Fahrer and Heath primarily focused on the following issues:

- the endogeneity of the terms of trade;
- the nature of variables that had been excluded from the long-run model estimated in the paper; and
- the reasons for, and the implications of, the positive short-term autocorrelations in the deviations of the actual exchange rate from its long-run equilibrium level.

On the first point, a number of discussants made the observation that when the pass-through of exchange rate changes to domestic prices was not instantaneous and complete, the terms of trade were endogenous with respect to exchange rate changes. While this pass-through issue was generally not seen to be a problem for homogeneous goods (predominantly agricultural and raw materials based goods), it was thought that it could be a problem for heterogeneous differentiated products where producers have some degree of market power.

Subsequent discussion tended to discount the problem of endogeneity of Australia's terms of trade, suggesting that it was more of an issue for the United States and Japan. However, the point was made that even though changes in the value of the yen may influence the Japanese terms of trade, there were also large exogenous changes caused by movements in the world price of oil. These terms of trade changes did have pronounced effects on the real value of the yen. It was suggested that one way of minimising the endogeneity problem would be to use a proxy terms of trade measure, calculated from prices in world markets. It was noted that when this was done for Australia, the terms of trade still exerted a powerful force on Australia's real exchange rate.

There was general, though not universal, agreement that the real exchange rate should vary over time. In addition to the terms of trade, net foreign debt and real long-term interest differentials, a number of other determinants of real exchange rates were put forward by discussants. It was suggested that in the long run, productivity differentials between countries were important determinants of changes in real exchange rates, and that it might be possible to include such factors in the model other than through their implicit presence in real interest rate differentials. Alternatively, it was suggested that productivity could be captured by including a time trend in the regression. Inclusion of variables to capture differences in fiscal and monetary policies between countries was also suggested, as were variables to capture resources booms, changes in export structure and differences in capacity utilisation between countries.

While there was general agreement with the conclusion that the autocorrelation patterns of deviations from the long-run equilibrium suggested some departure from the textbook efficient markets model, a number of other possibilities were also advanced. It was argued that the positive autocorrelations might reflect the gradual learning by the participants in the market about the nature of shocks. Such learning should not be interpreted as a failure of market efficiency. Another explanation was that the authorities themselves may take time to learn about the nature of the shocks, and any attempt to stabilise the nominal exchange rate by intervention or monetary policy changes may induce positive autocorrelations at short-term horizons.

The Exchange Rate and the Current Account

Michele Bullock
Stephen Grenville
Geoffrey Heenan*

1. Introduction

Other papers at this Conference (particularly Pitchford and Blundell-Wignall, Fahrer and Heath) examine the factors that determine the exchange rate. This paper explores how the exchange rate impinges on the separate components of the current account in the short run and the part it plays in longer-term balance of payments adjustment. In particular, it examines both the effect of the exchange rate on imports and exports and considers the role of the exchange rate in adjusting the economy to underlying structural changes.

The Australian economy since 1980 is an ideal 'test bed' for this. During this period:

- there was an important change of policy regime (the floating of the exchange rate in December 1983);
- the underlying current account deficit increased markedly compared with earlier periods, suggesting that there were important *structural* changes; and
- there was a wide short-term variation in the current account deficit, which exceeded 6 per cent of gross domestic product (GDP) three times in the decade.

The variety and extent of the experience should provide the opportunity to draw some conclusions about the role of the exchange rate. The distinction between short-term shocks and responses, on the one hand, and the longer-term adjustments to structural changes, on the other, provides a theme that will be important in analysing the variety of experience.[1]

The main forces driving the short-term movements in the current account were terms of trade changes and investment shocks. Large swings in the terms of trade played a central role in the activity cycles during the period and their impact shows clearly in the current account. While these terms of trade swings were large, they were generally reversed and provide evidence that, within a long-term steady, secular decline in the terms of trade, the larger fluctuations are temporary. There

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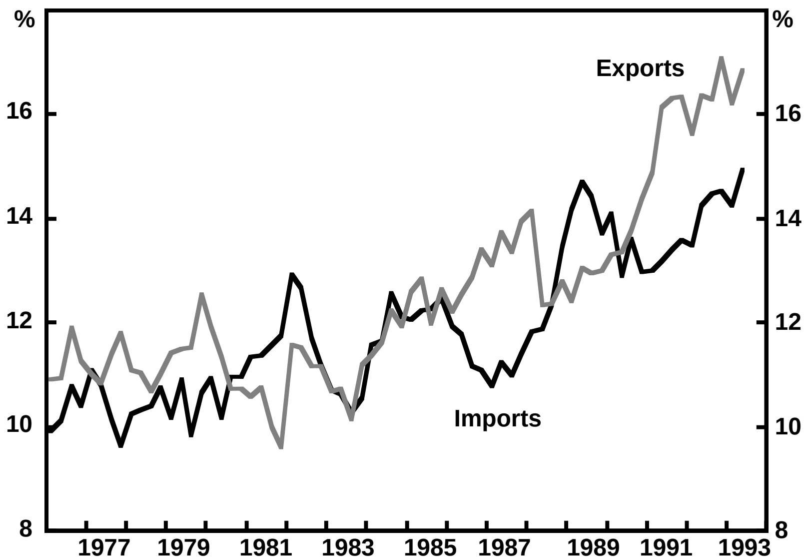
* Reserve Bank of Australia. This paper has benefited from comments and assistance from many colleagues in the Bank, particularly Adrian Blundell-Wignall.

1. For details of balance of payments developments in the 1980s, see Tease (1990).

were two major investment shocks which had a powerful impact on the current account.

Among the structural changes, increasing international integration was central. A high degree of integration of the capital account had been achieved before 1980, but during the 1980s both imports and exports rose significantly as a percentage of GDP (see Figure 1). This is a relatively recent phenomenon for Australia. Among the OECD countries, Australia was almost alone in *not* increasing its degree of international integration significantly in the 1960s and 1970s. In the second half of the 1980s, the picture changed markedly. Effective rates of external protection have been almost halved since 1984. Also, producers have come to recognise the importance and permanence of the change and have begun to adapt their productive capacity to this new world. The link between protection and the earlier failure of international trade to rise was noted by the 1984 Brookings study of the Australian economy (Caves and Krause 1984). As well, there has been significant (although unfinished) microeconomic reform, encompassing the labour market, public enterprises and a wide range of private industries. At the same time, Australia's external environment was changing, with the emergence of a number of rapidly industrialising countries in Asia, providing a new source of import supply and export markets. With the current account averaging nearly 5 per cent of GDP during the 1980s compared with 2 to 3 per cent which was the norm in earlier decades (see Figure 2), there was a build-up of foreign liabilities, which

Figure 1: Imports and Exports of Goods
(per cent of GDP, 1989/90 prices)



rose from around 10 per cent of GDP in the mid-1970s to almost 55 per cent in 1992 (see Figure 3).

Figure 2: Current Account
(per cent of GDP)

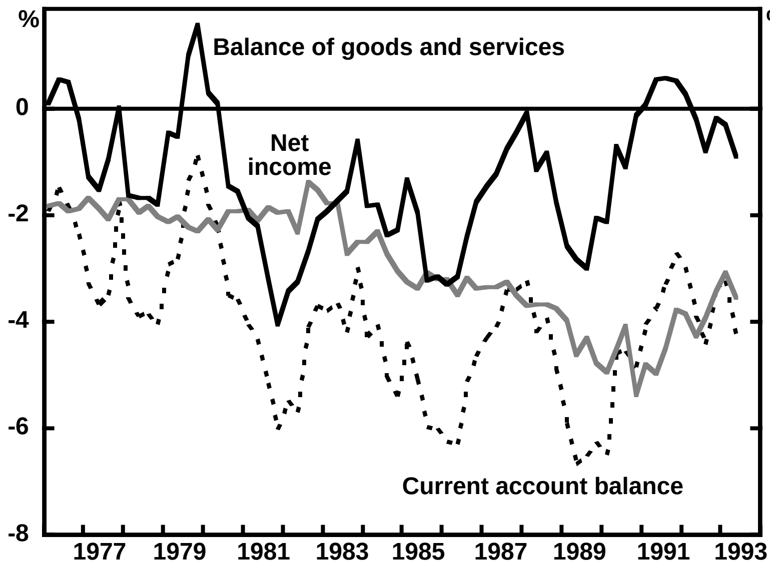
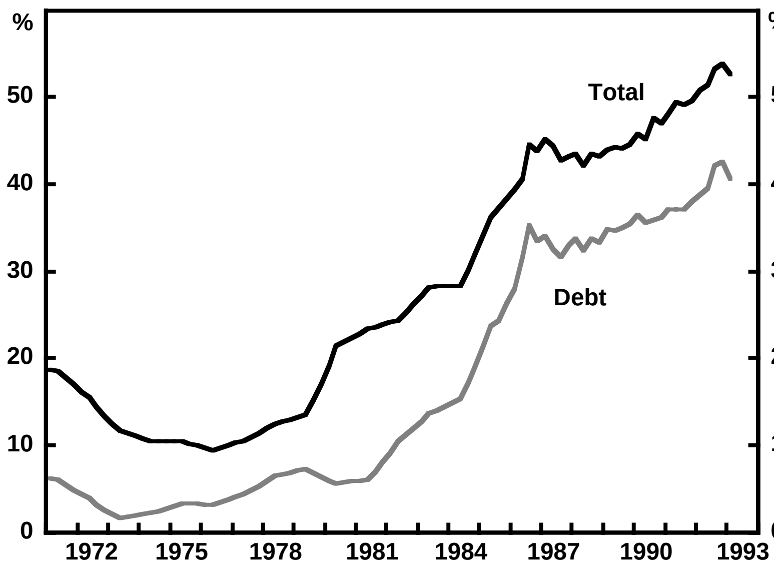


Figure 3: Net Foreign Liabilities
(per cent of GDP)



Accounting identities suggest that the external sector can be examined from three vantage points. Firstly, there is the external balance, focusing on trade in goods and services. Secondly, there is internal balance, highlighting the relationship between the nation's current account balance and its domestic saving-investment balance. Equivalently, this can be seen as the relationship between income (or production) on the one hand and absorption (expenditure) on the other. The third approach focuses on how a surplus or deficit is financed and the accumulation of claims on foreigners - that is, it emphasises intertemporal aspects. Each of these approaches is valid but the first and second approaches may provide more insights in short-run analysis, while the third will be important in the longer term. None of these relationships imply anything about causation. They are all interrelated parts of a system in which the relative importance of domestic and foreign factors can only be evaluated against the real world.

Section 2 explores responses to short-term shocks, while Section 3 describes some of the structural changes Australia experienced. Section 4 provides econometric estimates of imports and manufactured exports. Section 5 uses the findings of the two previous sections to examine the structural adjustment process. Section 6 examines how foreign liabilities (representing the cumulated current account deficits) play a role in the adjustment process, and looks at the debate on the sustainability of the external position.

2. Adjustment to Short-Run Shocks

This section takes as its starting point the sort of model set out in Pitchford's paper at this Conference, and uses the predictions from this model as a guide for comparing actual current account experience since 1980 in response to the two typical shocks that Australia experiences: an investment shock and a terms of trade shock. Of particular interest is the role of the exchange rate in the adjustment to these shocks. Of course, monetary and fiscal policy influenced the current account also, but the main focus of this section is on terms of trade and investment shocks.

2.1 The Framework

The expected response of the current account to the two shocks might be summarised as follows:

- shocks which can be characterised as a rightward movement in the IS curve (e.g. an investment surge) are expected to raise interest rates and the exchange rate, increase the current account deficit and increase domestic output (probably putting pressure on inflation). The role of the current account in these short-term shocks is to provide the opportunity to 'spill' excess demand into the international economy, ameliorating the problem of 'bottle-up' discussed in Blundell-Wignall *et al.* (in this Volume). The exchange rate change will also shift domestic resources into production of non-tradeables. The more closely the domestic and international goods and services markets are linked, the speedier and more complete is this process of 'spilling' excess demand (and the less inflationary pressure is on the domestic economy); and

- an adverse terms of trade shock reduces income and, at the same time, alters one set of relative prices (between importables and exportables). For Australia, the shock generally takes the form of an export price change. The reaction should depend on whether people view the terms of trade shock as permanent or temporary. If permanent, they should begin the process of adaptation to the fall in income, which will require a lower exchange rate to switch production towards tradeables (to offset the deterioration in the current account) and switch domestic demand towards non-tradeables (so as to maintain domestic balance). If the shock is seen as temporary, consumption smoothing considerations suggest that the current account should move towards deficit by the full extent of the terms of trade shock; corresponding to this change in the external account, savings are temporarily run down to accommodate the loss of income. No change in the exchange rate is needed, as no 'switching' of production or demand is required. In practice, of course, people cannot know whether the shock is permanent or temporary (nor would their adjustment to a permanent shock be instantaneous) and so a mixture of the two responses might be expected.

2.2 Short-Term Shocks in Four Episodes

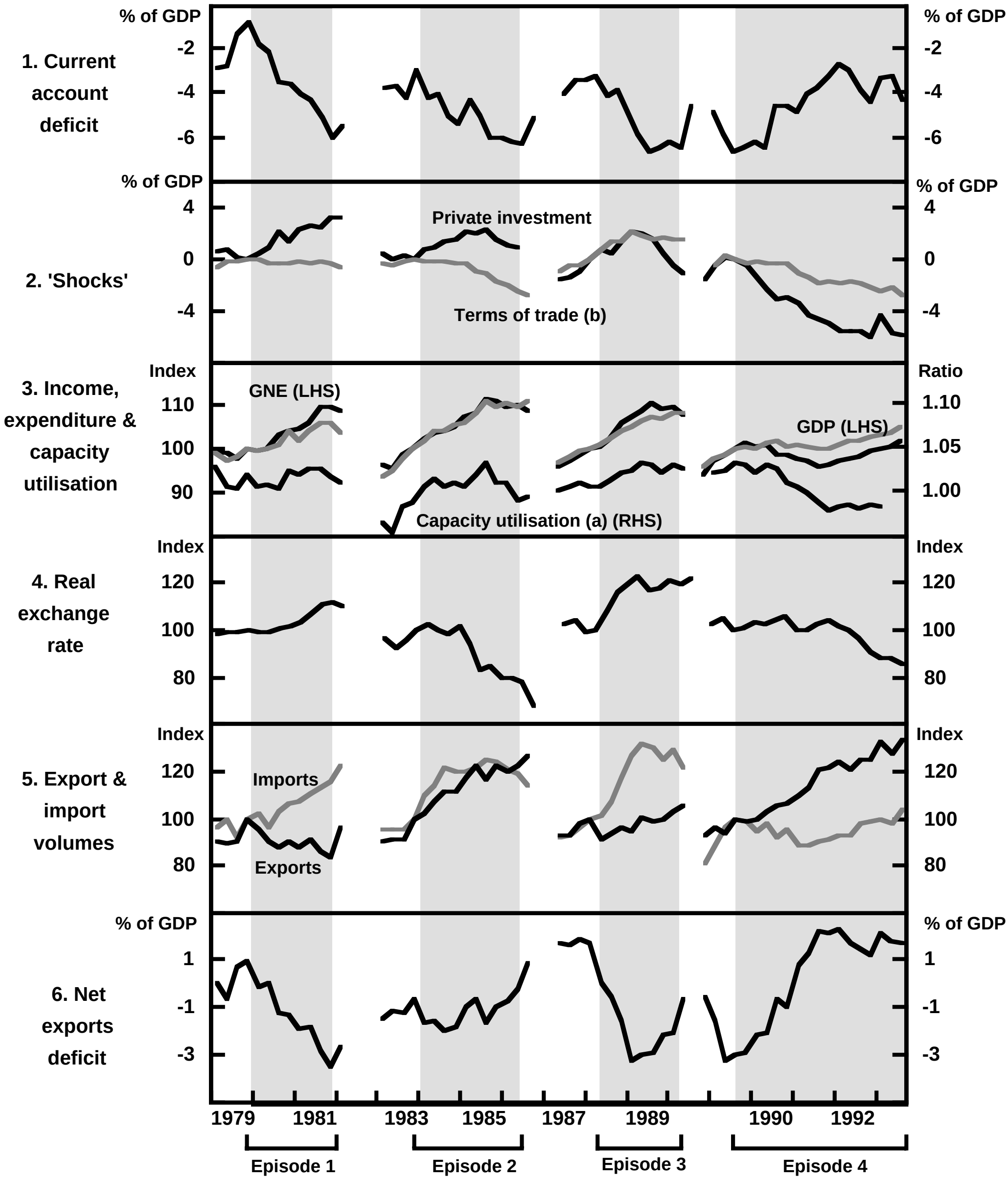
With these predicted responses in mind, this section examines the short-term adjustment process in action, in four episodes over the past 12 years. Does reality fit the model? Three of these episodes are associated with the three peaks in the current account deficit, and the fourth illustrates a period when there were strong forces tending to enlarge the current account deficit (in the form of an adverse movement in the terms of trade), but this was offset by contractionary income pressures. The four episodes provide case studies in the two prevalent types of shocks:

- investment booms - in 1980/81 and 1988/89; and
- adverse terms of trade movements - 1985/86 and 1990/91.

2.2.1 Episode 1: 1980/81

In this period, the current account deficit rose from around 1 per cent of GDP to 6 per cent (see panel 1 of Figure 4). This was driven by a strong rise in investment (panel 2), in turn reflecting the 'minerals boom' - a surge of optimism set off by the second OPEC oil price increase and the prospect of higher commodity prices (a prospect which was not, in fact, realised). This shock was

Figure 4: Four Episodes



Notes: (a) Ratio of real GDP to real GDP trend.
(b) The deviation of the terms of trade adjusted GDP from GDP(I) as a per cent of GDP(I).

equal to nearly 4 per cent of GDP, and so coincides reasonably closely with the expansion in the current account deficit. Changes in net export volumes, driven by imports increases (see panels 5 and 6), correspond closely in size and timing with the investment surge.

This episode provides an example of a fairly pure, investment shock. The exchange rate (and relative price changes) were an important part of the adjustment process, helping to 'spill' the excess domestic demand into the external sector.

2.2.2 Episode 2: 1984 to 1986

The early phase of this period had the same characteristics as an investment shock, but looking at the period as a whole, the terms of trade shock not only dominates, but entirely explains (in a proximate sense) the current account deficit increase - which amounted to 3 per cent of GDP. While the terms of trade decline was an important explanation for the 35 per cent fall in the exchange rate, one element of the terms of trade shock seems to have been delayed in its effect - the income-reducing impact of the terms of trade deterioration. Until 1986, this was offset by strong expansionary pressures coming from a strong world economy, a boost to investment from a change in factor shares in favour of capital and the beginnings of asset price inflation. By early 1986, monetary policy was tight and the income effects of the terms of trade deterioration were beginning to be felt: expenditure growth flattened. Net export volumes rose to offset part of the terms of trade loss, increasing by almost 3 per cent of GDP in 1986.

2.2.3 Episode 3: 1987 to 1989

In this episode, the current account deficit rose from about 3 per cent of GDP to over 6 per cent, reflecting two successive (and related) shocks: a reversal of the terms of trade decline of 1985/86 (which would tend to reduce the current account deficit); and an investment surge (which would tend to increase it).

Initially, expenditure and production expanded in concert, despite a very rapid recovery. As in 1984, there was room for domestic production to meet the expanding demand (see capacity variable in panel 3). This expansion was initiated by a terms of trade improvement equal to 3 per cent of GDP, but this was reinforced by an increase in private investment (amounting to 4 per cent of GDP), driven not only by the enhanced prospects that came with the terms of trade improvement, but by business euphoria associated with rapidly rising asset prices. The increase in the current account deficit roughly corresponded to the rise in investment. Both these shocks should appreciate the exchange rate, and this certainly happened, with a rise in the real trade-weighted index (TWI) of around 20 per cent.

2.2.4 Episode 4: 1990 to 1992

This episode was, to a large extent, the reversal of episode 3. The current account deficit fell by around 2 per cent of GDP, with a terms of trade fall equal to around 2 per cent of GDP and a reduction in private investment equal to 6 per cent of GDP (offset to some degree by the expansion of the budget deficit equal to 3 per cent of GDP). There was very little exchange rate movement until late 1991, probably reflecting the firm stance of monetary policy. Most of the action was in gross national expenditure (GNE), which fell by around 5 per cent. This can be seen as the dominant force of this episode - a fall in investment and income opening up a sizeable gap between GNE and GDP (see panel 3), with the main adjustment being driven by income elasticities rather than prices.

2.2.5 Observations

There are interesting contrasts between the two terms of trade declines. In 1985/86, the current account deficit expanded by about the same size as the terms of trade shock, while in 1990/91, the current account deficit actually got smaller. Does this contrast correspond with the temporary/permanent dichotomy? The change in the exchange rate does not appear to be consistent with this idea; if 1985/86 had been seen as temporary (and therefore consumption smoothing was the relevant model), the exchange rate would not have needed to change much. However, if the 1990/91 terms of trade deterioration had been seen as permanent, that would have implied a significant exchange rate change, which in practice was slow in coming. This cannot be explained solely by differences of monetary policy stance, as policy was tight in both episodes. The fundamental difference seems to be in the context of the time: there were a myriad of interrelated expansionary forces in 1985 (world growth, an investment boom, a change in the wages-profits share, optimism about fiscal policy and the beginnings of the asset price boom) which contrasts starkly with the gloomy environment of the 1990/91 episode, with its large fall in investment. These expansionary factors offset the income-contracting effect of the terms of trade fall in 1985. But if these forces were so strong, why did the exchange rate fall so far? Part of the answer is that it was reacting to the newly recognised realities of higher foreign debt and the limited benefits of the 1980 mineral boom (see Blundell-Wignall *et al.,* in this Volume).

The second comparison is between episodes 2 and 3 where in both cases, there was a substantial increase in the current account deficit, and a strong rise in both GNE and GDP. The major contrast here is in the behaviour of the exchange rate and therefore relative price movements. It is here, above all, that the importance of relative prices in the adjustment process is clear: in 1986, the depreciation and relative price change was enough to produce a positive change in net export volumes which went quite some distance to offsetting the adverse movement of the terms of trade on the current account, while in 1988/89 the rise in the exchange rate (and associated change in relative prices) was enough to ‘spill’ much of the income shock into the external sector - thus expanding the current account deficit.

Other generalisations can be made:

- the exchange rate *is* effective and plays an important part in changing net export volumes. In the two investment shocks (1980/81 and 1988/89), the exchange rate was effective in spilling excess domestic demand into the overseas sector and attracting incremental saving to finance real investment;
- terms of trade shocks generally seem to be seen as *permanent* rather than temporary (two characteristics of permanent changes are exchange rate responses and some adjustment of trade *volumes*). This seems curious, given that these large swings in the terms of trade have invariably proved to be only partly sustained, and that the long-term trend in the terms of trade has been quite modest; and
- where spare domestic capacity existed, GNE increases and GDP increases moved more or less in tandem. This suggests that goods and services markets are not perfectly integrated internationally, as domestic productive capacity was the first ‘port of call’ for meeting increased demand.

3. Structural Issues

Over the course of the 1980s, there have also been longer-term structural changes, which have seen Australian production become much more closely integrated with international markets. Merchandise trade volumes rose sharply as a share of GDP from the mid-1980s, following a period of relative stability in the 1970s (see Figure 1). Clearly, exchange rates and relative prices, by themselves, cannot explain this simultaneous rise in both imports and exports.

This greater integration is not, of course, a phenomenon confined to Australia. Since 1960, international trade has grown roughly twice as fast as average GDP growth in the OECD countries, and this is reflected in the rise in exports as a proportion of GDP in most industrial countries (see Table 1). What is different about Australia is how it has lagged the international trends in integration.

In Australia’s case, the most prominent specific policy factor driving this greater integration was the reduction in protection. Figure 5 shows the Industry Commission’s calculation of the effective rate of assistance for Australian manufacturing.[2] It captures tariffs, quotas and other assistance measures which distort the relative prices facing manufacturers. On this measure, protection fell sharply in the early 1970s (following the across-the-board cut in tariffs in 1973). Not much more progress was made (in fact, some reversion occurred) until the mid-1980s, and since then, another substantial downward movement has been recorded.

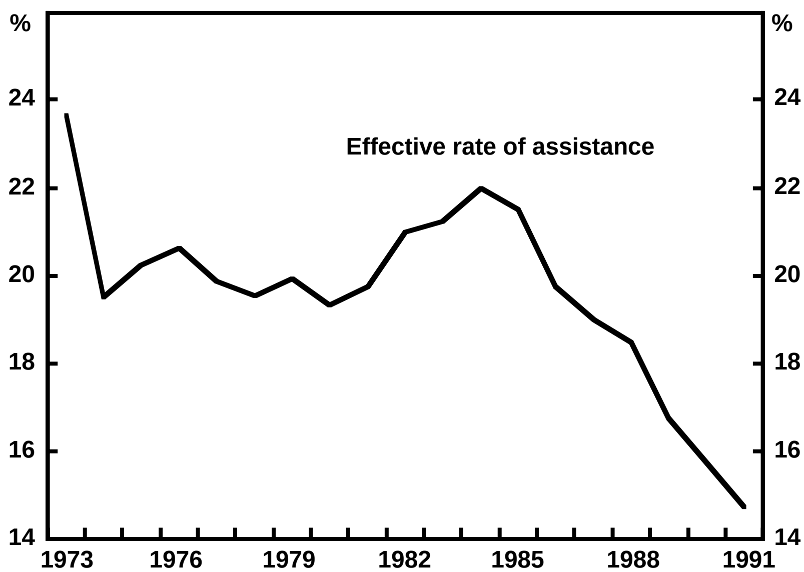
2. The series shown in Figure 5 is a spliced series. See Appendix A for details.

Table 1: Exports of Goods and Services to GDP
(constant prices, per cent)

	1970	1985	1992
Australia	13.9	16.5	22.7
Austria	25.4	40.9	47.3
Canada	21.2	27.0	32.0
France	15.1	23.0	27.1
West Germany	22.5	35.1	44.2
Italy	15.5	20.8	24.3
Japan	8.1	16.2	18.4
Switzerland	28.1	40.7	42.8
United Kingdom	21.5	28.6	30.9
United States	5.6	7.2	11.6

Source: OECD Quarterly National Accounts.

Figure 5: Effective Rate of Assistance



At the simplest level, this reduction in protection would be expected to have two effects - the exchange rate would depreciate in order to offset the tendency for imports to increase; and, as a result of this, exports would increase. So the reduction in protection might be one of the explanations for the increase in *both* imports and exports. This simple intuition is appropriate in the short run. It may not, however, be the end of the story. In the longer run, if the distortions imposed by tariffs are very large, removing the tariff increases national income and, like other increases in productivity, this would put upward pressure on non-traded goods prices and thus upward pressure on the real exchange rate. The dynamic distortions caused by tariffs may be potentially more important than the static distortions. A second qualification is that tariffs might impose a sufficiently high ‘tax’ on exports (imported inputs costs are higher than under free trade), that a general reduction in tariffs might actually improve the trade balance and cause a real appreciation (Johnson 1966). Neither of these considerations, however, alters the intuition that a reduction in tariffs would be expected to increase both imports and exports.[3]

The reduction in tariffs is only one example of the significant microeconomic reforms of the past 10 years (and, in these, the tariff reduction would often have been an important catalyst). The changes are often attitudinal and unquantifiable, but are reflected in the new-found emphasis on export orientation and ‘world-best practice’.[4] Many of these reforms have no clear direct balance of payments link (see Forsyth (1990)), but have served to make Australia more competitive and outward looking. While they cannot be quantified, they form an important backdrop to the greater international integration. These changes involved:

- a rise in intra-industry trade;
- rapid increases in manufactured exports; and
- a substantial alteration in the direction of trade, particularly in exports.

3.1 Intra-Industry Trade

Historically, much of Australia’s trade has been *between* industries - exporting commodities and importing manufactures - rather than within industries. Lowe (1990) showed that in 1987, intra-industry trade accounted for only 12 per cent of total Australian trade, the lowest proportion of any OECD country. In most European countries and North America, for example, intra-industry trade accounts for around 40 to 50 per cent of total trade. The structure of Australia’s resource endowment provides one explanation. Intra-industry trade tends to be lower in

3. Clements and Sjaastad (1984) discuss the theory of import protection, emphasising how much of the burden is borne by exporters. They also provide empirical estimates of the cost to exporters of protection. Swan and Zeitsch (1992) show, in the context of the ORANI model, that reductions in tariff protection result in increases in manufactured exports.

4. McKinsey & Company (1993) document the recent emergence of this export culture in many small and medium-sized firms.

goods which are relatively homogeneous - for example, commodities. Australia's large weighting towards these types of exports would, therefore, tend to decrease the amount of intra-industry trade as a proportion of the total.

Trade structure is not, however, the whole story. Lowe shows that even for trade categories in which intra-industry trade is prevalent (in particular, manufactured goods), Australia's intra-industry trade is much lower than the average. An important factor here has undoubtedly been protection of the domestic manufacturing industry in Australia. With reduced protection, intra-industry trade should expand. Indeed, while the share of intra-industry trade in total Australian trade remains very low, it has risen, particularly over the past decade, to levels nearly three times higher than 25 years ago (see Table 2). Individual industries show a more dramatic change. Intra-industry trade in the broad category of beverages and tobacco has risen from about 7.5 per cent in the 1960s and 1970s to almost 40 per cent at the beginning of the 1990s. The Closer Economic Relations Agreement has led to a dramatic expansion of intra-industry trade with New Zealand. Around 45 per cent of Australian trade with New Zealand is now of intra-industry type, compared with about 14 per cent in the 1960s. Furthermore, the growth of manufactured exports over the second half of the 1980s (see Section 3.2 below) has also embodied an increase in intra-industry trade.

Table 2: Australian Intra-Industry Trade

(as a percentage of total trade)

Period average	Total Goods	Manufactures
1965-69	5.1	6.2
1970-79	6.6	9.2
1980-85	8.2	9.8
1986-91	11.4	13.4
1991	13.8	17.4

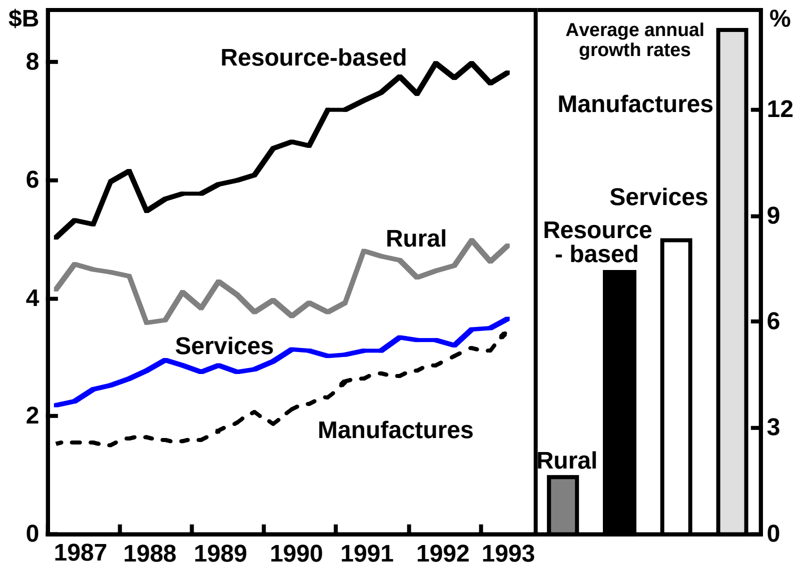
Sources: Lowe (1990) and Australian Bureau of Statistics.

3.2 Manufactured Exports

Figure 6 shows growth rates of the main categories of exports. Manufactured export volumes[5] have grown by almost 15 per cent per annum over the past six years, compared with about 6 per cent over the previous six years (see Figure 6).

5. Throughout the paper, manufactures are defined in a narrow sense to exclude some large, simply-transformed categories such as iron and steel and aluminium. These are classified as resource-based exports.

Figure 6: Composition of Exports
(1989/90 prices)



While this strong growth has been from a low base, it is symptomatic of important structural change occurring in the domestic economy. Some commentators have suggested that the growth reflects temporary rather than structural factors, arguing that the growth:

- is cyclical, reflecting sluggish domestic demand;
- is due to fast growth in a few markets and does not reflect a broader strength; and
- is all in categories which are receiving government assistance.

These explanations play some part in the story: in general, however, previous work has concluded that the growth appears to be too widespread across destinations and sectors to be attributable principally to the above factors.[6] More deep-seated structural forces seem to be at work.

3.3 Direction of Exports

There has been a substantial change in the direction of Australian exports over the past 40 years (see Table 3). In the 1980s, Asia (excluding Japan) became a very important destination for Australian exports, particularly exports of manufactures.

6. Reserve Bank of Australia (1992).

Table 3: Direction of Merchandise Exports
(per cent of total)

	1950s	1970s	1980/81	1991/92
United Kingdom	32.3	5.5	3.7	3.5
Other EEC	21.5	10.4	8.7	9.0
Japan	10.3	30.0	27.3	26.5
Other Asia	9.7	17.1	20.4	32.7
North America	9.7	13.2	13.5	11.0
New Zealand	4.8	5.1	4.8	5.1
Other	11.7	18.7	21.6	12.2
	100.00	100.00	100.00	100.00

Notes: (a) Other Asia - Bangladesh, Brunei, China, Hong Kong, India, Indonesia, Cambodia, Korea, Laos, Macau, Maldives, Burma, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam.
(b) North America - Canada, United States.
Source: Australian Bureau of Statistics Catalogue No. 5436.0.

The re-orientation away from Europe and towards Asia was initially driven by the formation of the EEC and the strong post-war growth of Japan. More recently, the strong growth in Asian countries other than Japan has presented Australia with further export opportunities. This group now accounts for one-third of Australia's merchandise exports (compared with less than 10 per cent in the 1950s and 20 per cent as recently as 1980/81). Taken together with Japan and New Zealand, our regional trading partners now account for nearly two-thirds of our merchandise exports.

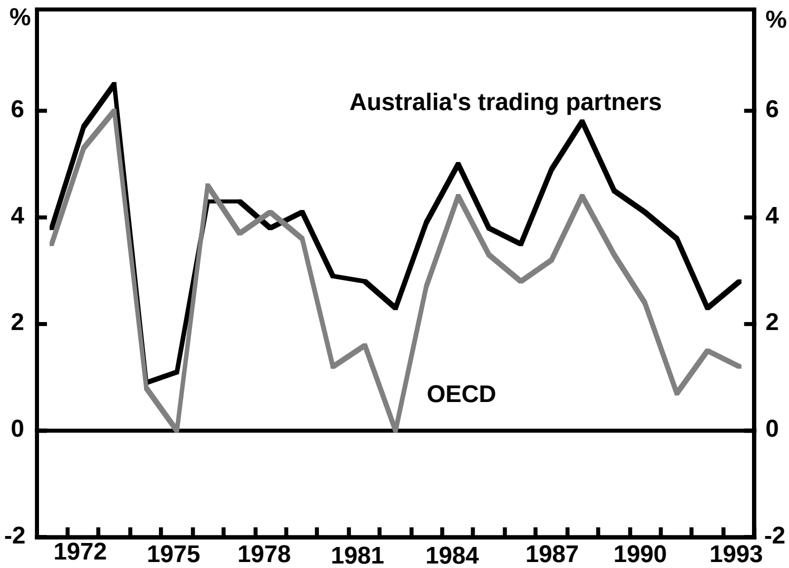
The economic growth of this 'Other Asia' area has been quite fast for the past couple of decades (about 6 per cent per year in the 1970s and 7 per cent in the 1980s), but it was not until the 1980s that the region's *absolute* size became significant. These countries have not only grown fast, but this has been outward-looking growth, with large increases in the proportion of GDP accounted for by international trade (see Table 4). The growing market in these countries can be seen in Figure 7, which compares GDP growth in OECD countries with that in Australia's trading partners, where the fast-growing Asian area has provided a rapidly growing export market. Unlike the earlier expansion in Japanese demand, the more recent expansion in Australian exports to this region has been focused on manufactured goods. Simply keeping pace with the growth of manufactured imports by this region, for example, has resulted in average annual growth in

Table 4: Selected Asian Economies: Exports/GDP
(per cent)

	1965	1990
China	4	18
Indonesia	5	26
Philippines	17	28
Thailand	16	38
Malaysia	42	79
Korea, Rep.	9	32
Singapore	123	190
Hong Kong	71	137

Source: World Bank, *World Development Report 1992.*

Figure 7: Output Growth
(year-ended percentage change)



Australian manufactured exports to Asia of over 20 per cent in the second half of the 1980s.

Table 5 shows growth in Australian manufactured exports to various countries and growth in manufactured imports by those same countries over the second half of the 1980s.

Table 5: Growth in Manufactured Exports

Country/region	Australian manufactured exports	Manufactured imports of these countries	Share of Australian manufactured exports
	(average annual percentage change, 1986-1991)		(per cent, 1991/92)
Singapore	31.0	24.7	6.1
Hong Kong	21.4	24.9	5.7
Indonesia	38.8	17.8	3.6
Korea	40.0	20.5	2.6
Taiwan	28.0	27.9	2.5
Malaysia	29.1	29.8	2.3
Thailand	35.0	34.1	2.2
Philippines	33.6	22.6	1.2
China	-1.8	7.6	1.0
Total Asia (excluding Japan)	**27.6**	**21.4**	**24.6**
Japan	30.2	21.1	7.9
New Zealand	17.7	7.0	18.8
OECD Europe	24.5	14.8	16.3
North America	27.6	6.3	16.0
TOTAL of above	**24.8**	**13.5**	**83.6**

Notes: (a) Due to data limitations, the statistics in this table are in value rather than volume terms.
(b) To account for differences in inflation rates among countries, growth rates are measured in US dollar terms. Details of the calculations are available on request.

Sources: OECD, *Foreign Trade by Commodities.*
Asian Development Bank, *Key Indicators of Developing Asia and Pacific Countries.*
United Nations, *International Trade Yearbook.*
Department of Foreign Affairs and Trade, *Central Statistics Section.*
Council for Economic Planning and Development, Republic of China, *Taiwan Statistical Data Book 1992.*

The data show that although there has been some gain in market share in Asia, there have been even more substantial gains for Australian manufacturers in the more 'traditional' markets of New Zealand, OECD Europe and North America. Furthermore, manufactured exports to Asia grew at about the same rate as exports to the other markets, even though the Asian markets were growing much more quickly. Figure 8 shows that after a long period of declining market share in Asia, Australian manufacturers have managed to hold market share since 1986, and

Figure 8: Australian Manufactured Exports to Asia[a]
(share of region's manufactured imports)

Note: (a) As defined in Table 5, but excluding China and Taiwan.

perhaps even increase it slightly. Some of these puzzles will be examined in the empirical work of the next section.

4. Estimating Trade Equations

So far, in looking at the short-term movements and structural changes, the analysis has been descriptive. The next two sections attempt to bring a degree of precision to the analysis, with econometric estimates of imports and exports. The discussion above suggests a number of possible explanators:

- relative prices;
- reductions in tariffs and other assistance; and
- strong growth in Asia.

4.1 Imports

In Section 3, the rise in the ratio of imports to GDP was noted as an example of structural change. High *short-term* income elasticities make some intuitive sense.[7] But in the longer term, elasticities closer to unity might be expected, so the sharp

7. An excess demand shock of the type described in Section 2 equal to, say, 1 per cent of GDP, which entirely 'spilled' into imports would, in an economy with an import ratio of 20 per cent, imply an income elasticity of 5.

rise in the imports/GDP ratio suggests that structural factors are at work. This section explores this through the estimation of an import equation.

A recent study by Wilkinson (1992) is taken as the starting point. This used an error-correction approach to estimation which seems particularly suited to trying to separate short-run and long-run elasticities. The results of this work differed somewhat from those of previous studies.[8] Estimates of the long-run income elasticity were much higher - in a range of 1.85 to 1.94 depending on the definition of imports and the activity variable used. At the same time, the estimates of price elasticities were generally lower than in previous studies: -0.3 to -0.8. Wilkinson's preferred equation succeeded in tracking, out of sample, the large rise in imports in 1988/89 and the subsequent fall.

One surprising characteristic of the Wilkinson equation is that there was no substantial difference between short and long-run income elasticities, even though the estimating technique had the potential to separate these. The relatively high income elasticities estimated make some sense for the short-run response to income shocks, but it is hard to see why the long-term elasticities should be so high. Five possible reasons could be put forward:

- computer imports became such an important component, and grew so quickly, that they need to be explained not only by income and relative price elasticities but also in terms of changing tastes in technology;[9]
- imports comprise capital goods, consumption goods and intermediate inputs (with the last category accounting for about half of endogenous imports). There may be too much diversity in the behavioural relationships underlying the various groups of imports to be able to model them successfully in aggregate;
- other structural changes, particularly on the domestic supply side, have been important and are being confounded with the income elasticities of the demand equation;

8. See Macfarlane (1979) for a survey of price and income elasticities of demand for imports from the 1960s and 1970s. Gordon (1986) reports price elasticities for a few studies in the 1980s.

9. When rebasing the constant price estimates to 1984/85 prices (in 1988), the Australian Bureau of Statistics (ABS) introduced a new method for calculating the volume of computers. They now use a computer price series, developed by the Bureau of Economic Analysis (BEA) in the United States, to deflate the value of computer imports. Due to the rapidly improving quality of computers over time, this price series falls almost continuously and very sharply, and the volume correspondingly rises very sharply. (See McCarthy (1989) for details of this method of calculation.) As a result, estimation of import demand functions which include computers will tend to find much larger elasticities on income and relative price than if computer imports had been excluded. Studies carried out prior to the introduction of this computer price series by the ABS (i.e. all of the studies reported in Macfarlane (1979)) will not be affected by this problem.

- the reduction of protection represents an important structural change which is not captured in the Wilkinson equation, but which might be expected to explain an important part of the increase in imports (and exports) as a per cent of GDP. The regression may be attributing to the income variable some of the influence of tariff reductions; and
- as a result of greater international integration, greater intra-industry trade may explain higher imports *and* exports, for any set of income and prices.

The final three relate to structural *supply-side* changes which are poorly defined in the sort of model estimated here. The final two were discussed in Section 3 as reasons why gross trade flows may be rising in general.

The following sections look briefly at the first two issues. A third section looks at whether reductions in protection help to explain the rise in import volumes. Intra-industry trade was discussed in Section 3 and will not be covered again here.

4.1.1 Excluding computers

Table 6 compares Wilkinson's results with a re-estimation of the same model excluding computers.[10] This gives some idea of the extent to which computer imports have influenced the relevant elasticities. Rebasing the constant price estimates resulted in a much lower growth in endogenous imports[11] and estimating Wilkinson's model using these rebased data and a longer sample, results in a

Table 6: Long-Run Elasticities of Import Demand

	Income	Relative Price
Wilkinson (1992) (1984/85 prices)		
1974:3 to 1989:3	1.94	-0.49
This study (1989/90 prices)		
1974:3 to 1992:4		
including computers	1.70	-0.45
	(33.55)	(-4.43)
excluding computers	1.55	-0.42
	(28.55)	(-3.36)

Notes: t statistics are in brackets. There were no t statistics reported in Wilkinson.

10. The model is estimated over a longer sample than Wilkinson's; September 1974 to December 1992. Furthermore, it is a simpler model. In particular, it excludes the relative price of exports and capacity constraints which, in subsequent work, were found to be insignificant in the long-run equation estimated using the Phillips-Hansen technique.

11. See Australian Bureau of Statistics Catalogue Nos 5227.0 and 5243.0.

significantly lower income elasticity.[12] The effect of excluding computers has been to reduce the income elasticity further, as would have been expected. While much lower, however, the income elasticity is still well above unity.

4.1.2 Disaggregation

Consumption goods might be expected to have a higher price elasticity than, say, investment goods, because there are close domestic substitutes for consumption imports. Producer inputs may be less responsive to changes in relative prices. Figure 9 shows growth of each type of import with a relevant activity variable and relative price. Long-run equations and error-correction models were estimated for each component of imports. Table 7 summarises the long-run elasticities. Details of the estimates are recorded in Appendix A.

Two main conclusions emerge. Firstly, for all three categories of imports, income elasticities are significantly greater than 1 (but below the Wilkinson estimate). Consumption imports appear to have a higher income elasticity than other types of imports. The high aggregate income elasticity, however, does not appear to be the result of behavioural differences in imports; whatever is pushing up the income elasticities is a general factor, affecting all types of imports. Secondly, there are substantial variations in price elasticities. Consumption and capital imports have price elasticities around -0.8, higher than for total imports. The relative price effect on 'other' imports (principally intermediate goods) is

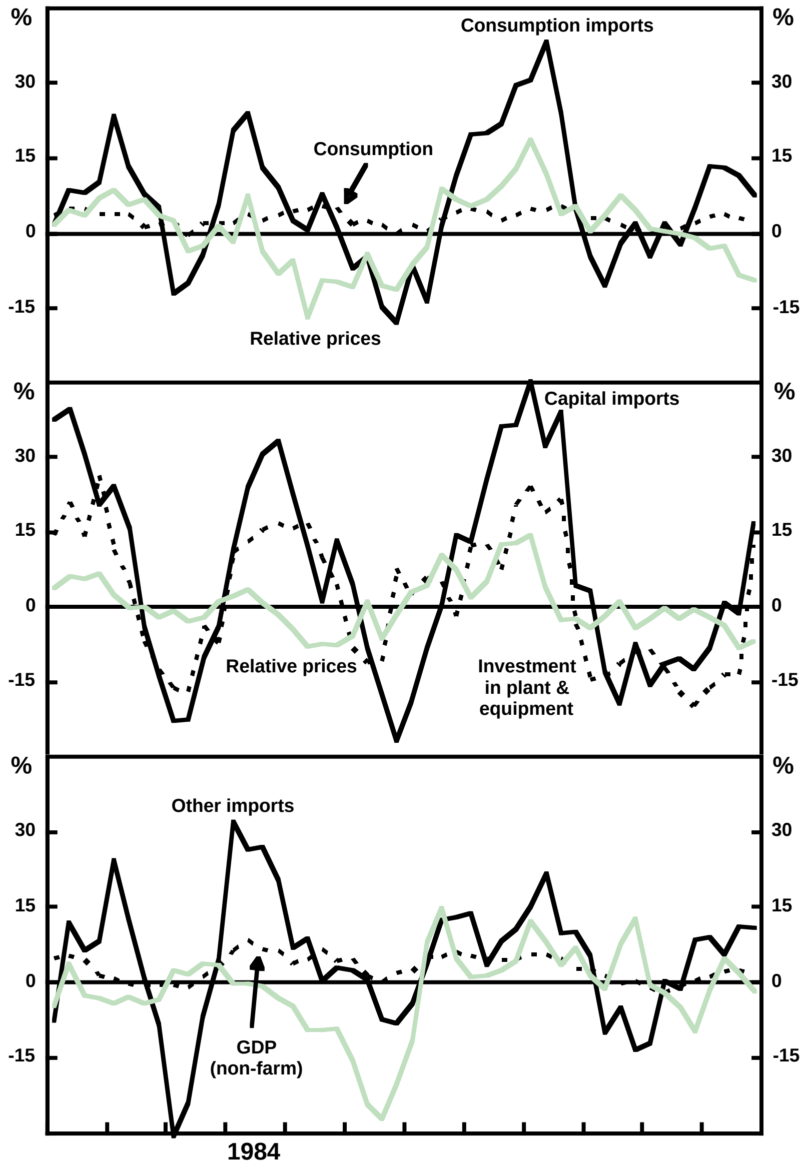
Table 7: Long-Run Elasticities of Import Demand

Component of Imports	Income	Relative Price
Consumption	1.73	-0.70
	(17.76)	(-5.15)
Capital (using GNE)	1.40	-0.76
	(5.48)	(-2.29)
Other	1.48	-0.18
	(12.01)	(-1.53)

Note: t statistics are in brackets.

12. The reason for this difference is not the sample period. When the model was estimated using the rebased data including computers over the same period as Wilkinson (1992) the income and price elasticities were 1.72 and -0.49, respectively.

Figure 9: Imports, Activity and Relative Prices
(year-ended percentage change)



much smaller at -0.2 and is statistically insignificant at the 10 per cent level. This makes some intuitive sense; there may well be limited domestic substitutes for imported inputs and producers may find it easier to pass these costs on.

4.1.3 Tariffs

With falling protection, the price of imports facing consumers will be falling relative to the price of domestic goods and the import penetration ratio will therefore be rising. The price of imports over the docks does not capture this effect so the relative price term in the import equations was adjusted to allow for falling tariffs.[13] The adjustments were made in both the aggregate equation and in the equation for consumption imports, reflecting an *a priori* belief that protection is most prevalent on consumption items.

Table 8 reports the results of this further estimation, comparing it with earlier estimates. Evidence of a tariff effect is very weak; the differences in the estimates are not statistically significant. Nevertheless, it is interesting to note that the income elasticity, in particular, moves in the expected direction; it falls when the tariff adjustment is included.

Table 8: Long-Run Elasticities

	Activity	Relative Price
Endogenous Imports:		
without tariff adjustment	1.55	-0.42
	(28.55)	(-3.36)
with tariff adjustment	1.50	-0.41
	(24.26)	(-3.52)
Consumption Imports:		
without tariff adjustment	1.73	-0.70
	(17.76)	(-5.15)
with tariff adjustment	1.64	-0.68
	(16.11)	(-5.03)

Note: t statistics are in brackets.

The evidence from Table 8 is not particularly compelling. An alternative model was therefore formulated to further test the importance of falling protection in import growth. The dependent variable was defined to be the import penetration ratio (endogenous imports/GDP) - i.e. the coefficient on domestic income was constrained to be unity. Two variables were tried to capture the tariff effect. Firstly, the effective rate of assistance (ERA, as shown in Figure 5) was used as an explanator, together with the relative price series used in the regression reported

13. See Appendix A for a description of this adjustment.

in Table 6 (RP1, it does not incorporate tariffs). The results are reported in Table 9. Secondly, a relative price which incorporates import prices measured at the *retail* level (i.e. including tariffs) was tried (RP2).[14] This variable is available only since December 1984, so the sample period is reduced to 32 observations. The performance of this relative price was then compared with the performance of the relative price term which does not incorporate tariffs.

The first regression indicates a significant relative price elasticity of around -0.7 and an elasticity on ERA of around -1.2, although this variable is not significant at the 10 per cent level. The second and third regressions show the results with the two different relative price variables. These tests should be interpreted cautiously. The sample period for these regressions is very short and the long-run coefficients reported may be biased (Inder 1991). For what it is worth, both relative price variables have significant long-run coefficients. The fourth column presents a simple test of the relative performance of each variable. The results suggest that RP2, the relative price including tariffs, performs better in modelling the import penetration ratio.

Table 9: Tests of the Effect of Tariffs

Endogenous imports/GDP regressed on:		Period of Estimation	Long-run Coefficient	F test (b)
(i)	ERA	74:3 - 92:4	-1.16	
			(-1.13)	
	RP1		-0.65	
			(-2.47)	
(ii)	RP1	84:4 - 92:4	-0.65	F(8,20) = 2.174
			(-4.83)	(0.076)
(iii)	RP2	84:4 - 92:4	-1.06	F(8,20) = 3.978
			(-3.15)	(0.006)

Notes: (a) t statistics are in brackets.
(b) F test of the hypothesis that all variables in the error-correction model could be excluded. The figures in brackets are significance levels.

A lot of weight should not be given to these results. Nevertheless, taken together, the results in Tables 8 and 9 are weak evidence of a role for tariff reductions in explaining the rise in imports. These results will be used in Section 5 in discussing structural change.

14. See Appendix A for details.

4.2 Exports

This section explores trade equations for exports, with the special interest being the role of the exchange rate and relative prices. Relative prices could find their way into export equations in three ways:

- export prices/domestic prices: this 'internal competitiveness' represents the supply-side effect, whereby a rise in export prices may attract resources away from other uses, principally in the non-traded sector;
- Australian export prices/world export prices: this reflects the competitiveness of Australian exports, *vis-à-vis* rival suppliers; and
- export prices/prices in the 'target' market: this captures the competitiveness of Australian exports, *vis-à-vis* alternative sources of supply within the importing country.

It has proven difficult to find clear relative price effects in export equations for Australia (although Goldstein and Khan (1985) report some success for other countries). For the bulk of Australia's exports (commodities), the supply-oriented relative prices are probably the most relevant, as there is no scope for price differentiation in this sort of homogenous good. Given the long lags in supply response, it is perhaps not surprising that this relative price effect is difficult to find.

The focus in this paper will be on manufactures, as this is not only the component of exports which has grown extraordinarily quickly since the mid-1980s, but it may also be more responsive to *demand*-oriented relative prices. Such goods are not homogenous; there is scope for product differentiation and, therefore, price differentials between similar goods on the world market. Furthermore, for a small country such as Australia, the price elasticities of demand for manufactured exports would be expected to be relatively high. With only a small share of world markets, growth in Australia's exports of manufactures should not be constrained by total market growth; a fall in the relative price of Australian manufactures would, therefore, be expected to result in a significant rise in exports of those goods.

4.2.1 Exports of manufactures

This section relates the growth in manufactured exports to a number of variables including relative prices and foreign income. The feature which distinguishes this study from earlier estimates[15] is that it uses cross-section as well as time series data. A panel of annual data on Australian manufactured exports to 21 countries from

15. See, for example, Hargreaves, Harrington and Siriwardana (1993), Menzies and Heenan (1993), and Ryder and Beacher (1990). Coppel, Simes and Horn (1988) report the results from the NIF88 model of the Australian economy.

1976 to 1991 is constructed and used in estimation. There are a number of advantages to using panel data in this situation. Firstly, quarterly data on exports are very volatile. Use of cross-section data allows the time series to be annual without immediately running into sample size problems. Secondly, the Asian countries have grown very quickly over the past decade and have become increasingly important destinations for Australian manufactured exports. Use of cross-section data allows these differential growth rates to be explicitly accounted for, and for any differences in income elasticities across countries to be tested. More generally, use of cross-section data introduces more variation to the data, which may assist in identifying the influence of particular factors. Finally, there are some econometric advantages which are discussed in Appendix B.

A general model of Australian manufactured export volumes is given in the following equation.[16]

$$X_{it} = f_i(Y_{it}, W_t, P_{it}, Z_{it}) \qquad (1)$$

where X_{it} is the volume of manufactured exports to country i at time t, Y_{it} is the real level of income in country i, W_t is the price of Australian manufactured exports relative to world manufactured exports, P_{it} is the price of Australian manufactured exports relative to country i's manufactures, and Z_{it} is any other variable that may impact on the penetration of Australian manufactured exports overseas.

Australian manufactured exports to country *i* are, at the simplest level, a function of the income in country *i* and the price of Australian manufactured exports relative to the price of competitors. Other factors which may be relevant are:

- 'internal' competitiveness: if supply is not infinitely elastic, some rise in the price of exports relative to goods sold domestically will be needed to induce an increase in the supply of exports. This may be a short-term switch (the same product simply being sold in a different market) or a long-term one (re-allocation of productive resources to production of traded goods rather than non-traded). The expected sign of this variable is ambiguous. A decline in the price of exports relative to other domestic goods may result in a decline in the supply of exports. On the other hand, the decline in the price of exports may reflect higher productivity in this sector and a flow of resources into exports. In this case, lower export prices relative to domestic prices will be associated with a rise in exports;
- Australian domestic demand: a frequently heard explanation for the strong growth in manufactured exports is that producers are exporting simply because they cannot sell their products in the domestic market due to domestic

16. See Appendix B for details of data constructions and sources.

recession. The implication is that penetration rises when domestic demand is weak and falls as domestic demand strengthens; and

- reductions in protection: tariffs and other forms of protection have a damaging effect on Australian exports through resource misallocation and higher input costs. Furthermore, they reduce pressure on domestic producers to innovate and improve efficiency, thus reducing their competitiveness in world markets. Therefore, as protection is reduced, exports would be expected to rise.

The approach was to obtain non-structural estimates of the impact of foreign incomes and relative prices on Australian manufactured exports. Other variables were then added to the basic formulation to see if they add any explanatory power and/or detract from the explanatory power of the basic variables.[17] Initially, two relative price terms were included; the price of Australian manufactures relative to world prices (the world relative price) and the price of Australian manufactures relative to the domestic price of manufactures in the importing country (bilateral relative prices). The bilateral relative price did not add significant explanatory power, so it was dropped from the basic model. The world relative price variable was significant when the bilateral price was included and did not vary much with its exclusion.

The results of the basic model are shown in the second column of Table 10. Here, the income and price elasticities are constrained to be the same between countries of export destination.

The coefficients on world relative prices and foreign GDP were significant and of the expected sign. An increase in the price of Australian manufactured exports relative to world prices is associated with a fall in manufactured exports. Although the significance level cannot be calculated from this formulation, the estimates suggest that the long-run effect of the world relative price on Australian manufactured exports is around -6.4. That is, over the period of estimation, a 1 per cent fall in Australian manufactured export prices relative to world prices is associated with about a 6.5 per cent rise in the volume of manufactured exports.

An increase in foreign GDP is associated with a rise in Australian manufactured exports; the constrained estimates from the basic model suggest a long-run ‘elasticity’ of 0.8 on foreign GDP, although once again, significance levels cannot be calculated.

The third to sixth columns of Table 10 show the results of including other factors in the basic model, one at a time. Apart from the effective rate of assistance, none of the other factors improved the fit of the model markedly (as measured by the sum of squared residuals (SSR) and the standard error of estimate (SEE)). The

17. See Appendix B for details.

Table 10: Summary of Results

$$\Delta x_{it} = \alpha_i + \beta_0 x_{it-1} + \beta_1 \Delta x_{it-1} + \omega_0 w_{t-1} + \omega_1 \Delta w_t + \omega_2 \Delta w_{t-1} + \eta_0 y_{it-1} + \eta_1 \Delta y_{it} + \eta_2 \Delta y_{it-1} + \xi_0 z_{it-1} + \xi_1 \Delta z_{it-1} + \xi_2 \Delta z_{it-1} + \varepsilon_{it}$$

Model	Basic Model	Domestic Relative Prices	Australian GNE	Capacity Utilisation	Effective Rate of Assistance
Exports	–0.25	–0.24	–0.28	–0.27	–0.31
x_{it-1}	(0.07, 0.00)	(0.08, 0.00)	(0.07, 0.00)	(0.07, 0.00)	(0.07, 0.00)
Δx_{it-1}	0.35	0.40	0.37	0.50	0.28
	(0.18, 0.05)	(0.22, 0.07)	(0.18, 0.04)	(0.22, 0.02)	(0.18, 0.13)
World relative prices	–1.60	–2.20	–1.96	–2.21	–1.54
w_{t-1}	(0.55, 0.00)	(0.61, 0.00)	(0.97, 0.04)	(1.02, 0.03)	(0.58, 0.01)
Δw_t	–1.37	–1.73	–2.00	–3.33	–1.40
	(0.51, 0.01)	(0.57, 0.00)	(1.08, 0.06)	(0.84, 0.00)	(0.60, 0.02)
Δw_{t-1}	0.76	1.29	1.58	1.88	0.60
	(0.47, 0.10)	(0.57, 0.02)	(0.98, 0.11)	(0.74, 0.11)	(0.42, 0.16)
Long-run elasticity	–6.36	–9.05	–7.00	–8.09	–5.00
Joint significance	11.8	13.83	4.34	21.1	8.65
	(0.01)	(0.00)	(0.23)	(0.00)	(0.03)
Importing country GDP	0.20	0.11	0.10	0.01	0.19
y_{it-1}	(0.12, 0.08)	(0.15, 0.47)	(0.13, 0.45)	(0.14, 0.95)	(0.12, 0.10)

Δy_{it}	1.78	1.77	1.87	1.85	2.12
	(0.94, 0.06)	(1.01, 0.08)	(0.97, 0.05)	(0.91, 0.04)	(0.96, 0.03)
Δy_{it-1}	0.17	1.29	0.28	0.01	0.31
	(1.04, 0.87)	(0.57, 0.02)	(0.99, 0.78)	(1.03, 0.99)	(0.88, 0.72)
Long-run elasticity	0.80	0.45	0.36	0.03	0.61
Joint significance	6.63	4.90	6.57	6.56	8.24
	(0.08)	(0.18)	(0.09)	(0.09)	(0.03)
Added variable	—	–0.36	0.14	0.25	–1.07
z_{it-1}		(0.40, 0.37)	(0.30, 0.65)	(0.29, 0.40)	(0.25, 0.00)
Δz_{it}	—	0.83	–0.95	0.33	–0.35
		(0.74, 0.26)	(0.83, 0.25)	(0.19, 0.09)	(0.50, 0.49)
Δz_{it-1}	—	0.15	–1.85	–0.68	1.26
		(0.66, 0.82)	(1.26, 0.14)	(0.32, 0.03)	(0.66, 0.06)
Long-run elasticity	—	–1.47	0.49	0.90	–3.46
Joint significance	—	3.41	9.49	20.75	18.62
		(0.33)	(0.02)	(0.00)	(0.00)
R^2	0.15	0.11	0.16	0.10	0.27
SSR	31.60	33.20	31.20	33.50	27.20
SEE	0.33	0.34	0.33	0.34	0.31

Notes:
(a) For coefficient estimates, the numbers in parentheses are, firstly, the standard error of the coefficient estimate and, secondly, the significance level.
(b) All standard errors are Newey-West corrected for heteroscedasticity and serial correlation.
(c) Joint tests of significance are Wald tests distributed as χ^2 (3) and figures in parentheses indicate the significance level.

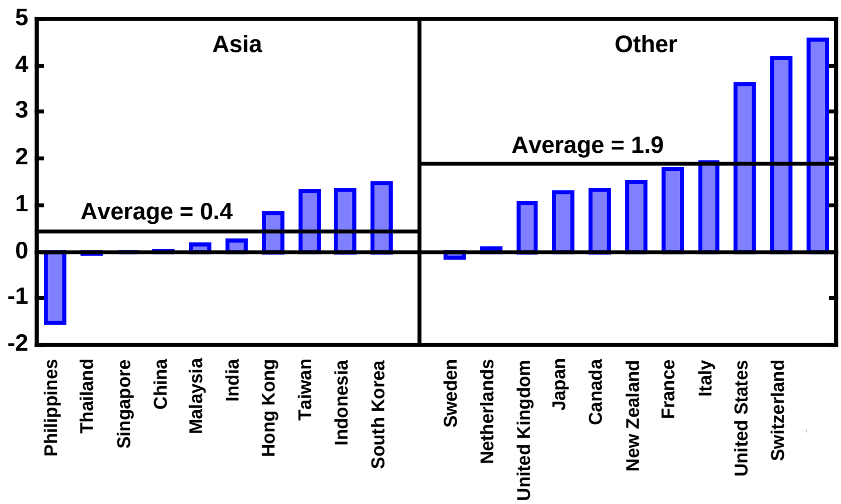
domestic relative price terms were jointly insignificant. Both Australian GNE and domestic capacity utilisation were jointly significant when added to the basic model but improved the fit only marginally. In both cases, there is a negative effect in the short run. The implied long-run effects, however, are positive, probably capturing the relationship between output and exports; over the long run, output and exports will tend to rise together.

The inclusion of the effective rate of assistance in the model improved the fit markedly. The coefficients were jointly significant and the implied long-run 'elasticity' of the expected sign. It also reduced the income and price elasticities. The estimates show that the fall in assistance over the past decade helps to explain the growth of manufactured exports over this period. This is discussed in more detail below.

Importantly, the addition of extra variables did not greatly change the conclusion on relative prices. Even when the effective rate of assistance is included, the implied long-run 'elasticity' on the relative price is still high at 5. On the other hand, the effect of foreign-country GDP on Australian manufactured exports seems more unstable with the addition of further variables.

One advantage of panel data is that it is possible to test the hypothesis that the income elasticities for individual countries are equal. Figure 10 shows the results of estimating the basic model with protection while allowing income elasticities to vary across countries. It shows the implied long-run elasticities for all countries, divided into two groups - Asia and all others.[18] The horizontal lines represent the

Figure 10: Income Elasticities of Australian Manufactured Exports



18. Japan is not included in Asia as it is an industrialised country and a long-standing trading partner of Australia.

average for each group. The difference between the two groups is marked. In general, income elasticities for the Asian countries tend to be much lower than for the other countries included in the estimation. The average income elasticity for the 10 Asian countries is 0.4, compared with an average elasticity of 2 for the other 11 countries. A test of the hypothesis that coefficients on income could be constrained to be equal across countries was conclusively rejected. This result is discussed more fully in Section 5. Once again, this variation on the basic model does not detract from the significance of either the relative price variable or the effective rate of assistance. The implied long-run elasticity on the relative price remains around 5 and that on the rate of assistance around 3.5.

The next section interprets these findings in the context of long-term structural adjustment and the stylised facts outlined in Section 3.

5. Structural Change: What Has Been Achieved?

This section brings together the descriptive material from Section 3 and the econometrics from Section 4 to assess how the process of structural change (as opposed to the cyclical behaviour examined in Section 2) is proceeding. The adaptability of the trade balance is of particular interest: are the changes which were noted in Section 3 simply ‘one-off’ accidents, or is there a process of adjustment underway which will improve our adaptability and flexibility? In particular, what is the role of the exchange rate and relative prices?

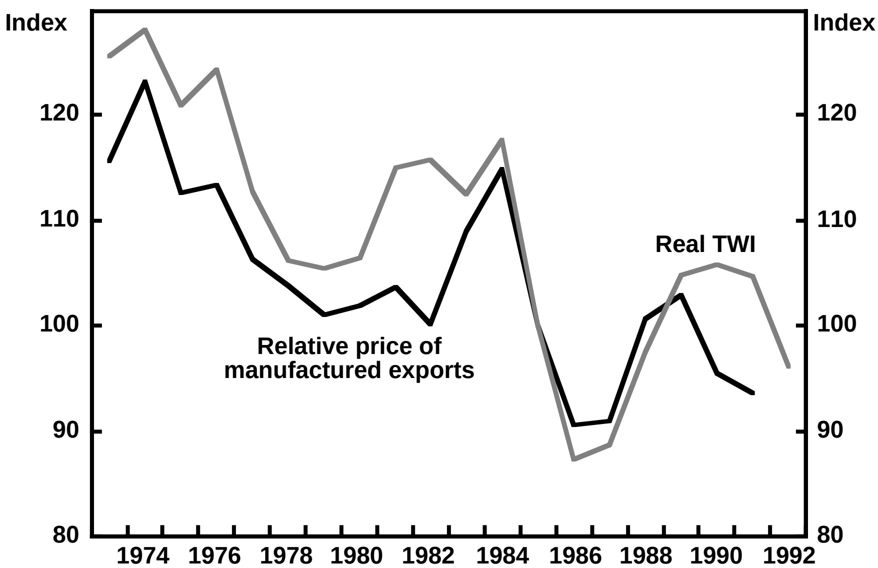
Two factors were at the heart of the adjustment process: the substantial cut in industry protection since 1984; and a real exchange rate that has been, on average, 13 per cent lower since 1986 than it was in the previous decade.

The structural adjustment of the real exchange rate reflected three influences. Firstly, the foreign debt build-up, identified by Blundell-Wignall *et al.* as an influence on the exchange rate (in this Volume). The real exchange rate needed to depreciate in a trend sense so that a more positive trade balance would offset the permanent increase in net income payments to the rest of the world.

Secondly, the exchange rate responded to commodity price movements, smoothing the Australian dollar ($A) prices of commodities. In the mid-1980s, the exchange rate changed to offset cyclical movements in world commodity prices. Also, the secular weakness in commodity prices lowered the exchange rate in the longer term. So the exchange rate has not only reduced fluctuations in the return to exporters, but has probably left a longer-term effect. The story is more complicated for *non-resource* exporters. As the exchange rate buffers the $A prices received by commodity exporters, this imposes a counterpart pattern on the receipts of other exporters. This has resulted in more volatility within the commodity price cycle and some enhancement of international competitiveness of manufactures in the longer term. In practice, Australian exporters of manufactures seem to have held their export prices in Australian dollars fairly steady in the face of exchange rate fluctuations: Australian manufacturing export prices *relative to their rival foreign suppliers' prices* improve, more or less *pari passu,* when the exchange rate depreciates (see Figure 11). This behaviour is also clear in the work on export price pass-through by Dwyer, Kent and Pease (1993). In the first instance, exporters pass on the benefits of a more favourable exchange rate to their buyers, thus enhancing their international competitiveness. This behaviour means that commodity price fluctuations may provide exporters of manufactures with the opportunity to make their products very competitive in international markets. It also fits with the idea of 'beachheads' (see below), and with the general picture which is emerging - that the events of the mid-1980s were very important in triggering off structural change within the balance of payments.

Thirdly, the exchange rate had to adjust downwards with the opening up of the economy through reductions in effective rates of assistance. While there are dynamic gains for exports, greater openness influences imports even more directly. It is likely that the very large income elasticity identified in the import equations reflects reductions in assistance that could not be captured by the simple adjustments to prices used in the econometric estimation. Tariff reductions, other things being given, would cause the trade balance to deteriorate. For longer-run

Figure 11: Manufactured Export Prices and Real TWI
(1985 = 100)



balance of payments equilibrium, the real exchange rate would have to fall.[19] When these views are placed alongside the estimated relative price elasticities of imports and manufacturing exports, the reason why both of these variables have risen as a share of GDP comes more clearly into perspective. While opening up the economy encouraged both exports and imports, the effect was greater on imports, which explains their rise. The trend fall in the exchange rate had a much greater impact on increases in exports (or at least on the manufacturing component, which contributed one-quarter of export growth over the past six years) than it did on reducing imports.

The impact of reduced protection was most clearly identified, in an econometric sense, on the export side. The average effective rate of assistance from 1986 to 1991 was 15 per cent lower than over the previous 10 years. With an elasticity of -3.5, this accounts for a rise in manufactured exports of a bit over 50 per cent. Therefore, of a total rise in manufactured exports of around 130 per cent over this period, this variable accounts for around 40 per cent. In principle, the effect of tariff reductions on exporters' costs would be expected to be picked up in the relative price term. The explicit tariff variable may, therefore, be picking up the dynamic aspects of opening up the manufacturing sector to competitive pressures. These dynamic supply-side effects (discussed in general terms by Edwards (1989) and Krugman (1989a)) are difficult to identify more precisely than with these crude elasticities, but there is little doubt that such changes are underway. They show clearly in, for example, the rapid rise of intra-industry trade. Over time they will make firms more efficient or will cause resources to move from less efficient to more efficient sectors.

However, 80 percentage points of the 130 per cent rise in manufactured exports is explained by other factors. Improved competitiveness over the past seven years (via a lower real exchange rate) is, according to the econometric estimates, the main reason for the fast growth. With a price elasticity of around 5, this accounts for around half of the 130 per cent increase in export volume growth since 1985/86.

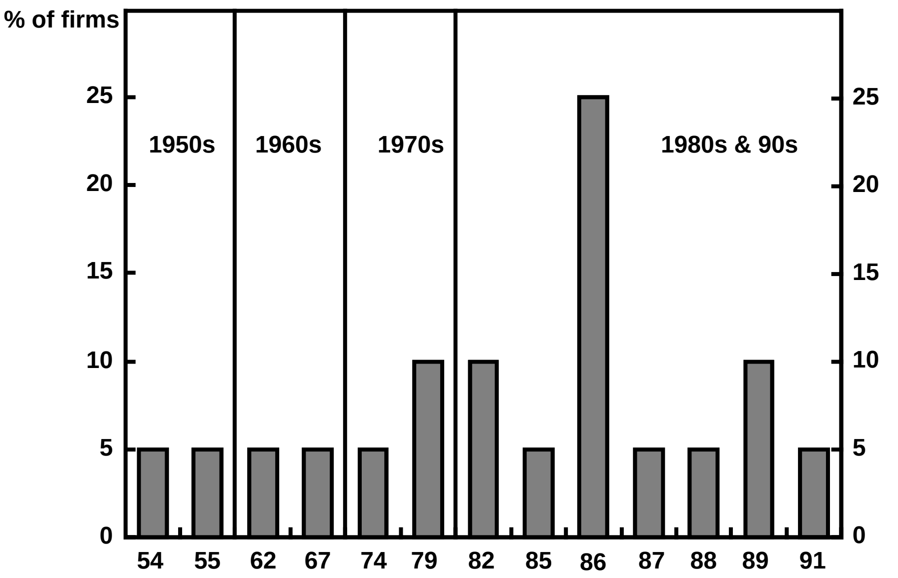
Other evidence also suggests the importance of this sharp change in the exchange rate during the mid-1980s. Menzies and Heenan (1993) presented econometric evidence that there is some threshold relative price change which will trigger firms to enter export markets. Once 'beachheads' are established, the sunk costs of entering foreign markets mean that firms will continue to export, even

19. The longer-run outcome may be more complicated. If the dynamic efficiency gains that come with tariff reductions are significant (which they may well be in the long run), the productivity increases for the tradeable goods sector that come from this will *appreciate* the real exchange rate.

when relative prices move less favourably (as they did in 1988 and 1989, see Figure 11). Furthermore, survey evidence reported in the paper showed that for a relatively large number of firms, exports first became a significant part of sales in 1986 (see Figure 12) and that 60 per cent of firms cited the exchange rate as an important factor in their decision to commence exporting.[20]

The price elasticity is much higher than other studies of Australian manufactured exports have estimated.[21] Although theory would suggest a relatively high elasticity, the actual estimate may be capturing other effects as well. In particular, there seems to have been a change in attitude towards exporting in recent years, particularly to the Asian region. McKinsey & Company (1993, p. 37) attribute this change in export culture to both a 'stick' and a 'carrot'. The 'stick' is 'the relentless internationalisation of the Australian economy and the growing competition that our Asian neighbours are providing in domestic markets'. The 'carrot' is a combination of perceived government support for exporting (both psychological and financial), peer pressure and media attention. If the change in

Figure 12: First Year when Exports Exceeded 10 per cent of Sales



20. For the purposes of the survey, exports were defined as 'significant' when they exceeded 10 per cent of sales. This result is broadly consistent with the results of a study by McKinsey & Company (1993) which was based on a much larger sample.

21. The studies listed in Footnote 15, for example, estimated price elasticities in the range -0.7 to -1.5.

'culture' occurred simultaneously with the sharp change in the exchange rate in the mid-1980s and the fall in tariffs, it may be difficult to separate these effects. This is not to say that the change in culture occurred independently of relative prices: the increased competitiveness may well have been the catalyst for attitudinal changes. Once this started, demonstration effects and other less tangible factors probably played an important role in keeping the process going, even without any further improvements in competitiveness.[22] So the relative price term (with its seemingly high elasticity) may well be capturing a range of interrelated changes that are unique to the estimation period. We would not want to interpret it as a simple price elasticity, with the implication that a small improvement in competitiveness will always bring about a large increase in export volumes.

The income elasticities of these equations, too, will pick up a variety of factors. They incorporate rising import penetration in the importing country, but will also capture compositional effects reflecting the changing mix of the recipient country's imports and the interaction of this with Australia's export supply capabilities. So the interpretation of these elasticities is not straightforward. Nevertheless, some tentative conclusions can be made, in answer to the question: 'How dependent was the growth of Australian manufactured exports on the 'tailwind' from the rapid growth of Asian economies?' Income in the Asian countries has been growing much more quickly than elsewhere, but the income elasticities for these countries are, on average, much lower - often less than unity (see Figure 10). Strong growth in this region has therefore been helpful but, by itself, is not enough to explain the exceptional performance of Australian manufactured exports.

At face value, this suggests that without continual improvements in competitiveness, exports of Australian manufactures to Asia will not keep pace with their growth. One possible reason for this result is the priority given in Asian economies to developing their own manufacturing sectors. This would imply relatively low income elasticities of demand for manufactured imports by those countries. Asian imports of manufactures have, however, grown very strongly over the past two decades: at the same time, Australian exporters have lost market share (see Figure 8).

An alternative possible explanation is related to the *composition* of Australian manufactured exports and the pattern of development of the Asian economies. It may be that these countries were encouraging (with tariffs and other types of assistance) the very industries which Australia, with its history of tariff protection, had encouraged, so their imports were a poor 'fit' with our supply capabilities.

22. One such effect, cited by Menzies and Heenan (1993), is the 'vanguard' effect; exporters entering new markets make it easier for others to follow.

Their imports were, perhaps, concentrated on manufactures which we were ill-equipped to supply. It was only the increased competitiveness in 1985/86 that stopped the slide in market share.

This might suggest that these low income elasticities were a reflection of the estimation period, and that structural change in Australia may raise the relevant elasticities. As protection for Australian manufacturing has declined, resources have moved into different areas and the character of the domestic manufacturing base has changed. McKinsey & Company (1993) highlight the rise of the 'small to medium-sized, high value-added manufacturers', exporting to niche markets in which quality and service are important. As these types of exporters continue to increase in importance, the income elasticity of demand for Australian manufactured exports to Asia is likely to rise.

Table 11 summarises the influence of the various factors discussed above.

Table 11: Growth in Manufactured Exports: 1986-1991

	Elasticity	Change in variable (percentage points)	Contribution to growth (percentage points)
Protection	-3.5	-15	53
Relative prices	-5	-13	65
Income(a)			21
Total			139
Actual growth in manufactured exports			130

Note: (a) Calculated using actual income growth with estimated income elasticities for each country.

6. Conclusion: the Adjustment Process

Concerns about the external sector have been longstanding, with an overlay of 'brooding pessimism'.[23] The concerns were threefold:

- Australia's heavy dependence on commodity exports meant that international fluctuations buffeted the economy. To the extent that exchange rate changes buffered commodity export producers in the face of changing world prices, this delivered increased volatility to non-commodity exporters - notably, manufacturers. With this went a concern that commodity prices were on a long-term secular downward trend, and this would constrain our incomes and our export earnings;

23. As discussed by Corden (1968).

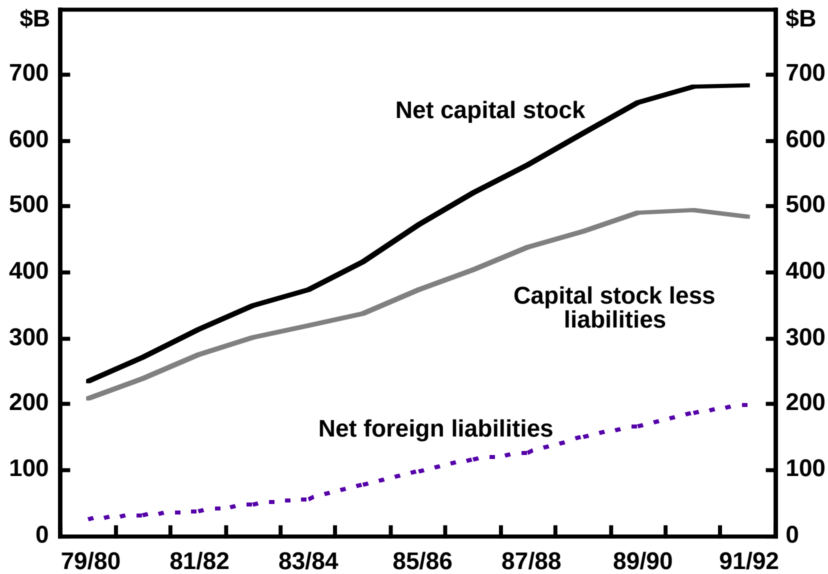
- Australia seemed particularly subject to 'elasticity pessimism' - import income elasticities higher than export elasticities, combined with price elasticities which were small, so that depreciations did little to improve the trade balance. To this was added the apparently adverse 'J curve' effect - valuation effects made the current account look worse (in $A terms) following a depreciation; and
- there was a feeling that dependence on substantial foreign capital inflow made Australia vulnerable.

These concerns and pessimism did not disappear with the floating of the currency. The float and the greatly increased integration with world capital markets did, however, change thinking about the nature of the external constraint. No longer was it seen in terms of excessive current account deficits threatening to exhaust official foreign exchange reserves within a fixed exchange rate framework. There was an increasing recognition that the central issue was the readiness of foreigners to take on Australian assets, and Australians to take on foreign liabilities, and that the focus should be on the *sustainability* of Australia's foreign liabilities. As these liabilities rose (see Figure 13), they became the centre of vigorous debate, some of which spilt over from time to time into the foreign exchange market. Some saw the likelihood of a 'hard landing', along the lines predicted by Marris (1985) for the United States. Others have had the more sanguine view embodied in Stein's law - 'if something cannot go on forever, it will stop' - and its corollary - 'if something cannot go on forever, and everyone knows that it cannot go on forever, it will slow down and stop before it reaches the point beyond which it cannot go on' (Stein 1991, p. 262).

The discussion in Section 5 suggests that adjustment is underway: but is it enough or is the 'brooding pessimism' still justified? As the analytical time horizon lengthens, the considerations of foreign debt build-up and the funding aspects of the external balance become central. The enlarged current account deficit in the 1980s led to an accumulation of foreign debt which, in time, should induce adjustments in the trade balance. Figure 13 shows the relative importance of foreign liabilities, by (notionally) netting these against the capital stock. Part of the adjustment occurs through the influence of income and wealth on spending: in this, issues such as the productivity of investment become important. If the debt allowed an increase in effective productive capacity, the higher domestic income provides the wherewithal to service the debt. If the savings-investment imbalance reflected increased consumption or unproductive investment, the adjustment comes about via a lower national income and decrease in domestic wealth over time. As the savings-investment balance changes, counterpart changes occur in the current account, and the exchange rate is an element in this adjustment.

The structural adjustments examined in the previous three sections not only

Figure 13: Capital Stock and Foreign Liabilities

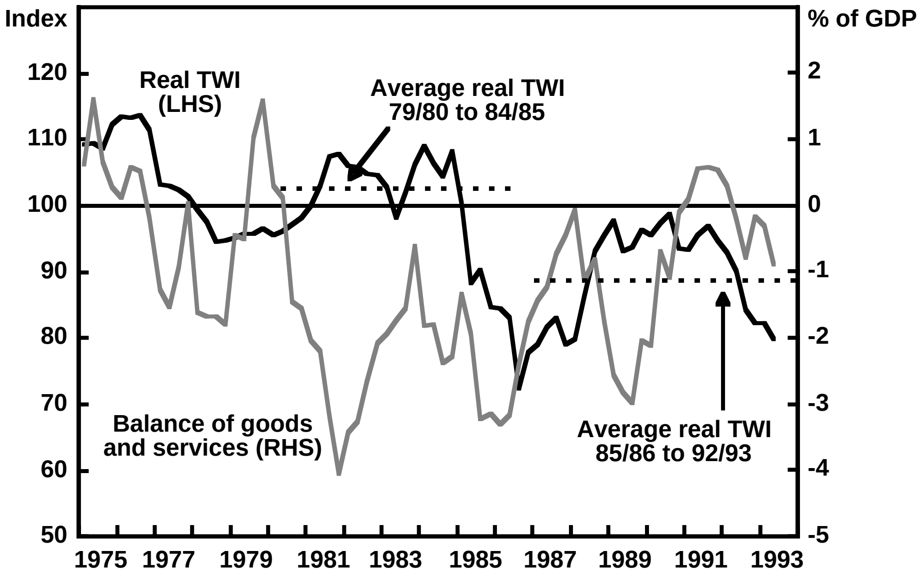


increased exports and imports, but brought an improvement in the overall trade balance. The cyclical behaviour of activity and commodity prices make the underlying improvement difficult to measure with precision, but Figure 14 suggests that the goods and services balance has improved by about 1.5 per cent of GDP over the 1980s. This, if it continues, is consistent with the proposition that Australia's longer-run balance of payments is adjusting according to the requirements of longer-run sustainability.[24] The adjustment in the trade balance has allowed the underlying current account deficit to remain steady in the face of a build-up in foreign income debits. Sustainability - in one sense - is being achieved. With a constant current account deficit, foreign liabilities will asymptotically rise over time towards a fixed ratio of foreign liabilities to GDP.

The central issue, however, is whether this adjustment process is a smooth one, or might involve discontinuities coming from shifts in sentiment. Sustainability is ultimately defined by participants in foreign capital markets and their view may change over time. Those who worry about this see the demand for foreign liabilities as a behavioural relationship that can shift markedly in response to changes of sentiment. The exchange rate elasticity of the demand for foreign liabilities is important also. If there is a widely held, stable view of where the equilibrium exchange rate should be, then a small fall in the exchange rate is

24. See, for example, Whitelaw and Howe (1992).

Figure 14: Balance of Goods and Services and Real TWI



enough to encourage capital inflow. If, on the other hand, the equilibrium rate is not well defined and 'positive feedback' occurs to reinforce any downward shift in sentiment, adjustment can be disruptive. The 'elasticity pessimism' of the trade account is relevant here. If the trade account responded quickly and substantially to changes in the exchange rate, this would smooth the adjustment process. Just as a responsive, well-integrated, outward-looking production sector (characterised by high price elasticities on international trade equations and, often, a high ratio of imports and exports to GDP) allows short-term shocks to 'spill' into the external economy easily and protects the domestic economy from inflationary disruption, close integration facilitates longer-term adjustment.

Appendix A: Estimation of Import Equations

A.1 The General Approach

In Wilkinson (1992), the demand for imports was modelled as the excess demand for importables. The demand for imports is, therefore, shown to be a function of the relative prices of importables, exportables and non-traded goods, real income and production capacity in the Australian economy.

Wilkinson estimates equations for total and endogenous imports, using techniques appropriate for the analysis of non-stationary time series. Firstly, it is established that the series involved are non-stationary, possessing at least one unit root. Secondly, an OLS regression is carried out on the log levels of the variables and the residuals from this equation are tested for stationarity. If the residuals are stationary, the variables are said to be cointegrated and the equation represents a long-run relationship between the variables. Thirdly, a 'short-run' equation is estimated, where the change in the dependent variable is modelled as a function of lagged changes in itself, lagged changes in other explanatory variables and the lagged residual from the long-run equation (which represents the deviation from long-run equilibrium). This approach yields long-run and short-run elasticities for imports.

A.2 Some Simple Models

The general approach described above was used to estimate price and income elasticities for the different categories of imports. Each category of imports was modelled as a function of an activity variable and a relative price. Table A1 shows the explanatory variables used for each equation. The specifications are more simple than Wilkinson's aggregate model in that they exclude the relative price of exports and capacity constraints.

For each type of import, an activity variable was selected which was thought to best reflect the demand factors driving imports. Consumption imports were thought to depend on private consumption. Likewise, capital imports were thought to depend on investment but, as reported below, the results were not satisfactory using this variable. A second model was therefore estimated for capital imports using total domestic spending (GNE) as an explanatory variable. This variable should capture the derived demand nature of investment and capital goods. 'Other' imports are essentially intermediate goods and demand for these will also be a derived demand. Non-farm product is therefore used as an explanator, although there are clearly any number of different variables which could be used instead.

Table A1: Disaggregated Import Equations

Type of Import	Explanatory Variables
Consumption (CM)	• Real private consumption (PC) • Relative price of consumption imports (RPCM). Consumption imports deflator/private consumption deflator
Capital (KM)	*Version 1* • Real investment in plant and equipment (IPE) • Relative price of capital imports (RPKMI). Capital imports deflator/IPE deflator *Version 2* • Real gross national expenditure (GNE) • Relative price of capital imports (RPKMG). Capital imports deflator/GNE deflator
Other (OM)	• Real gross non-farm product (NFP) • Relative price of other imports (RPOM). Other imports deflator/price of home-produced inputs to manufacturing

For consumption and capital imports, the relative price of each particular type of import is defined with reference to the price deflator associated with the relevant activity variable. For other goods, however, the relative price is defined using a price index of home-produced inputs for manufactures.

The sample period for these disaggregated categories is only 12 years. This presents some difficulties in assessing the long-run properties of the series involved and estimating long-run relationships in the manner described above. The results should, therefore, be assessed with this problem in mind.

A.3 Time Series Properties of the Data

Wilkinson (1992) found both total endogenous imports and real GNE to exhibit non-stationary properties over the period September 1974 to September 1989. Table A2 presents Augmented Dickey-Fuller (ADF) tests and Z_t tests for non-stationarity of the additional series used here. The null hypothesis for both tests is non-stationarity, so rejection of the null implies stationarity. All series are in log levels and seasonally adjusted.

The null hypothesis of non-stationarity is accepted for the log level of every series at the 5 per cent level of significance. Non-stationarity of the first differences

Table A2: Unit Root Tests

Variable	Sample		ADF	Z_t
PC	59:3-92:4	level	-2.58	-2.66
		1st difference	-10.53	-10.61
IPE	59:3-92:4	level	-1.80	-2.27
		1st difference	-16.01	-16.03
NFP	59:3-92:4	level	-2.26	-2.47
		1st difference	-12.25	-12.32
CM	79:3-92:4	level	-1.01	-1.11
		1st difference	-6.60	-6.74
KM	79:3-92:4	level	-2.29	-2.52
		1st difference	-3.09	-6.61
OM	79:3-92:4	level	-1.38	-1.36
		1st difference	-6.87	-7.09
RPCM	79:3-92:4	level	-1.56	-1.89
		1st difference	-7.48	-7.71
RPKMI	79:3-92:4	level	-1.82	-2.08
		1st difference	-6.53	-6.66
RPKMG	79:3-92:4	level	-1.61	-1.89
		1st difference	-3.29	-6.62
RPOM	79:3-92:4	level	-1.29	-1.36
		1st difference	-6.47	-6.57

Notes: (a) Tests of the null hypothesis that the series has a unit root.
(b) The ADF tests were constructed to include as many lagged differences as was necessary for the elimination of serial correlation; LM tests for first and first-to-fourth order serial correlation were used for this purpose. The Z_t tests used five lags of the covariance.
(c) All the tests in Table A2 include a constant. The critical values from Fuller (1976) are -3.51 at the 1 per cent level and -2.89 at the 5 per cent level.

is rejected at the 5 per cent level for all series and at the 1 per cent level for most, indicating the presence of one unit root in the levels.

A.4 Estimation

With evidence of non-stationarity, cointegrating relationships between the relevant variables were estimated. The Phillips and Hansen (1990) technique was used to estimate the following equation for each type of import:

$$M_t = \alpha + \beta ACT_t + \gamma RP_t + u_t \qquad \text{(A1)}$$

where M_t is the (log of the) relevant import series at time t; ACT_t is the (log of the) activity variable corresponding to the import category; and RP_t is the (log of the) relevant relative price series.

Table A3 presents the estimates of the coefficients obtained from this procedure. The estimation of the cointegrating relationship for other imports indicated that the relative price term was insignificant at the 5 per cent level so the equation was also estimated without relative prices.

Table A3: Long-Run Elasticities Estimated from Equation A1

Components of Imports	β	γ	ADF	Z_t
Consumption	1.73 (17.76)	-0.70 (-5.15)	-2.76	-3.06
Capital (using IPE)	1.41 (8.38)	-0.91 (-1.86)	-2.64	-2.60
Capital (using GNE)	1.40 (5.48)	-0.76 (-2.29)	-3.56	-3.69
Other	1.48 (12.01)	-0.18 (-1.53)	-3.93	-3.82
Other (excluding relative prices)	1.33 (14.69)	—	-3.82	-3.77

Notes: (a) t statistics are in brackets.
(b) The null hypothesis for the ADF and Z_t tests is non-stationarity (or non-cointegration). The critical values (from Phillips and Ouliaris (1990)) are -3.77 at the 5 per cent level and -3.45 at the 10 per cent level. For the other imports equation without relative prices, the critical values are -3.37 and -3.66 respectively.

The null hypothesis of non-cointegration is rejected at the 10 per cent level for capital imports when GNE is used as an explanatory variable. For other imports without relative prices, non-cointegration can be rejected at the 5 per cent level; relative prices are, therefore, unnecessary for cointegration. On the other hand, the null hypothesis cannot be rejected for consumption imports or for capital imports when IPE is used as an explanatory variable.

These results are unexpected. Given that total imports have been found to be cointegrated with demand and relative prices, we would expect the individual components to be cointegrated with relevant components of demand. One difficulty might be the relatively short sample period. As a second test of cointegration, the residuals from the Phillips-Hansen estimation (Res) are used in estimating a model of the form:

$$\Delta M_t = \sum_{i=1}^{l} \alpha_i \Delta M_{t-i} + \sum_{i=0}^{k} \beta_i \Delta ACT_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta RP_{t-i} + \theta \mathrm{Res}_{t-1} + u_t \qquad \text{(A2)}$$

If θ, the coefficient on the lagged residual, is significant, this is evidence of cointegration. The error-correction models for each category of imports are presented in Table A4. The approach used was one of general-to-specific modelling. Each equation started with four lagged changes of each variable and was tested down to give a more parsimonious representation.

In the cases of consumption and other imports, θ is significantly different from zero, which is evidence of a cointegrating relationship between imports, activity and relative prices. This is also the case for capital imports when GNE is used as the activity variable. When IPE is used as an explanatory variable for capital imports, however, the results are not as clear-cut.[25] When included in the most general specification of the ECM for capital imports, the coefficient on the residual is insignificantly different from zero. As the model is tested down, however, it gradually becomes significant. The lack of consistency in this reinforces the initial evidence that cointegration between capital imports, IPE and relative prices is tenuous.

The short sample period may also mean that the long-run elasticity estimates reported in Table A3 are biased (see Inder (1991)). One simple check on the estimates is to see if they seem broadly consistent with the results obtained for aggregate imports which were estimated over a longer time period. The average of the income and price elasticities (giving more weight to other imports) are around 1.5 and -0.5, respectively - very similar to the aggregate estimates. This suggests that the long-run elasticities are not too biased.

A second consistency check on the long-run elasticities was carried out by estimating an unrestricted error-correction model (ECM) for each category of imports. The model estimated was of the form:

$$\begin{aligned} \Delta M_t = \mu + \sum_{i=1}^{l} \alpha_i \Delta M_{t-i} + \sum_{i=0}^{k} \beta_i \Delta ACT_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta RP_{t-i} \\ + AM_{t-1} + BACT_{t-1} + CRP_{t-1} + u_t \end{aligned} \qquad \text{(A3)}$$

The long-run elasticities are easy to calculate from this formulation. The income elasticity is *-B/A* and the price elasticity *-C/A*. The standard errors for the long-run coefficients cannot be calculated, so the statistical significance of the

25. These results are not reported here but are available on request.

Table A4: Error-Correction Models

Consumption imports - DCM

Period of estimation: 1980:2 to 1992:4

Variable	*Coefficient*	*Standard error*	*t statistic*
$Residual_{t-1}$	-0.416	0.104	-4.011
DCM_{t-2}	0.276	0.104	2.647
DPC_t	2.464	0.500	4.926
DRP_t	-0.343	0.163	-2.111
R^2		0.508	
Adjusted R^2		0.477	
DW		1.802	
SSR		0.064	
SEE		0.037	

Capital imports - DKM

Period of estimation: 1980:2 to 1992:4

Variable	*Coefficient*	*Standard error*	*t statistic*
$Residual_{t-1}$	-0.338	0.089	-3.78
$DGNE_t$	0.838	0.499	1.680
$DGNE_{t-1}$	0.805	0.448	1.796
$DGNE_{t-2}$	1.749	0.492	3.554
R^2		0.516	
Adjusted R^2		0.485	
DW		2.333	
SSR		0.143	
SEE		0.055	

Other imports - DOM

Period of estimation: 1980:1 to 1992:4

Variable	*Coefficient*	*Standard error*	*t statistic*
$Residual_{t-1}$	-0.761	0.118	-6.446
DOM_{t-1}	0.265	0.113	2.347
$DNFS_t$	0.391	0.097	4.035
R^2		0.471	
Adjusted R^2		0.449	
DW		2.022	
SSR		0.101	
SEE		0.045	

elasticities from this formulation cannot be tested.[26] However, it does give some indication of how robust the point estimates of the long-run elasticities are to different estimation techniques. Table A5 reports the long-run elasticities estimated from equation (A3).

Table A5: Long-Run Elasticities from Unrestricted ECM

Components of Imports	Income	Relative Price
Consumption	1.8	-0.8
Capital (using IPE)	0.4	-3.2
Capital (using GNE)	1.3	-0.6
Other	1.4	—

The estimates of the long-run elasticities derived from equation (A3) are very similar to those obtained from the Phillips-Hansen technique, except for capital imports when IPE is used as the activity variable. In general, modelling capital imports using IPE was not successful - there is limited evidence of a long-run relationship and estimates of long-run elasticities are not robust to estimation technique. Estimates using GNE as an activity variable perform much better on all criteria.

A.5 Incorporating Tariffs

Section 4.1.3 reports the results of adjusting the relative price term for tariffs. The adjusted relative price is defined as:

$$RP_t = \frac{MIPD_t(1 + T_t)}{EIPD_t} \qquad \text{(A4)}$$

where $MIPD_t$ is the implicit price deflator for endogenous imports at time t, $EIPD_t$ is the implicit price deflator for domestic expenditure and T_t is the tariff rate. The relative price of consumption imports is defined analogously, using the *IPD* for consumption imports and the *IPD* for domestic consumption. The tariff is defined as the ratio of customs duty receipts to the total (free-on-board) value of endogenous imports.[27]

26. The Bewley transformation can, in theory, be used to derive valid t statistics for the long-run coefficients.

27. Ostry and Rose (1992) construct a similar measure for testing if tariffs have any macroeconomic effects. This is clearly an imperfect measure: it excludes import quotas and other non-tariff barriers (although it does correspond, in its broad movements, with the measure of effective assistance shown in Figure 5). Furthermore, where tariffs are prohibitive, revenue collection will be negligible.

Section 4.1.3 also reported the results of two other tests for the role of tariffs. The first included the effective rate of assistance as a separate explanatory variable. The second test introduced a new relative price variable (RP2), replacing the free-on-board import price with the imported component of the consumer price index (CPI). Although this variable only captures tariffs on items in the CPI bundle, it does represent a final retail price.

Table 9 in the text reported the elasticities estimated using the Phillips-Hansen technique. In order to test if there is evidence of a cointegrating relationship, the residuals from the three equations were used in an error-correction model. Table A6 reports the coefficients and t statistics on the lagged residuals when the most general model is specified with three lagged changes in all variables.

Table A6: Significance of Lagged Residual in ECM

Model	Coefficient on residual *t-1*	Standard Error	t statistic
i	-0.227	0.082	-2.776
ii	-0.481	0.190	-2.536
iii	-0.854	0.217	-3.929

In each case, the coefficient on the lagged residual is significant at the 5 per cent level, evidence of cointegration.

A.6 Data Sources

Data on Gross National Expenditure (GNE), Private Consumption (PC), Gross Non-Farm Product (GNFP), Investment in Plant and Equipment (IPE), Non-Farm Stocks (NFS) and their deflators are available from the Australian Bureau of Statistics (ABS), *Australian National Accounts*, Catalogue No. 5206.0.

Data on endogenous imports, consumption imports, capital imports, other imports and their deflators are available from the ABS, *Balance of Payments, Australia*, Catalogue No. 5302.0.

Data on the price of home-produced inputs to manufacturing are available from the ABS, *Price Indexes of Materials used in Manufacturing Industries*, Catalogue No. 6411.0.

Data on computer import values and volumes are unpublished and non-seasonally adjusted ABS data. Standard International Trade Classification categories 752 and 75997 are used.

Data on customs duty receipts are available from the Department of Finance, Commonwealth Financial Transactions (monthly).

The effective rate of assistance to manufacturing was derived by splicing shorter-run series published by the Industry Commission (Plunkett, Wilson and Argy 1992).

The imported component of the CPI is available from the ABS, *Consumer Price Index: Effect of Changes in Prices of Imported Items*, Catalogue No. 6444.0.

Appendix B: Econometric Estimates for Manufactured Exports*

B.1 The General Approach

The log-linear specification of (1) in the text can be written as:

$$x_{it} = \alpha_i + \sum_{j=1}^{k} \upsilon_j v_j + \varepsilon_{it} \tag{B1}$$

where lower case letters represent logs and the v_j are the k explanatory variables in (B1). A more general specification that allows a long-run equilibrium relationship with short-run dynamics is an autoregressive distributed lag model with two lags:

$$x_{it} = \alpha_i + \delta_1 x_{it-1} + \delta_2 x_{it-2} + \sum_{j=1}^{k} (\upsilon_{j0} v_{jt} + \upsilon_{j1} v_{jt-1} + \upsilon_{j2} v_{jt-2}) + \varepsilon_{it} \tag{B2}$$

This can be re-parameterised as an unrestricted error-correction model (UECM):

$$\Delta x_{it} = \alpha_i + \beta_0 x_{it-1} + \beta_1 \Delta x_{it-1} + \sum_{j=1}^{k} (\gamma_{j0} v_{jt-1} + \gamma_{j1} \Delta v_{jt} + \gamma_{j2} \Delta v_{jt-1}) + \varepsilon_{it} \tag{B3}$$

where:
$$\beta_0 = \delta_1 + \delta_2 - 1$$
$$\beta_1 = -\delta_2$$
$$\gamma_{j0} = \upsilon_{j0} + \upsilon_{j1} + \upsilon_{j2}$$
$$\gamma_{j1} = \upsilon_{j0}$$
$$\gamma_{j2} = -\upsilon_{j2}$$

In this form, the long-run elasticities are $-\gamma_{j0}/\beta_0$, etc.

As a first step, a basic UECM specification was estimated; the volume of manufactured exports was modelled as a function of the relative price of Australian manufactured exports and foreign country output. In the context of this basic model, other variables were added to see if they added significant explanatory power.

B.2 Panel Estimation Issues

For the basic model, it was assumed that individual country effects were restricted to the intercept coefficients.

In dealing with the individual country effects, it was decided to use a fixed effects model, rather than a random effects model, as the individual effects are likely to be correlated with the other regressors, especially foreign country

* Denzil Fiebig provided some technical advice regarding the estimation procedure. The authors are responsible for any errors.

output.[28] Further, unlike panel estimations based on cross-sections of persons, the data from this cross-country panel are measurements of populations, rather than of individuals. This also implies that, in this case, the individual effects are less likely to be random in nature.

Estimating dynamic models within a fixed effects framework is problematic. It is well known that the fixed effects estimator is inconsistent when the set of regressors contains lagged dependent variables and the sample is finite in the time dimension.[29] This is because, within each country, each disturbance term is correlated with every observation of the dependent variable. This leads to inconsistent parameter estimates.

This problem can be corrected by instrumental variables (IV) estimation. However, there is a difficulty selecting suitable instruments for x_{it-1}, and Δx_{it-1} since in the probability limit the instrument should be correlated with the lagged dependent variable and uncorrelated with the error terms. Clearly, any lag of manufactured exports to country *i* is an unsuitable choice for an instrument, since all observations within country *i* are correlated with all of the disturbances for that country. $\Delta\Delta x_{it-1}$, was considered as an instrument, but was found not to be well correlated with the level of x_{it-1} or Δx_{it-1} .

It was decided, instead, to use manufactured exports to a third country as an instrument - that is, the instrument for x_{it-1}, was x_{jt-1}, $i \neq j$. Exports can be expected to be correlated across countries because:

- shocks affecting the supply of Australian exports will impact across all countries; and
- the macroeconomic shocks that affect demand for manufactured exports will be correlated across countries, inasmuch as business cycles are correlated internationally.

The variables used as instruments for the lagged dependent variable were constructed in the following way. A correlation matrix was computed for the 21 dependent variable series. For the manufactured export series of each country, the series with the highest correlation was identified. These series were then ‘stacked’ to form a new variable, the lag and lagged differences of which were used as instruments in the IV estimation.

These instruments can be assumed to be uncorrelated with the disturbance terms, since the use of the fixed-effects model does not imply anything about the correlation of the dependent variable and the disturbance terms across countries.

28. For a discussion of the relative merits of fixed versus random effects models, see Hsiao (1986, pp. 41-47.)

29. See Hsiao (1986, pp. 73-76) for a proof.

One of the advantages of panel data estimation is that it is no longer necessary to assume the stationarity of the dependent variable and regressors as a condition for the asymptotic normality of the disturbance terms.[30] This is because the effect of the nuisance parameters distorting the disturbances can be made to approach zero by letting $N \longrightarrow \infty$ while keeping T finite.

B.3 The Choice of the Relative Price Measure

The response of manufactured exports to movements in relative prices will depend on the measure used. A fall in the price of Australian manufactured exports relative to the price of manufactures from other sources will generally lead to an increase in demand for Australian exports. For a foreign consumer, the alternatives to Australian manufactures are, firstly, exports from third countries, and secondly, local goods produced by import-competing firms. In the first case, the world price of manufactured exports will be relevant. The ‘world’ relative price is, therefore, defined as the price of Australian manufactured exports relative to the world price of manufactures. In the second, it is possible that the price of local manufacturing production may exert an independent effect on the volume of Australian manufactured exports. The ‘bilateral’ relative price is, therefore, defined as the price of Australian manufactures relative to the price of domestically produced manufactures in each country.

The relationship between the price of manufactured exports and supply is less certain. If the price of exports falls relative to the price in the domestic market, manufacturers may find it more profitable to supply the local market and hence reduce exports. If, on the other hand, exporters have some degree of market power, then a fall in the relative price of exports may reflect cost reductions due to increases in productivity specific to exporters. This is likely to be the case if exporters, by being exposed to international competition, achieve faster productivity growth than firms selling only to the domestic market.

B.4 Estimation Procedure and Results

Initially, the basic model was estimated with both world and bilateral relative prices and with two lags of each variable. Income elasticities were constrained to be equal across countries. The results indicated that the world relative price had a significant influence on manufactured exports, whereas an additional effect from bilateral relative prices was not significant. This is consistent with a situation where the prices of import-competing manufactures in other countries are determined by the world price of manufactured exports. Given the lack of significance of bilateral relative prices, this variable was dropped from subsequent estimations.

30. See Goodrich and Caines (1979) for a proof.

It was found that the second lags of all variables were not jointly significant, and the final basic specification was as follows:[31]

$$\Delta x_{it} = \alpha_i + \beta_0 x_{it-1} + \beta_1 \Delta x_{it-1} + \omega_0 w_{t-1} + \omega_1 \Delta w_t + \omega_2 \Delta w_{t-1} + \eta_0 y_{it-1} + \eta_1 \Delta y_{it} + \eta_2 \Delta y_{it-1} + \varepsilon_{it} \tag{B3}$$

This specification was used as the basis for subsequent tests of the significance of the other variables mentioned above, the results of which were reported in Table 10 in the text.

In order to test the equality of income elasticities across countries, the basic model with the effective rate of assistance was re-estimated, allowing income elasticities to vary. Results for this estimation are reported in Table B1.

Individual estimates for foreign country output terms were mostly insignificant and so are not reported. However, the joint test of the significance of these terms was $\chi^2(63) = 407.8$ and the null hypothesis could be rejected at the 1 per cent significance level. The hypothesis that the coefficients on the various foreign

Table B1: Income Elasticities Varying Across Countries

	Coefficient Estimate	Standard Error	Significance Level
Exports			
x_{it-1}	-0.33	0.11	0.01
Δx_{it-1}	0.28	0.32	0.38
World relative prices			
w_{t-1}	-1.55	0.58	0.01
Δw_t	-1.55	0.68	0.02
Δw_{t-1}	0.52	0.45	0.27
Effective rate of assistance			
z_{t-1}	-1.17	0.32	0.25
Δz_{t-1}	0.12	0.62	0.84
Δz_{t-1}	1.45	0.79	0.07

Notes: $R^2 = 0.37$, SSR = 23.4, SEE = 0.32.

31. The joint test of the significance of all second lags and the bilateral relative price terms was $\chi^2(7) = 7.36$. The null hypothesis that the coefficients on these terms were equal to zero, therefore could not be rejected even at the 20 per cent confidence level.

output terms were equal across countries was also rejected at the 1 per cent significance level.

With regard to the other variables, the long-run elasticities for world relative prices and the effective rate of protection were -4.7 and -3.5, respectively. These results are similar to those obtained from other estimations.

B.5 Error Structure

To test for heteroscedasticity related to the cross-sectional nature of the data, Breusch-Pagan tests were conducted using country dummies as explanatory variables. In all cases, the null hypothesis of no heteroscedasticity was rejected at the 1 per cent level of confidence.

Lagrange multiplier tests for up to fourth order autocorrelation were conducted. In all cases, the null hypothesis of no autocorrelation was rejected at the 1 per cent level of confidence. Varying lag lengths did not appear to markedly affect these results.

Unless corrected for, the presence of heteroscedasticity and autocorrelated errors would lead to inconsistent estimates of the standard errors. Accordingly, Newey-West standard errors have been reported for each estimation.

B.6 Structural Stability

Menzies and Heenan (1993) reported evidence of a structural break in the behaviour of Australian manufactured exports in the late 1980s. To test this with the panel data, Chow tests for a break in the relationship from 1986 onwards were conducted for each model. In all cases, the null hypothesis of stability of the coefficient estimates could not be rejected at the 5 per cent level of significance.

B.7 Data Description and Sources

The panel consists of a balanced sample of 21 countries with annual data from 1977 to 1991. The countries were selected on the basis of their importance as markets for Australian manufactures, as well as data availability. The full list of countries is shown in Table B2.

The definition of manufactures used in this study is Standard International Trade Classification (SITC) Sections 5 to 8, excluding Divisions 67 and 68. This corresponds to the categories ‘Transport’, ‘Machinery’ and ‘Other Manufactures’ as classified in the Australian Bureau of Statistics (ABS) publication *Balance of Payments, Australia*, Catalogue No. 5302.0. Current price estimates of export values at a SITC division level for various countries from 1982 to 1991 were obtained from the Central Statistics Section, Department of Foreign Affairs and

Table B2: Countries included in Estimation

Canada	Italy	South Korea
China	Japan	Sweden
France	Malaysia	Switzerland
Germany	Netherlands	Taiwan
Hong Kong	New Zealand	Thailand
India	Philippines	United Kingdom
Indonesia	Singapore	United States

Trade. Prior to 1982, these series were obtained from OECD Foreign Trade magnetic tapes. Adjustments were made to correct for a break in 1978 due to the change from SITC Revision 1 to SITC Revision 2.

Constant price estimates were calculated at a SITC division level using deflators provided by the ABS. These were then aggregated to obtain the final constant price estimates for manufactured exports to each country.

The world relative price is the ratio of the manufactured exports deflator (balance of payments basis) to the unit value of world manufactured exports. The latter series is obtained from GATT (1992).

Bilateral relative prices are the ratio of the manufactured exports deflator to the price of domestically manufactured goods in each country. The latter series were obtained from the World Bank (1992). Missing observations were replaced using spliced producer or consumer price series obtained from the IMF's *International Financial Statistics.* The exchange rates used were period averages published in the IMF's *International Financial Statistics.*

The domestic relative price is the ratio of the manufactured exports deflator to manufacturing producer prices (excluding petroleum). The latter was obtained from the ABS, *Price Indexes of Articles Produced by Manufacturing Industry, Australia,* Catalogue No. 6412.0.

Foreign country output is (in general) real gross domestic product, obtained from the IMF's *International Financial Statistics.* Data on real Australian GNE were obtained from the ABS, *Australian National Accounts,* Catalogue No. 5206.0.

The measure of capacity utilisation was taken from the results of the ACCI/Westpac Survey of Industrial Trends. The net balance of respondents indicating an increase in capacity utilisation (plus 100 to avoid negative values) was used. The effective rate of assistance to manufacturing was derived by splicing shorter-run series published by the Industry Commission (Plunkett, Wilson and Argy 1992).

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Discussion

1. Arthur Grimes

The principal purpose of the paper by Bullock, Grenville and Heenan is to understand the role that the exchange rate plays in balance of payments adjustment. Presumably, behind this purpose are two more fundamental concerns - the ability to:

- forecast likely outcomes; and
- guide policy in response to certain shocks.

The successful pursuit of the policy purpose also relies to a large extent on the ability to forecast what would happen in the absence of policy and to forecast the effect of potential policy responses. The paper is very much an empirical paper - it seeks to make little or no theoretical contribution to our understanding of the issues. Therefore, my comments concentrate on how the empirical work in the paper will be able to help policy makers (and others) forecast balance of payments outcomes and the outcomes of potential policy responses.

The paper provides a useful description of four current account episodes since 1980. It discusses some of the intangible contributions to current account outcomes (such as the role of perceptions) as well as more measurable contributions (such as the role of the exchange rate).

As a result of the descriptive portion of the paper, we know quite a lot about the last four current account 'battles'. But has this knowledge helped us in planning the strategy of the next battle? Here, I have some doubts. It is not clear to me that we will be able to forecast current account outcomes and responses to potential policy actions materially better in the future than we did in the past. We may frequently be in the situation where we can rationalise past current account outcomes but find it difficult to know how to react to emerging current account trends.

To substantiate this view, I wish to focus on three issues arising from the paper. Two of these arise from the econometric work:

- the income elasticity of imports; and
- the structure of the export equations.

The third issue surrounds the role of intangible factors in current account outcomes.

1.1 Income Elasticity of Imports

Much of the section on imports attempts to address the apparent anomaly of the income elasticity of the demand for imports being significantly greater than unity. This restriction is adopted in most standard growth models. I was pleased to see that the authors did attempt to address this issue at a slightly disaggregated level. My own experience is that this is necessary, given that imports are far from homogeneous and that the elasticities differ substantially across product groupings. It was unfortunate, therefore, that the import equations for capital goods were not able to be specified in the hypothesised form as a function of real investment in plant and equipment. Possibly the problems relate to the very short sample period (12 years used here) or to the lack of homogeneity even amongst investment goods.

Even the disaggregated approach is unable to obtain an income elasticity close to unity. On reflection, the attempt to find some functional form that enables the unity restriction to be accepted is probably a fruitless exercise. My experience using New Zealand data is that I have never been able to accept this restriction. Nor should this be at all surprising.

The authors note that since 1960 international trade has grown roughly twice as fast as GDP growth in OECD countries. The ratio of exports to GDP has risen by between 50 and 100 per cent in most of the countries cited in the paper. These statistics are not likely to be consistent with each country having an income elasticity of unity for imports. Rather, as country incomes increase, people demand to purchase a greater proportion of foreign goods: on average, imports in most countries are treated as luxury goods.

Given this observation, I see little to be gained in trying to explain away the high estimated income coefficient. As a corollary, regarding the effect of tariffs on imports, I doubt the results obtained from a model that restricts income elasticity to unity.

1.2 Specification of Export Equations

I had considerable difficulty in interpreting the manufacturing export equations provided in the paper. An *ad hoc* specification of the equation is thrown up and estimated, sometimes supplemented by additional variables. The initial group of variables implies that a demand equation is being estimated. This is consistent with the observation in the paper that Australian manufacturers tend to be price makers. The explanatory power of the initial demand equation is low [$R^2 = 0.15$]. This makes one wary about the estimated coefficients in the equation as it could suffer materially from omitted variables bias. The possible collinearity of the real exchange rate with the intangible factors discussed in the paper makes the coefficient on the real exchange rate term, in particular, somewhat suspect.

The authors proceed to supplement the initial demand equation with additional supply-side factors. I have problems with this approach. We know from basic econometrics that a combination of supply and demand factors in the same equation leaves nothing that can be interpreted structurally; indeed the authors note that they obtain non-structural estimates. As a result one cannot assert, even on the basis of the estimated coefficients, that a policy-induced 1 per cent (real) exchange rate depreciation will induce a 5 or 6 per cent rise in manufactured exports. We are left none the wiser from this exercise as to what will happen to manufactured exports if policy makers are able to induce a real exchange rate change. Similarly, we cannot advise what will be the likely future response to further tariff changes on the basis of these equations. Policy prescriptions and forecasts do not seem to have been facilitated materially by this exercise.

1.3 Intangibles

Throughout the paper, a number of intangible elements are discussed that are hypothesised to have contributed to some of the cited balance of payments outcomes. Such elements include:

- newly recognised realities of higher foreign debt;
- recognition of the limited benefits of the 1980s minerals boom;
- attitudinal and unquantifiable changes reflected in the newly found emphasis on export orientation and 'world-best practice';
- psychological (and financial) government support for exporting;
- peer pressure; and
- media attention.

These elements are all plausible. Indeed, in many ways they probably explain as much, if not more, of the outcomes than do the measurable factors.

Further, many of these intangible developments will be correlated with the sharp depreciation in Australia's real exchange rate in the second half of the 1980s. This factor is likely to have caused a problem in obtaining reliable export elasticities and will have been exacerbated by the unusually pronounced real exchange rate change which may have had a once-and-for-all effect on the perceptions of potential exporters. Thus a 15 per cent change in the real exchange rate may have been associated with a 75 per cent change in manufactured exports, but a 1 per cent real exchange rate change may have considerably less than a 5 per cent effect on manufactured export volumes.

If the econometric estimates are difficult to use for forecasting and policy purposes, one might be tempted to revert to the macroeconomic approach adopted earlier in the paper and look instead at investment and terms of trade developments. Unfortunately, this approach is also likely to reveal little about emerging current account developments because of the difficulties in interpreting investment and terms of trade trends. Investment trends themselves are probably the most difficult of all the macroeconomic variables to forecast, seemingly being explained as much by 'animal spirits' as by any variable entering explicitly into the investment equation. And anyone who can predict the terms of trade (especially in a commodity producing country) should be playing the commodity futures market, not working in a central bank.

Thus, it appears that even though we can describe past episodes, we are left as impotent as ever at predicting when a renewed current account crisis is about to occur. And even if we could do so, the econometric estimates would not tell us much about how exports, in particular, would respond to potential policy measures. This pessimistic conclusion is not principally a criticism of the paper, but a realisation, based on experience, that interpreting and predicting developments in the current account - the almost negligible balance between two huge flows - is an extraordinarily difficult task.

2. General Discussion

Discussion about the Bullock, Grenville and Heenan paper centred on the estimated elasticities presented in the paper and the links between the government budget deficit, the savings-investment relationship and the current account balance.

There was considerable discussion concerning the size of the income elasticities of imports presented in the paper, with a number of speakers arguing that they were unreasonably high. Imports, in the long run, cannot increase indefinitely as a share of GDP. On the other hand, several participants argued that the estimates were not unreasonably high. Some of the views expressed were that:

- attempts to disaggregate the data had not gone far enough. Further disaggregation might increase the price elasticities and reduce the income elasticities;
- while the income elasticity might be close to unity in the very long run, sample periods were not long enough to allow this to be identified. Since the Second World War the growth in the volume of world trade has systematically exceeded the growth in output, suggesting that this was certainly not a long enough period in which to identify a unit elasticity; and
- it was questionable as to whether or not unit income elasticity of imports was a reasonable assumption for the long run. As incomes rise, the desire for variety also increases. This leads to imports growing faster than income. In addition to this, a 'ratchet' effect was suggested. When income falls the desire for variety does not fall, so that business cycle swings lead to a gradual ratcheting up of the import share of GDP. This ratchet effect may make it difficult to estimate the dynamics of adjustment.

The size of the price elasticities of imports and exports also received considerable attention. One speaker noted that generally, in the case of industrial countries, price elasticities are often estimated to be around unity. Such estimates might be considered to be low, since they are calculated over periods when the structure of the economy is broadly given. In the long run, changes in relative prices can affect the structure of the economy. If these effects could be taken into account, much larger elasticities might be identified.

Some participants wondered whether the high export price elasticities estimated from the bilateral trade data in the paper might have been due to the failure to take account of non-linearities. The exchange rate changes in the mid-1980s had been very large, going well beyond inertia bands present in the case of smaller exchange rate fluctuations. This may have stimulated exports, and once ‘beachheads’ had been established in new markets, improved export performance continued in spite of subsequent adverse exchange rate movements.

There was also some discussion of the role that reducing protection plays in increasing trade penetration ratios. One speaker argued that the international evidence was that declines in tariffs generated a much larger increase in exports than had been expected. There was fairly widespread, though not universal, support for the notion that the changes in protection were an important catalyst for much of the recent change in Australia’s trade penetration ratios. However, it was also argued that in a period of rapid structural change, like the one Australia has been experiencing recently, it is difficult to be precise about attributing changes in imports and exports to specific variables. In this respect, there was considerable support for the notion that the parameters presented in the paper are period specific.

Several issues concerning the relationship between budget deficits, the savings-investment relationship and the current account balance were also discussed. Many participants voiced the view that changes in the savings-investment balance could affect the real exchange rate and hence the current account.

There was some dispute about the links that exist between the current account and the budget deficit. Some participants felt that the budget deficit was a serious problem for Australia and that if there was not a major policy change in the near future, prospects for the savings-investment balance further down the track would deteriorate. Ultimately this would increase the difficulty of achieving external adjustment. Other participants pointed out that the Australian Government’s debt-to-GDP ratio was one of the lowest in the OECD. This was taken as evidence that the budget deficit could be used for stimulatory purposes in the short run, and would not necessarily be a constraint on achieving external balance later on. On this view, fiscal policy and the current account should not be considered as being inextricably linked.

The Exchange Rate and Macroeconomic Policy in Australia

John Pitchford*

1. Introduction

The choice of an exchange rate regime is thought to have significant implications for macroeconomic outcomes and macroeconomic policy. Therefore, it is interesting that after nearly 10 years of a floating Australian dollar ($A) there is little disagreement with the view that exchange rates should be market determined. This could be partly due to the fact that substantial fluctuations in the prices of commodities traded by Australia are a major source of external shocks to the economy and a reasonably freely floating rate is expected to provide a degree of insulation from foreign price movements, thereby cushioning terms of trade shocks. The facility to operate an independent monetary policy is another important and related property of floating that is believed to have been of value to Australia. One task of this paper is to review Australia's exchange rate experience and policy in an attempt to ascertain whether these expected benefits for macroeconomic policy from floating the currency have been delivered. With some exceptions, the conclusions of the paper are supportive of the present system of managing exchange rates, though not necessarily in agreement with the monetary policy behind some of the exchange rate movements.

Of course, many authors have considered these issues before. For Australia, two influential papers are those by Sieper and Fane (1980) and Blundell-Wignall and Gregory (1990). The first of these is a comprehensive and detailed examination of exchange rate regimes and exchange control written for the Australian Financial System Inquiry. It is worth quoting from its concluding paragraphs:

> Which regime one prefers must clearly depend on one's judgement as to the main sources of exogenous disturbances. The greatest shocks appear to have come from changes in world prices ... In these circumstances a floating exchange rate has obvious advantages over a fixed rate ... in the intermediate run, the exchange rate regimes differ mainly in their implications for the domestic price level. Under fixed exchange rates a country is forced to inflate, or deflate, at roughly the same rate as the rest of the world ... Under flexible exchange rates each country can choose its own inflation rate ... Flexible rates permitted the great hyperinflations; but flexible rates have also enabled

* I am indebted for discussion and for comments on various drafts to Adrian Blundell-Wignall, Alan Catt, George Fane, David Gruen, Ian Macfarlane and Philip Lowe, none of whom necessarily share the views expressed here.

> Japan, Switzerland and West Germany to avoid inflating as fast as the rest of the world in the 1970s [pp. 256-257].

They saw floating the $A as conferring a major advantage of being able to choose an inflation rate different from that of the rest of the world and not dictated by world commodity price cycles. Blundell-Wignall and Gregory (1990), on the other hand, contend that a floating rate is necessary because Australia's real exchange rate is likely to fluctuate with its terms of trade. Thus they argue that adjustments in the real exchange rate would be much harder to achieve and damaging to the real economy if domestic prices, rather than the exchange rate, were required to facilitate the changes. The present paper demonstrates that these two views are closely related and argues that they are probably still valid for Australia.

The consequences of the exchange rate regime for inflation are a major concern of the paper. Foreign inflation is likely to be imported with a fixed rate but, as discussed above, a flexible rate system may insulate the economy from foreign price rises. The consequences for policy are considerable. If the exchange rate floats and insulation works, there is no necessity for the authorities to watch foreign price movements as part of an anti-inflationary policy. If it floats, but insulation does not work, there is an implication that foreign price rises cause disequilibrium in goods markets and that attempting to prevent them from affecting the economy may compound this disequilibrium. In this connection, the logic of the practice of targeting the nominal exchange rate to achieve particular inflation outcomes needs to be closely examined. Nominal depreciation is by no means always inflationary. For instance, it can be part of a real rate response in which case it represents a *relative* price adjustment, or an insulating response to foreign price falls when it will not produce domestic price rises. However, if price insulation does not work, monetary policy as well as exchange rate targeting will have a difficult task sustaining equilibrium while not absorbing foreign price shocks. While such issues arise from consideration of inflation questions, they nevertheless have implications for real outcomes because of the relations between real variables and inflation, and between an anti-inflationary policy and real variables.

Several further macroeconomic issues in the operation of exchange rate policy warrant attention. Firstly, there is the question of the large depreciations in 1985 and 1986. These depreciations raised many macroeconomic policy issues, including that of the appropriate connection between wages policy and currency depreciations. Secondly, how should the exchange rate behave when there are current account deficits? Thirdly, what purpose, if any, does the Reserve Bank of Australia's (RBA) policy of exchange market intervention achieve? Finally, it should be recorded that because of time limitations a number of important topics are not covered at all or, at best, only briefly. In particular, the role of the exchange rate mechanism, if any, in transmitting foreign growth cycles to Australia has not been examined and the paper only touches on the question of how terms of trade shocks impinge on domestic demand and activity.

A recurrent theme in the paper is that there are a variety of causes of nominal exchange rate movements. Hence, it is not possible to infer any policy conclusions from a nominal rate movement. Unless the cause is known, it cannot be inferred that a particular nominal depreciation is inflationary. Nor can it be deduced that it will have particular consequences for the current account deficit. For example, it could be a response to a rise in saving, a fall in foreign currency traded goods prices, a deterioration in the terms of trade, or a monetary expansion. The implications for the economy and for policy can differ for each case.

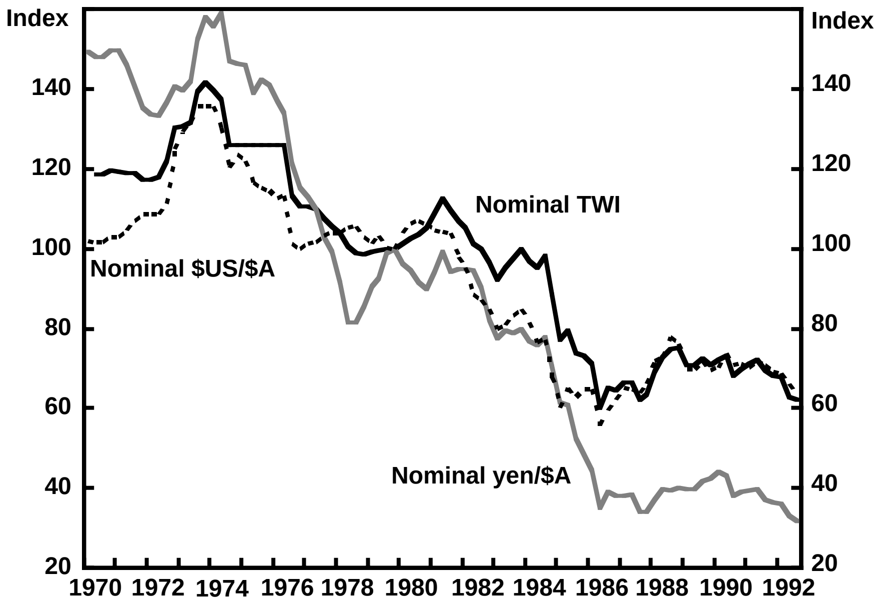
The first section sets out data on various relevant concepts. In particular, it demonstrates the volatility of Australia's terms of trade and of the foreign currency traded goods prices on which it is based. Related to this, it is argued that conventional concepts of the real exchange rate are inappropriate for many purposes for which they are used and suggests that measures of traded goods prices should supplement them. Section 2 briefly treats major theories of exchange rate determination relevant to issues of macroeconomic policy. Section 3 examines the issue of monetary independence and Section 4 asks about the capacity of a floating rate regime to cushion shocks in traded goods prices and the terms of trade, respectively. Section 5 addresses the question of the relation between exchange rate behaviour and inflation and whether the exchange rate should be used to target inflation. An appraisal of the experience of macroeconomic activity and policy in relation to exchange rates since the float in December 1983 is one of the purposes of the paper and is set out in Section 6. Conclusions are summarised in Section 7.

1.1 Stylised Facts

Nominal exchange rates are measured as the number of units of foreign currency per Australian dollar.[1] Movements in various nominal exchange rates are shown in Figure 1. Notable features are the steady depreciation of the trade-weighted index (TWI) from the mid-1970s until the latter part of the 1980s, the large depreciations in 1985 and 1986 and the generally similar pattern of movement between the US dollar ($US), yen and TWI rates, apart from the depreciation of both the $US and $A against the yen in the 1980s.

1. I shall follow the Australian convention (unless otherwise stated) of defining the nominal exchange as the foreign price of domestic currency when looking at data. However, again following convention, the reciprocal measure (price of domestic currency) is used in the theoretical sections.

Figure 1: Nominal Exchange Rates Indexes
(March 1980 = 100)



Fluctuations in international commodity prices are among the most important types of shocks affecting the Australian economy.[2] Figure 2 shows annual inflation rates of the US dollar-valued RBA commodity price index and the OECD consumer price index. There were substantial falls in commodity prices in the early 1980s, then rises in the mid-1980s followed by falls. The direction taken in many propositions in this paper is motivated by the observation that the prices of commodities have a far greater amplitude of fluctuation than do prices of final goods and services.

Commodity price movements are reflected in the foreign currency prices of Australian exports and imports. Because Australia's share of the market for many of its traded commodities is typically small, it is usual to assume that foreign currency prices are determined independently of domestic supplies and demands. The domestic currency price indexes of these traded goods have been converted to 'foreign currency' values by multiplying by the trade-weighted exchange rate index. If the 'law of one price' holds, this gives estimates of average foreign currency prices, bearing in mind the averaging techniques used to construct export and import prices indexes and the TWI. Rates of change of these indexes are compared in Figure 3, where it can be seen that prices of both groups of Australia's

2. Indeed, it is often said that Australia has a commodity currency. See, for example, the papers in the volume edited by Clements and Freebairn (1989).

Figure 2: RBA Commodity Price Index and OECD Consumer Price Index
(inflation rates, per cent per annum)

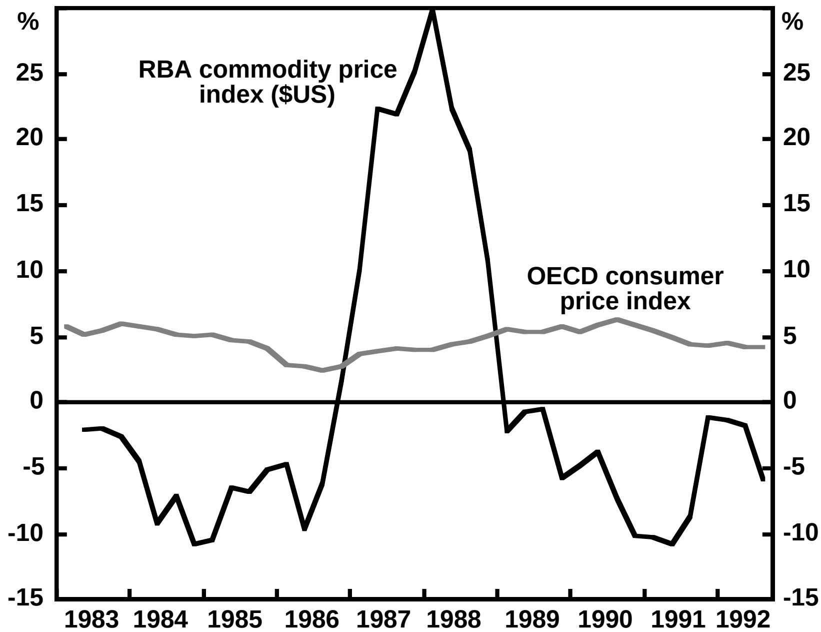
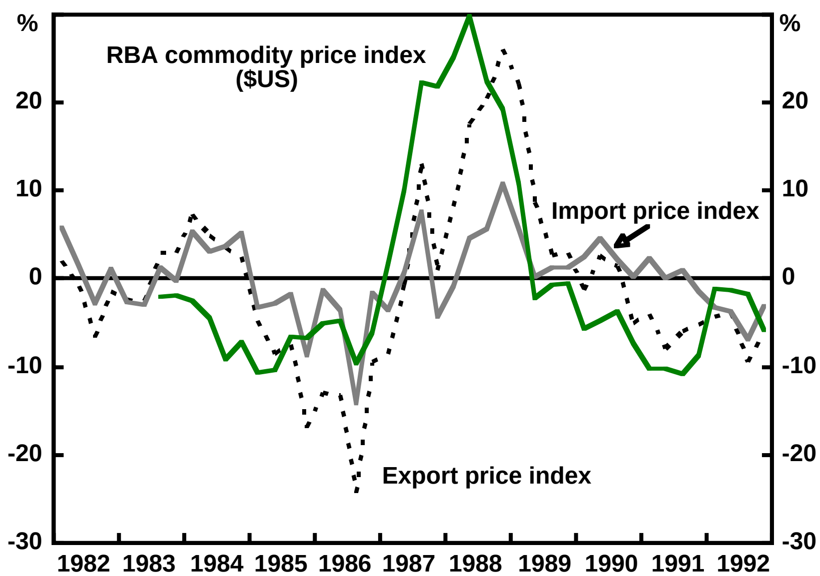


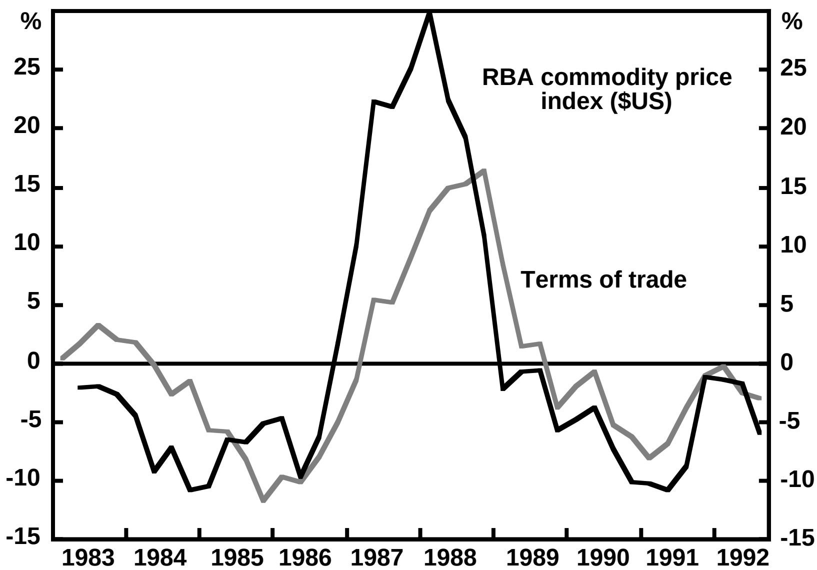
Figure 3: Traded Goods Prices and Commodity Prices: Inflation Rates
(traded goods prices adjusted by TWI, per cent per annum)



traded goods move in a similar fashion to each other and to commodity prices and that export price fluctuations often have a greater amplitude than those of import prices.[3] The consequence is that the terms of trade usually also move in a similar fashion to commodity prices (Figure 4). The terms of trade worsened from the September quarter 1984 to the September quarter 1987, improved until the December quarter 1989 and thereafter worsened again. These movements have significant implications for Australia's real income stability, prices and exchange rates.

One important consequence of the diversity of movement of both commodity and trade prices as compared with consumer prices is that the concept of 'the real exchange rate' is by no means clear-cut. Real exchange rates are a measure of relative prices, usually of home and foreign goods. When relative prices at home and abroad are constant, the real exchange rate is unambiguously the ratio of a domestic price, say the consumer price index (CPI), to the foreign CPI, the latter being translated by the nominal exchange rate into domestic currency. The notion captures the idea of the amount of country X's bundle of consumption goods that can be exchanged for a given amount of the domestic consumption bundle.

Figure 4: Commodity Price and Terms of Trade Fluctuations
(per cent per annum)

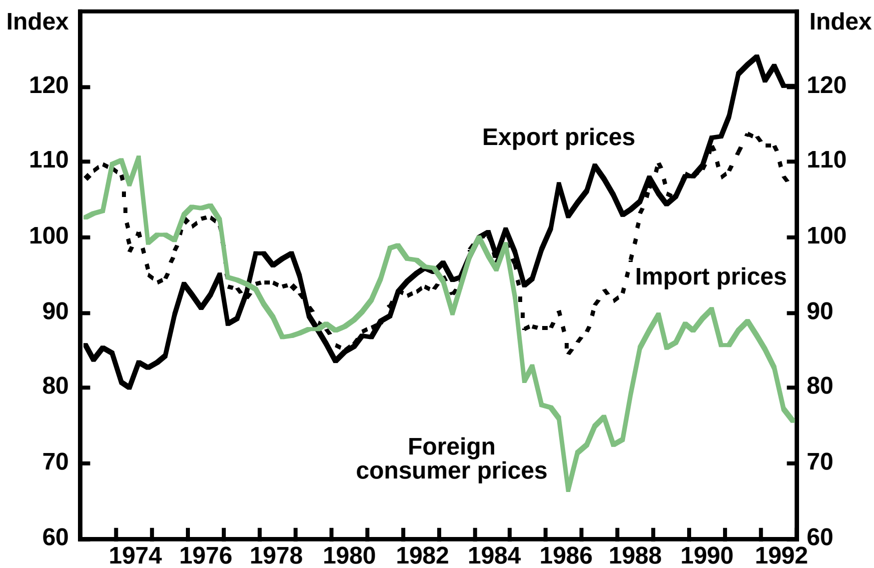


3. The oil price shocks of the 1970s are notable exceptions.

However, when relative prices are changing this concept is not always satisfactory. Nevertheless, it is the conventional measure in Australia and is constructed by taking the ratio of a price index of domestic consumption to foreign consumption prices. In Figure 5, the series labelled foreign consumer prices is put together from the CPIs of 22 countries with which Australia trades, converting them to Australian currency values, weighting them according to trade values and dividing the resultant index into the Australian CPI. It depreciated substantially in 1985-86, appreciated through 1987-88, was steady during the 1989-91 period and thereafter has depreciated.[4] The concept is relevant to those contemplating foreign travel, but if traded goods prices behave very differently from consumer prices, it will not be an appropriate measure for those engaging in trade. Exporters, for instance, are ultimately interested in the number of units of domestic consumption goods which can be exchanged for the domestic currency value of their foreign currency earnings.

Hence, for several reasons it would seem desirable to define measures of the real exchange rate in terms of the relative prices of non-traded goods to prices of

Figure 5: Real Exchange Rates, Trade and CPI-Based Indexes
(1984 = 100)

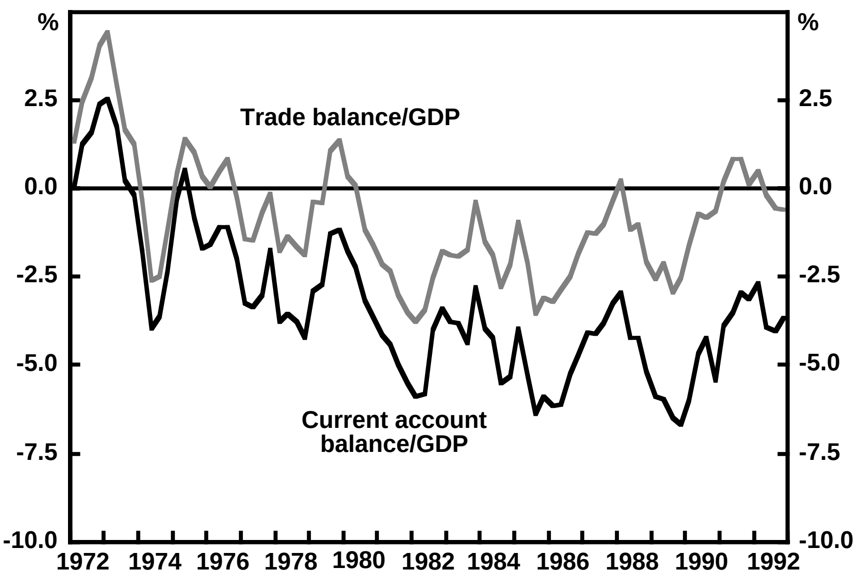


4. I am grateful to the Reserve Bank of Australia for supplying the data for this series. The method of compilation is described in Jones and Wilkinson (1990).

imports and exports.[5] For this purpose, further real exchange rate indexes are defined by taking the ratios of a domestic price index to the import and export price indexes. I shall call these indexes 'trade-based' by contrast with the CPI-based measures. An interesting feature of Figure 5 is the difference in behaviour between the three measures of the real exchange rate. Starting from December 1984, the TWI depreciated significantly through 1985 and 1986. The conventional CPI-based real exchange rate measure also depreciated at this time, but the import-based measure depreciated by much less and the export-based index hardly at all. Subsequently, the export-based index appreciated steadily while the import-based and CPI-based indexes appreciated through 1987 and 1988. All measures have shown a tendency to depreciate in the past two years.

In Figure 6 the current account balance and the balance on goods and services (trade balance) are shown as a per cent of GDP. The major difference between the two balances is the net foreign income balance. Net income, being dependent on the size of net foreign liabilities, is partly determined by the history of the current account balance. Hence, so far as exchange rate issues are concerned it is often

Figure 6: Current Account, Goods and Services Balances
(per cent of GDP, quarterly, seasonally adjusted)



5. Blundell-Wignall and Gregory's (1990) work involves both terms of trade shifts and separate prices for non-traded goods. They define the relative price of imports to non-traded goods as the real exchange rate. This neglects the role of the relative price of exports. See Section 4 for further discussion.

preferable to examine the behaviour of the trade balance. Long-term adjustment of the current account balance must lag that of the trade balance because of inertia in the income balance when it is large. The two main features of the performance of the trade balance are that it can be seen to follow cycles similar to those in real GDP and that the trade deficit increased in the early 1980s and fell in the latter part of the decade. The trend increase evident for much of the 1980s in the current account balance has been a matter of concern for policy makers. However, there is some suggestion of a trend *reduction* in the trade deficit through the latter part of the 1980s. Each peak and trough is a little higher through the decade than the one that preceded it. This has occurred despite the appreciation of the export-based real exchange rate.

Both short and long-term real interest rates, calculated using actual to stand for expected inflation rates, are shown in Figure 7. The notable features of their behaviour are, firstly, that it can be shown that they have followed cycles with a similar period to and roughly in phase with those of GDP. Secondly, from negative levels in the 1970s, real interest rates rose to become positive in the early 1980s and since then, have shown a slight upward trend.

Finally, GDP growth is central to macroeconomic policy and is illustrated in Figure 8. The three recent recessions are evident as periods of low or negative growth. The real interest rate and current account series also have three distinct peaks in the last 12 years, strongly suggesting a relationship with GDP cycles.

Figure 7: Real Interest Rates
(deflated by implicit consumption prices)

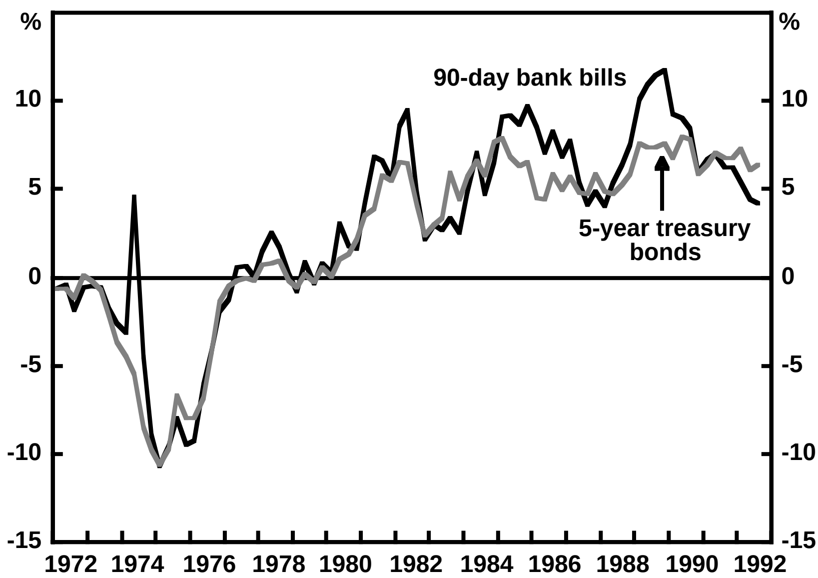
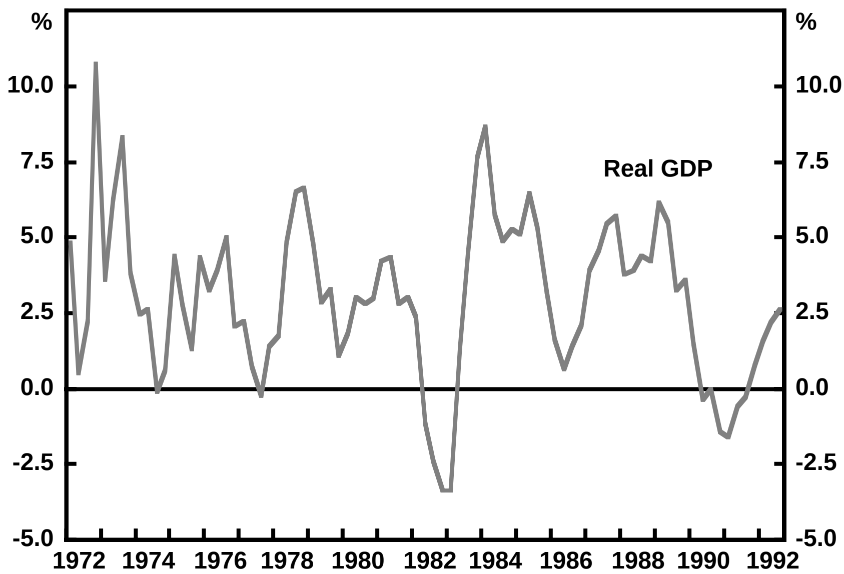


Figure 8: Real GDP Growth Rate
(year-ended percentage change)



Moreover, Australian GDP fluctuations have followed a similar pattern to those in comparable economies. Growth cycles similar to those referred to above have taken place in most Western economies. Apart from shocks in trade goods prices, fluctuations in world activity would appear to be a significant, though related, source of disturbance to the Australian economy.

2. Exchange Rate Determination

There have been considerable developments in the theory of exchange rate determination in recent decades, though econometric testing of theories has not been particularly successful.[6] In a world of internationally mobile financial capital and floating rates, the old notion that the exchange rate is determined by the balance of payments has little credibility. To see how it worked, define π and e as the real and nominal exchange rates, respectively, Y the level of real output, NX net exports and K the capital account balance. Then, the balance of payments is:

$$NX(\pi, Y) + K = 0 \tag{1}$$

6. See MacDonald and Taylor (1992). Their survey finds that, apart from covered interest parity, none of the major theories of exchange rate determination receive strong support from the empirical studies.

In the theoretical sections the real and nominal exchange rates are defined as the reciprocals of the conventional measures for Australia. For simplicity, it is assumed that there are no changes in reserves and also that the net income item in the current account is zero with the consequence that the current account balance equals net exports. To suggest a world of limited capital mobility, suppose that K is constrained to be a constant. Then with Y determined by consumption and investment plans and macroeconomic policy, the balance of payments does indeed determine the real exchange rate. Taking monetary policy to determine the level of domestic prices P, the nominal exchange rate is found from:

$$\pi = eP^*/P \qquad (2)$$

where P^* is the foreign currency price of imports. However, with *unconstrained* international capital flows, K is a residual satisfying the demand for funds at current international and domestic interest rates.[7] The factors determining the exchange rate do not include the condition in equation (1). To see this, consider the simple open economy Mundell-Fleming type model which is based on the assumption that the foreign good is imported, but not produced domestically and that there is a single good produced at home and exported:

$$M = PL(i,Y) \qquad LM \qquad (3)$$

$$Y = C(Y) + I(i) + G + NX(\pi,Y) \qquad IS \qquad (4)$$

$$i = i^* \qquad \text{interest parity} \qquad (5)$$

$$Y = Y(\overline{W}/P) \qquad \text{supply} \qquad (6)$$

where variables not previously defined are:

- M nominal money supply
- i nominal interest rate
- C consumption
- I investment
- G government expenditure
- $\overline{W}$ nominal wage

and * refers to foreign variables. Both the foreign interest rate and the foreign currency price of imports are taken as exogenous. The simpler versions of the Mundell-Fleming system avoids dynamics, in part by assuming that expectations

7. This point has long been absorbed in the theoretical literature, but continues to surface in ‘practical’ discussions. See Kouri (1976) for further discussion of the point that the balance of payments does not determine the exchange rate.

about exchange rates and prices are static.[8] It is modified above by the addition of a supply function (6), that incorporates the assumption that the nominal wage is determined at any time by exogenous wages policy.[9]

Substituting out for equation (5) in the system (2) to (6) determines the endogenous variables (P, Y, e) given the exogenous variables $P^*, M, i^*, G, \bar{W}$. In particular, the system determines the real and nominal exchange rates without reference to (1). Thus, given the usual assumptions about signs and some choice of $\bar{W}$, output of the home good is an increasing function of the price of the home good. Substituting (6) in the *LM* equation, monetary policy can then be shown to determine the price level $P(M,\bar{W})$. Substituting $Y[P(M,\bar{W})]$ into the *IS* curve, it is seen that the supply and demand for the home good determine its relative price $1/\pi$, which is the reciprocal of the real exchange rate. Finally, the nominal exchange rate is found by substituting solutions for π and P in (2).

Although the model is short run and limited in ways previously and to be described, it possesses properties of more complete systems. It is readily shown that:

1. The real exchange rate is a relative price determined by domestic supply and home and foreign demand for the home good.
2. The nominal exchange rate is determined not by the balance of payments but by relative prices, wages and monetary policy.
3. The system allows an autonomous monetary policy.
4. A rise (fall) in the foreign price level will induce an exactly offsetting appreciation (depreciation) of the nominal exchange rate. This follows because P is determined by monetary policy and labour market conditions and π by the market for home goods. This is the ‘inflation insulation’ property of flexible rates.
5. The usual assumptions about the signs of the system ensure that there will be a unique real exchange rate for given values of exogenous variables $M, i^*, G,$ and $\bar{W}$.
6. The nominal money supply influences the real exchange rate because nominal wages are taken to be exogenous. At the other extreme, if nominal wages are allowed to adjust to clear the labour market at the

8. This or some variant is the more convenient approach for those who find difficulty in solving the comparative dynamics of second or higher order non-linear difference and differential equation systems in their head.
9. This must be regarded as a first approximation to wages policy as it does not explicitly allow for wages to be adjusted according to particular rules. Also, it would be preferable to include relative prices in the supply function as the supply of labour depends on both domestic and foreign prices. See Pitchford (1990).

natural rate of unemployment, the real exchange rate then depends only on i^*, G and monetary changes will not affect real variables.

As the model stands, aggregate demand shifts, such as those induced by fiscal policy, have no effect on real variables. An increase in government spending on the home good will appreciate the real exchange rate just sufficiently to crowd out an equal amount of private expenditure so resulting in no change in real output. This traditional Mundell-Fleming result no longer holds if a wage adjustment rule, such as partial or even full indexation, is added to the system.[10] It then follows that:

7. Shifts in the exogenous variables i^* and G will shift output, employment and the real exchange rate; for instance, fiscal expansion will increase output and appreciate the real and nominal exchange rates.

The propositions above contrast with those which would be obtained if the older view, embodied in condition (1) was imposed, that is that the current account deficit had to remain unchanged. According to this view, if either monetary or fiscal expansion are thought to raise output, this would tend to increase a current account deficit and then depreciation would be necessary to ensure the trade balance did not change.

The model needs to be amended in a number of ways both to add realism and to ensure that properties such as homogeneity hold where appropriate. It is worth mentioning these qualifications briefly. Relaxing the Mundell-Fleming model assumption that exchange rate expectations are static introduces the interest parity condition that domestic and foreign nominal interest rates differ by the expected depreciation rate between the currencies involved. This also brings dynamics into the model. Further, it needs to be recognised that current account imbalances imply changes in net foreign assets which in turn affect investment and consumption behaviour. The current account feedback models developed to capture these effects usually neglect the relationship between private foreign borrowing and the investment which is its purpose. If capital stock effects are overlooked, these models give an incomplete and often misleading picture of the current account feedback process.

Models such as those surveyed by Branson and Henderson (1985) incorporated the assumption that foreign and domestic bonds need not be perfect substitutes. In the widest version of this ‘portfolio balance’ class of models agents hold a portfolio of bonds, equity and money denominated in various currencies on the basis of their expected future returns. Current account imbalances lead to accumulation or decumulation of these asset stocks in a potentially bewildering variety of ways. Finally, there are numerous models of optimal intertemporal

10. This extended model is set out in the Appendix, Part B, where it is used to discuss the effects of shifts in real wages on the trade balance.

borrowing and lending by consumers and/or producers.[11] While they deal satisfactorily with the motives for intertemporal substitution, it is not straightforward to incorporate them into macroeconomic models driven by aggregate demand.

Given this range of additions to the original system it is unlikely that the behaviour of the nominal exchange rate could be fully comprehended without the aid of an extensive econometric model. Notwithstanding, economists make attempts to short-circuit the complications and understand the workings of the system from selected parts. For instance, differentiating (2) with respect to time:

$$\hat{e} = \hat{P} - \hat{P}^* + \hat{\pi} \tag{7}$$

If the real exchange rate is assumed to be constant this amounts to the 'relative purchasing power parity' theory of exchange rate determination. If also it is assumed, that output is constant, using (3) and (5) for both the domestic and foreign economy:

$$\hat{e} = \hat{P} - \hat{P}^* = \hat{M} - \hat{M}^* \tag{8}$$

which is the one of the tenets of the 'monetary approach' to the balance of payments. Despite the neatness and appeal of these hypotheses, they will be satisfied in practice only to the extent that the theoretical and empirical assumptions on which they are based are satisfied.

While the model just studied is popular because of its simplicity, it cannot deal with complications which were shown in Section 1 to arise from the behaviour of Australian traded goods prices. The alternative model in the literature is the traded/non-traded goods system. This allows for domestic production of both goods, but is still inadequate for many purposes because of its assumption that the terms of trade are fixed. In order to represent typical price shocks for the Australian economy, the system should allow for the production and consumption of exportables, importables and non-traded goods. For the present, note that now two relative prices, namely eP^*_X/P_N and eP^*_M/P_N (where subscripts $_{X}$, $_{M}$ and $_{N}$ stand for exports, imports and non-traded goods, respectively) and, hence, two real exchange rates are relevant to trade issues.[12] Arising out of this model are the issues of whether and to what extent exchange rate policy can cushion foreign currency price shocks and terms of trade fluctuations. The appropriate theory will be spelt out in the section on these effects.

Finally, there is the question of whether monetary policy should be conducted

11. See, for instance, Blanchard and Fischer (1989), Pitchford (1989, Ch. 2), Svensson and Razin (1983).

12. Some of the properties of this model are discussed in Long and Pitchford (1993) and Pitchford (1993).

according to rules which involve the exchange rate. Firstly, various monetary policy 'rules of thumb' have been suggested for particular macroeconomic purposes. Leaning against the wind involves tightening monetary policy when the exchange rate is depreciating and loosening it when it is appreciating, apparently with the intention of slowing down, or even reversing market-induced changes in the exchange rate. Closely related are monetary policy rules which target other endogenous variables. For instance, the 'modified monetary targeting' practiced in the 1970s in Australia and other countries involved adjusting the target money growth rate down when inflation exceeded desired levels. Roper and Turnovsky (1980), for example, show that rules of this type may perhaps be justified as optimal policy responses.[13] They formulate a simple open economy Keynesian model, similar to that above and allow for random shocks in aggregate demand, the domestic money supply and the foreign interest rate. Provided the authorities know the structure of the economy, including the means and variances of the distribution of the shocks, it is optimal to adjust the money supply in line with variations in the exchange rate.[14] The criterion for optimality is the minimisation of real income fluctuations. The information demands of such a scheme, even at the level of the simple theoretical model they study, are such that it is unlikely that it could form the basis of useful policy. In practice, the realistic operating response for active monetary policy is to respond to each shock as it occurs, with little guide as to its future size and duration. It is doubtful that econometric results will be able to do more than inform such choices in a general, rather than a precise way.

3. Monetary Independence

Views differ as to the value of monetary policy independence. An economy wishing to improve its inflation performance and credibility may choose to peg its exchange rate to that of a country with a record of low inflation. Alternatively, it may choose to select its own means of implementing anti-inflationary monetary policy. As noted, Australia is subject to foreign trade price disturbances which behave very differently from foreign CPI inflation rates. Unless such cycles were to disappear, price stability is hardly likely with pegged exchange rates. Moreover, if it is believed that monetary policy has real effects, even if only in the short run, there is a danger evident in recent European experience that real as well as monetary disturbances might be imported by pegging to particular economies. Finally, pegged rates would make it difficult or impossible to use monetary policy in a counter-cyclical way and/or to offset undesirable real shocks.

13. The considerable literature on optimal intervention is surveyed in Pilbeam (1992).

14. The sign of the response function is ambiguous so that it cannot be shown that leaning against the wind is necessarily optimal.

Of course, if pegged exchange rates are adjustable, it may be possible to realise a degree of monetary independence by changing the peg as necessary. However, this requires the authorities to imitate the trends of a floating rate. The value of floating is that rate adjustments are not subject to the delays, forecast errors, calculation uncertainties, political and bureaucratic influence and speculation which characterise adjustable pegged systems. Open market operations to sterilise unwanted monetary movements is another way in a pegged rate system of seeking to offset undesired foreign influences on the domestic money supply. However, this can only be a short-term measure, for unless the causes are short run, the factors responsible will continue to put pressure on the money supply to change.

For the reasons indicated above it would seem desirable that Australia have a reasonable degree of monetary independence.[15] Has floating brought this about? It is convenient to start with the situation before floating when exchange rates were managed or pegged. In the case of a pegged rate and perfect mobility of financial capital, a monetary expansion would, in theory, lead to downward pressure on domestic interest rates, a capital outflow and eventually a complete offset of the monetary expansion.[16] On the other hand, with a pegged rate, a balance of payments surplus, due say to improved trading conditions resulting in a current account surplus, would generate an increase in the money supply.

An episode in the early 1970s suggests that Australia's monetary independence was limited before floating. As a result of a high rate of exploitation of Australian mineral and oil resources through the 1960s and the export price boom of 1972-73, Australia experienced increasing trade surpluses in the late 1960s and early 1970s. Foreign exchange reserves rose by 80 per cent in 1971 and 72 per cent in 1972. At the time, wool prices were low and for political reasons the Coalition Government did not appreciate the exchange rate. Open market operations were successful in confining the growth in the money supply (M3) to 8.6 per cent in 1971, but with a substantial rise in unemployment in 1971 and an election in prospect, open market sales were reduced and M3 rose by 18 per cent in 1972 and 22 per cent in 1973.[17] This experience suggests that, at least in the short run, there is some scope under pegged rates for the monetary authorities to moderate external pressures on the money supply. However, when the need for an adjustment of the exchange rate is resisted, exercising control over the money supply can be an increasingly difficult task.

15. With monetary policy implemented through control of short-term interest rates, the money supply becomes endogenous. Monetary independence in such circumstances can be interpreted to mean the facility to set independent short-term interest rates without credit or other financial controls.

16. Offset was rarely found to be complete. See Macfarlane (1979) for a survey of the Australian results.

17. These events are described in Pitchford (1977).

Some evidence of monetary independence since the float is that Australia realised a money growth and inflation rate significantly above that of its main trading partners for most of the 1980s. From 1983 to 1989 Australia's average inflation rate was 7.3 per cent, whereas that for the United States was 4 per cent and for Japan 1.2 per cent. Also the rapid increase in Australia's M3 in the late 1980s, often regarded as a consequence of financial deregulation, has no counterpart in most G7 (i.e. 'Group of Seven') countries.[18]

4. Insulation

4.1 Insulation, Traded Goods Prices and the Terms of Trade

The inflation insulation property of flexible rates is usually established on the assumption that there is only one type of foreign good.[19] This simplifies the analysis greatly because it precludes changes in the relative prices of foreign goods, which incidentally implies an unambiguous definition of the foreign real interest rate. However, it has been established that many of the interesting questions about Australian exchange rate behaviour specifically require that foreign production of exportables as well as importables be recognised. Assume that the market for non-traded goods clears, so that the expression for zero excess demand in that market is given by:

$$-\gamma i^* + \delta_X (e + s - p) + \delta_M (e + q - p) = 0 \qquad \text{non-traded goods market} \quad (9)$$

where the symbols are defined below. The model is completed by adding expressions for the price index and the money demand function, respectively, as shown below:

$$\psi = a_X (e + s) + a_M (e + q) + a_N p, \; a_X + a_N + a_M = 1 \qquad \text{price index} \quad (10)$$

$$m = -\mu i^* + \beta(s - q) + \psi \qquad \text{money demand} \quad (11)$$

where all variables except interest rates are in logarithms and

- e exchange rate (price of foreign money)
- s foreign currency price of exports
- q foreign currency price of imports
- p price of non-traded goods

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18. Foster (1993) argues that this money supply growth was significantly related to the property market boom of the time and that financial deregulation was only a minor factor.

19. 'Foreign price insulation' will be referred to just as 'insulation' in the paper. If necessary, other types of insulation will be given distinguishing labels.

ψ price index of domestic consumption

m nominal money supply

i^* foreign nominal interest rate

All elasticities and parameters $\gamma, \delta_i, a_i, \mu, \beta$ are positive. In equation (9) excess demand for non-traded goods is influenced by interest rates and the relative prices of each traded good to the non-traded good. As in Section 2, the complications associated with interest parity are avoided by assuming static price and exchange rate expectations. Real money demand depends on the nominal interest rate as well as real income which, in turn, can be shown to depend on the terms of trade $s - q$. As in the system of Section 4, exchange rate and price expectations are static if the domestic nominal interest rate equals the foreign nominal interest rate. Notice that, for simplicity of exposition, a number of factors that will affect real exchange rates both in the short and the long run have been omitted. These include real output (other than terms of trade effects), government variables and measures of disequilibrium in markets.

Differentiating (9) to (11) and rearranging:

$$de = -(a_X + \beta + a_N\delta_X)\, ds - (a_M - \beta + a_N\delta_M)\, dq + dm \qquad (12)$$

The coefficients of ds and dq in (4.4) add to -1 for:

$$(a_X + \beta + a_N\delta_X) + (a_M - \beta + a_N\delta_M) = a_X + a_M + a_N\,(\delta_X + \delta_M) \qquad (13)$$

and it is shown in Long and Pitchford (1993) that $\delta_X + \delta_M = 1$. Moreover, it is reasonable to take the case where the coefficient of dq is negative.[20] As a consequence, movements in the nominal exchange rate are a weighted average of the proportional changes in foreign currency traded goods prices plus the proportional change in the money supply. In particular, when both foreign currency prices change in the same proportion, the nominal exchange rate will, other things being equal, appreciate in that proportion, hence exactly offsetting the rise and leaving the domestic currency value of traded goods prices unchanged. This is the conventional ‘foreign price insulation’ property of flexible exchange rates. Here the concept is extended to the circumstance of any foreign currency traded goods price shifts, in which case it can be seen that the exchange rate response offsets a weighted average of the foreign currency trade price changes. The expression for exchange rate movements (12) can be viewed as an extension of purchasing power parity (8) to take account of foreign traded goods price

20. The terms of trade effect coefficient β in the money demand function consists of the response of real income to an increase in the terms of trade times the income elasticity of demand for money. The first effect is shown in Long and Pitchford (1993) to equal the share of exports in total expenditure. Unless the money elasticity is very large the coefficient will be negative.

movements rather than consumption price inflation or deflation.[21] Notice that the exchange rate response can be written as:

$$\begin{aligned} de &= -dq - (a_X + \beta + a_N\delta_X)(ds - dq) + dm \\ &= -ds + (1 - [a_X + \beta + a_N\delta_X])(ds - dq) + dm \end{aligned} \tag{14}$$

and hence is shown to consist of a terms of trade adjustment and a pure insulation effect with respect to an absolute price change.

From (10) and (12), the effect on the price index can be shown to be:

$$d\psi = -\beta(ds - dq) + dm \tag{15}$$

The absolute foreign currency price effects disappear, but the price index will fall with improving and rise with deteriorating movements in the terms of trade. However, it can be seen that this terms of trade effect arises from the change in the demand for money induced by the influence of the terms of trade on real income. It would seem reasonable for monetary policy to finance such real income changes, in which case there would be an accommodating monetary response of:

$$d\tilde{m} = \beta(ds - dq) \tag{16}$$

The change in the price index would then be given by any further monetary expansion and the foreign price changes would have no impact on the index. Insulation would be complete. Notice that this money demand effect is quite independent of the size of absolute price shocks, depending only on the change in the terms of trade.

Finally, the effects on domestic currency prices of exports and imports are given by:

$$d(e + s) = (a_M - \beta + a_N\delta_M)(ds - dq) + dm \tag{17}$$

$$d(e + q) = -(a_X + \beta + a_N\delta_X)(ds - dq) + dm \tag{18}$$

These movements can be seen to depend on terms of trade shifts and monetary growth. For a terms of trade improvement, for instance, if $dm = 0$ the domestic currency prices of exports will rise and imports prices will fall, the magnitudes of these changes being smaller than the corresponding foreign price changes. The export and import-based real exchange rate movements, using the price index ψ

21. However, in principle, allowance should also be made for factors that might shift real exchange rates, and for non-traded goods markets not clearing.

in their definition, are:

$$de + ds - d\psi = (a_M - \beta + a_N\delta_M)(ds - dq) + dm - d\psi = (a_M + a_N\delta_M)(ds - dq) \quad (19)$$

$$de + dq - d\psi = -(a_X + a_N\delta_X)(ds - dq) \quad (20)$$

assuming (15) to apply. In the context of exogenous price shocks and monetary movements, these real exchange rate concepts depend solely on shifts in the terms of trade.[22]

Adding further complications such as non-static exchange rate expectations and the absence of market clearing for non-traded goods and labour need not necessarily affect this result. Firstly, the result is a partial one so that further sources of shocks do not necessarily upset it. Secondly, in models with simpler production structures the result is robust to most such qualifications.[23] However, in these models it is required that the foreign Fisher effect operates. The result may not have to be greatly qualified if this does not hold, provided real interest effects are small in the short run.

Given the substantial fluctuations evident in Australia's foreign currency trade prices the benefit of insulation is that nominal exchange rates will move to offset much of their nominal effects. In a world of nominal contracts, if not money illusion, this has the potential to mitigate the effects on real as well as nominal variables. In the 1980s a typical foreign price shock involved rises or falls in foreign currency export prices in a greater proportion than foreign currency import prices. For instance, in the case of an unexpected fall in the foreign currency prices of agricultural exports, other things being equal, the exporters concerned will have already incurred costs of production and their losses will be greater the greater the fall in the *domestic* currency prices of their products. The exchange rate will depreciate so as partially to offset foreign currency price falls, so limiting the extent of income falls. However, the depreciation obviously cannot offset the *terms of trade* decline and its effects on exporters' incomes. The events associated with the first oil price shock of the 1970s is an example of a terms of trade decline produced by the foreign currency price of imports rising more than that of exports. With a pegged rate it would be difficult to avoid this having substantial effects on the domestic price index. The insulating response is an appreciation which partially offsets the import price rise and produces falls in the prices of exportables. Because all terms of trade shocks must involve a rise or fall in some absolute foreign currency traded goods price, it is not appropriate to talk about the effects

22. Of course, other real shocks, such as shifts in saving and investment, real interest rates, or product market disequilibrium will affect them.

23. See, for example, Pitchford and Vousden (1987).

of such shocks independently of absolute price changes. In the two cases given above, the nominal exchange rate appreciates when the terms of trade deterioration is produced by an import price rise and depreciates when an export price fall is the cause.

The present section has much in common with a paper by Blundell-Wignall and Gregory (1990) which advocates exchange rate flexibility as the most appropriate method of dealing with terms of trade shocks. Their basic argument is that the real exchange rate depends on the terms of trade. Hence, real exchange rate adjustment to terms of trade shocks will be easier if the exchange rate is allowed to facilitate the required changes. For the present model it has also been shown that the two possible measures of the real exchange rate depend solely on the terms of trade (see (19) and (20) above). A reconciliation of the two approaches results when account is taken of their assumptions both that the ratio of import prices to the domestic goods price is 'the' real exchange rate and that foreign currency import prices are held constant. On the first point, their model contains two relative prices pertinent to trade issues. The second point they justify on the grounds that export prices are more volatile than import prices. Given their choice of the ratio of domestic currency import prices to non-traded goods prices as the real exchange rate, their fundamental relationship is closely analogous to (20). While their approach is basically the same as given here, it obscures two aspects of the process. Firstly, terms of trade movements arising from import price fluctuations are obviously not covered. Secondly, the absolute foreign price insulation aspects of floating exchange rate mechanisms, while implicitly part of their analysis is not accorded its appropriate significance.

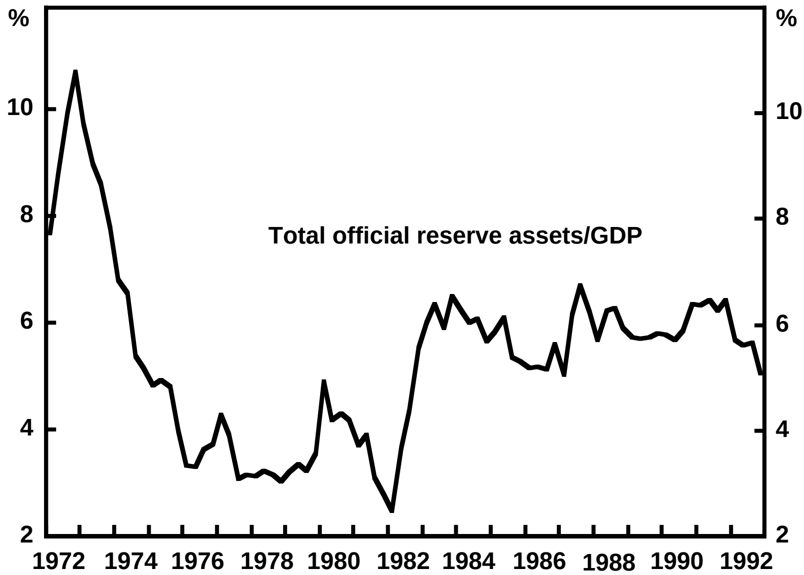
To verify the closeness of the two approaches, note that their basic relationship (20) can be rearranged to yield (19). Further, another rearrangement of (20) gives:

$$\begin{aligned} de &= -dq - (a_X + a_N\delta_X)(ds - dq) + d\psi \\ &= -(a_X + a_N\delta_X)ds - (a_M + a_N\delta_M)\,dq + d\psi \end{aligned} \tag{21}$$

which is a version of the basic relationship (12) of this section. In fact, substituting (15) into (12) yields (21), so that (21) can be seen to be a special case of (12) where the effects of terms of trade shifts on the demand for money have not been incorporated into the analysis.

The analysis so far has not taken account of interest parity. The Appendix, Part A, investigates the conditions under which insulation will apply when it is considered. It is sufficient for insulation if the foreign real interest rate is independent of the foreign inflation rate and that the foreign inflation rate is a particular weighted average of the inflation rate of the foreign currency prices of the goods Australia trades.

Figure 9: Total Official Reserve Assets
(per cent of GDP)



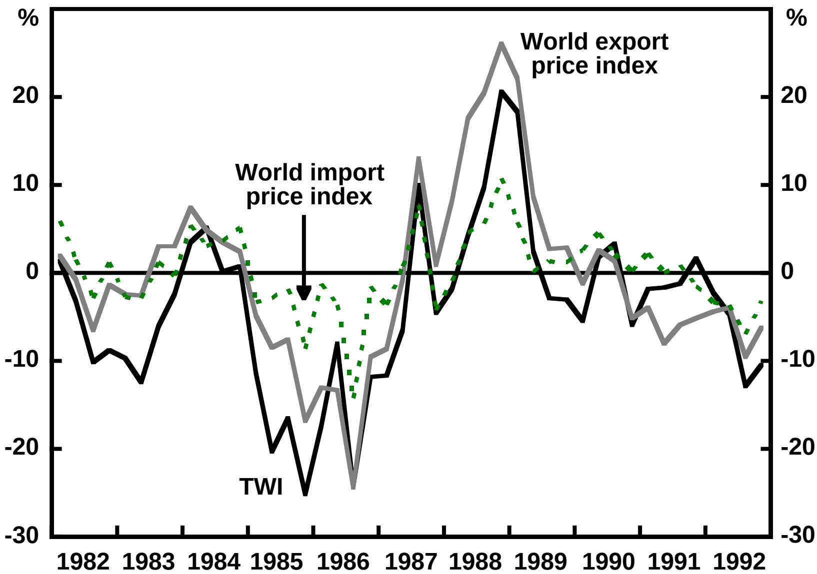
4.2 Insulation in Practice

The insulation property could not be expected to operate if the exchange rate was pegged or heavily managed.[24] There would then be a tendency to import foreign price movements. Given that countries that float often take the option of retaining foreign exchange reserves, how can a judgement be made that these reserves have been held at levels that are neutral with respect to intervention? If the option retained is that of returning to a pegged or heavily managed rate, the authorities would need to hold reserves in some reasonable ratio to imports or GDP. Figure 9 shows reserves as a percentage of GDP and the picture is similar for imports. This measure has been fairly stable since the float, certainly as compared with its behaviour in the 1970s and so does not suggest a long-term operation to affect exchange rates. However, an active policy of sterilised intervention in the foreign exchange market has been operated since the float. Its possible effects are discussed in Section 5.

Given the proposition that the float has been relatively clean, how could the insulation property be examined and tested? The record of foreign currency price

24. See Pitchford and Vousden (1987) for examples of how various forms of management interfere with insulation. Another combination of rigidities which would impede its short-run effectiveness is set out in the discussion of exchange rate policy and inflation in Section 5.

Figure 10: Rates of Change of TWI and Traded Goods Prices
(per cent per annum)



movements since the float can be examined to determine whether the direction and magnitude of exchange rate shifts have been of a sign and size appropriate for insulation.

Figure 3 shows that there were two major commodity price shocks in the 1980s. Falls occurred in foreign currency traded goods prices and the terms of trade during 1985-86 and rises during 1988-89.[25] Did anything like an insulation response (which for the first episode would be a depreciation) happen in practice? In fact, as Figure 10 shows, this was a period of substantial nominal depreciation for the TWI which fell 24 per cent in the year to September 1986. Of course, some or all of the depreciation could have been due to other factors, such as monetary expansion or falls in investment. A feature of an insulating response when the terms of trade worsen is that the export-based real exchange rate appreciates and the import-based rate depreciates (see Figures 4 and 5). In fact, the export-based index depreciated slightly, indicating that there could have been other causes of nominal depreciation.

In 1988, both the export and import price indexes measured in foreign currency rose, with the terms of trade improving. Annual rises to December 1988 were

25. Measured in foreign currency, export prices fell 23 per cent and import prices 17 per cent in the year to September 1986.

28 per cent for exports and 13 per cent for imports. The TWI appreciated by 21 per cent over the same period and the export-based real index depreciated slightly while that for imports appreciated over the same period by 13 per cent. Again these nominal and real exchange rate changes could have had some further cause. However, the money growth rate was positive and high at this time and the inflation rate was of the order of 7 per cent. For both episodes the nominal exchange rate movements were essentially consistent with their being insulation responses.

This experience contrasts with that in the 1970s when there were foreign currency trade price shocks both from the export and import side and the exchange rate was pegged or heavily managed. In all these cases Australia appeared to import significant inflation pressures. For example, following the first oil price shock the domestic currency import price index rose by 34.6 per cent and the consumption price deflator rose by 19.6 per cent over the year to March 1975. Without exchange rate flexibility, attempting to combat these direct effects on the price index by monetary restraint led to lower activity but did not prevent inflation.

It has been seen that the model tested by Blundell-Wignall and Gregory (1990) embodies the insulation property. Hence their econometric tests amount to tests of (20) and also of (21), but with the restrictions that the coefficients of ds and dq add to -1 and that of $d\psi$ is unity, already imposed. The econometric work they have done on this relation which supports their basic relationship is also a test of (12) with the above coefficient restrictions imposed. Their conclusions are generally supportive of their form of the insulation hypothesis and so the form used here. Further investigation of the insulation response is contained in Pitchford (1993) and again the results are not inconsistent with the exchange rate providing insulation from foreign price shocks.

Finally, it must be recognised that the insulation property may not work to produce the essence of the results outlined here. Inflation then, at least initially, would be imported directly through the effects of commodity price shocks and, perhaps, also indirectly through the inability to control the money supply. The problems this might raise for macroeconomic and exchange rate policy are considered in the following section.

5. Inflation and the Exchange Rate

At one extreme, if exchange rates are pegged or heavily managed it will be difficult to avoid importing foreign inflation. At the other, a floating rate has the potential to insulate the economy from foreign currency trade price movements and to provide monetary independence. In between, if the rate floats without significant intervention, but insulation is incomplete, some part of foreign price rises will be reflected in the domestic price index. In this last case, it would seem necessary to know the nature of the failure of insulation in order to appreciate the implications for macroeconomic policy. The context of this discussion is a convenient one in which to discuss a policy approach which seems to have attracted attention, that of 'targeting' the exchange rate to produce desired inflation outcomes. It is pertinent to ask whether or not this is an effective way of combating inflation. Imported inflation is treated briefly in the first subsection, the failure of insulation in the second, exchange rate targeting in the third and the question of what might be an appropriate inflation target in an economy with a floating exchange rate in the last.

5.1 Imported Inflation

It is useful to treat imported inflation because the possibility exists that inflation will have some of the features of a fixed rate regime if insulation does not work. Consider an equilibrium in a pegged rate system in which the real interest rate is constant and foreign currency export and import prices are rising at a common and constant rate. If there is truly equilibrium, other nominal magnitudes (in particular the money supply, non-traded goods prices and hence an index of consumer prices) will all be rising at the same rate.[26] From the system of Section 4, equilibrium is definable for constant values of $i*$ and s-q. Where · denotes the derivative with respect to time, it follows that:

$$\dot{\psi} = \dot{s} = \dot{q}, \text{ for } \dot{e} = 0 \tag{22}$$

That is, it will not be possible to achieve a lower inflation rate than that of external prices without creating disequilibrium.

As has been noted, the data show that steady rates of increase of traded goods prices are not common. Rather, price surges lasting two to three years have been the rule. Equilibrium of the kind referred to above would occur, at most, only briefly. However, the discussion still suggests that fixed rate regimes will have little chance of achieving independent inflation outcomes except by policies that must imply disequilibrium.

Suppose a Phillips curve equation for non-traded goods prices of the form:

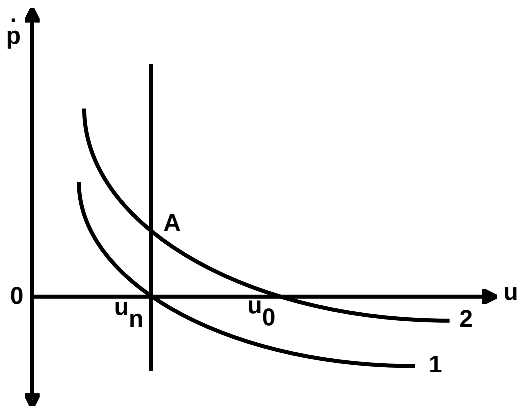
$$\dot{p} = E[\dot{\psi}] + f(u) \tag{23}$$

where $E[\dot{\psi}]$ is the expected inflation rate and u the unemployment rate. Using the definition of the price index given in (10) and assuming perfect foresight:

$$\dot{p} = (a_X\dot{s} + a_M\dot{q})/(1 - a_N) + f(u)/(1 - a_N) \tag{24}$$

26. In the classic case, the domestic money supply will not be controllable by the monetary authorities and will be growing at the same rate as foreign inflation.

Figure 11: Phillips Curve



In Figure 11 inflation is given by curve 1 for the case of zero foreign inflation. If foreign inflation occurs, foreign currency price rises shift the Phillips curve upward to curve 2. Equilibrium is now at point A. Zero inflation for non-traded goods prices can be achieved by raising unemployment from u_n to u_0. For the price index to be stable, non-traded goods prices would have to fall to offset the effect of rising traded goods prices, so that a still higher unemployment rate than u_0 would be necessary. By contrast, it was shown in Section 4 that, with a flexible rate, foreign inflation or deflation will not impinge on the domestic economy if insulation works. In this case, curve 1 applies for the flexible rate system.

5.2 If Insulation Fails

Although the behaviour of the Australian economy since the float suggests that monetary and inflationary outcomes have been largely independent of foreign influences, it could be that this proposition may be proven false in the future. If the exchange rate floats, but insulation does not work, some or all of average foreign currency trade price changes are liable to be imported into domestic prices. Unlike in the case of pegged rates, appreciation is possible, but is not sufficient to offset foreign inflation. However, the possibility exists that monetary policy could induce the *further* appreciation needed to prevent foreign currency price rises being imported. Notice also that the conditions for monetary independence may not be met if the exchange rate mechanism does not work in an insulating way, in which case foreign monetary shocks, probably related to the price changes, will also be imported. This situation is likely to arise out of systematic exchange market intervention.

One set of conditions that would inhibit a short-run insulation response are set out in Pitchford (1985). They are that exchange rate expectations are static, the price of non-traded goods moves sluggishly to clear the non-traded goods market and foreign and domestic bonds are imperfect substitutes. Assume the current account balance is initially zero. A once-and-for-all rise in the absolute foreign currency price of traded goods elicits no immediate exchange rate response so is fully imported. This leads to a relative price rise, so creating excess demand for non-traded goods and a rise in net exports. The price of non-traded goods will begin to rise. To this point the behaviour of the economy is similar to the case of pegged rates, but here the exchange rate is flexible. The rise in the relative price of traded goods, being a depreciation of the real exchange rate, produces a surplus on the current account. This eventually causes the exchange rate to appreciate.[27] The absolute and relative price of traded goods starts to fall and the system moves back toward the initial equilibrium levels of real *and* nominal variables. In the long run, unless there is money illusion, insulation works. However, this is not the end of the story, because as the price of non-traded goods has initially been pushed upward by excess demand, it must now be brought down by excess supply to get back to equilibrium. Hence, the lack of short-run insulation leads to phases of domestic disequilibrium.

Rather than static exchange rate expectations, various types of forming expectations, such as adaptive expectations, give partial insulation to the extent that they track exchange rate movements though with a systematic bias.[28] Partial insulation responses could then lead to less extreme forms of the processes outlined above. In the class of models considered here rational expectations is a necessary but not sufficient condition for complete insulation. The problem will be made more difficult if the non-traded goods price does not adjust rapidly to clear this market.

In terms of the direct effects through the price index, foreign price shocks are potentially inflationary if a weighted sum of foreign currency price movements is positive. To see this rearrange the expression (12) in the form:

$$d\psi = de + \alpha ds + (1 - \alpha)dq, \quad \alpha = a_X + a_N\delta_X \tag{25}$$

For simplicity, take the case where monetary expansion in excess of that needed to compensate for terms of trade changes is zero. There will be inflationary or (deflationary) pressure on the price index from traded goods prices as:

$$\alpha ds + (1 - \alpha)dq > (<) 0 \tag{26}$$

27. The asset side of the model is a portfolio balance system. The nominal exchange rate appreciates to adjust the domestic currency value of foreign currency bonds to the increased supply caused by the current account surplus.

28. See Floyd (1978) and Van Duyne (1980) for examples of this.

If the insulation property does not operate fully:

$$-de < \alpha ds + (1 - \alpha)dq \quad \text{for} \quad \alpha ds + (1 - \alpha)dq > 0, \quad \text{and}$$

$$de < -\alpha ds - (1 - \alpha)dq \quad \text{for} \quad \alpha ds + (1 - \alpha)dq < 0 \tag{27}$$

Given all the above assumptions (25) can be written as:

$$\begin{aligned} d\psi &= \alpha(ds+de)+(1-\alpha)(dq+de)=dq+de+\alpha(ds-dq) \\ &= ds+de-(1-\alpha)(ds-dq) \end{aligned} \tag{28}$$

where *de* is an exchange rate response that does not give complete insulation. Consider two cases of the several that can be constructed of exogenous price shifts. If a fall in the terms of trade involves falling export prices and constant import prices (in foreign currency terms), that is, $ds < 0$, $dq = 0$ and insulation is incomplete, there will be a *deflationary* effect on the price index. Notice that this is separate from the deflationary effect of the fall in the terms of trade on real income and hence aggregate demand. Symmetrically, a terms of trade improvement of the form $ds > 0$ and $dq = 0$ will be inflationary.

It is sometimes argued that exportables will feature only to a minor extent in the Australian consumer price index. Moreover, it is suggested that in this case, the terms of trade decline will be inflationary because the depreciation induced by the terms of trade decline will raise the index because it will raise the import component. To investigate this, take the extreme case in which $\alpha = 0$, though this implies also that substitutability between non-traded goods and importables is zero. Equation (25) then becomes:

$$d\psi = de + dq \tag{29}$$

With no change in the import price index there will be no depreciation. The terms of trade fall does not affect the nominal price index and this is reasonable because $\alpha = 0$ ensures that exportables do not figure in domestic consumption and are not close substitutes for domestic goods. For the same reasons the real exchange rate defined in this case as the reciprocal of the relative price of home goods to imports is not affected. The terms of trade decline will still reduce real income because income from exports is reduced, but absolute and relative prices are unaffected and the insulation mechanism is not called into operation. If α is small, these results will imply that nominal depreciation and absolute and relative price effects will be small, and with incomplete insulation the effect is still a price fall.

To complete the catalogue of simple cases, note that a terms of trade decline produced solely by a rise in foreign currency import prices will be inflationary when insulation is partial, despite the appreciation of the exchange rate. In the same circumstances, an improvement in the terms of trade caused by a fall in import prices will be deflationary as the exchange rate will not depreciate sufficiently to offset the effects of the import price falls.

What are the options for policy when insulation is incomplete? Because the exchange rate is market determined, the extreme results of the fixed rate case do not hold. Nevertheless, failure of insulation means that foreign nominal price changes will cause real disequilibrium, which, while transitory, may persist for a significant period. There are no simple policy choices. Monetary restraint could be used to produce an appreciation which offsets the effect of the rise in the domestic currency value of traded goods prices. However, in the sort of world where insulation is incomplete, this raises domestic interest rates and reduces real expenditure on both traded and non-traded goods. This effect would have to be offset by some form of expansionary policy to have a chance of leaving the real economy largely unaffected by the process.[29] Monetary restraint is not enough by itself. The other pole involves importing inflation to the extent that insulation fails and using an expansionary monetary policy to avoid the development of excess supply in the non-traded goods market.

5.3 Targeting the Exchange Rate to Inflation

Other things being equal, a depreciating exchange rate will put upward pressure on the prices of traded goods used domestically and on the general price index, while an appreciating rate will produce downward pressure. Therefore, it is tempting for governments seeking low inflation to use monetary policy to resist depreciation and, indeed, to encourage appreciation in the interest of an inflation target. Enough has been said above to suggest that, in a floating rate system, exchange rate depreciation has purposes that only sometimes reflect inflationary pressures. If one considers the factors that can cause depreciation it can be seen that offsetting monetary policy may well give rise to undesirable consequences and may not be the best way to manage inflation. Some of the major factors likely to cause depreciation are:

- the insulating exchange rate response to foreign currency trade price falls;
- exogenous reductions in the demand for exports or increases in the demand for imports;
- a financial capital outflow in response to higher world interest rates;
- a process of adjustment toward a lower current account deficit;
- exogenous increases in private saving or falls in investment;

29. An example of this is given in Pitchford (1985). Knowledge of the structure of the economy and of the reasons for the failure of insulation would need to be considerable.

- reduced government expenditure or increased taxes; and
- domestic monetary expansion.[30]

Consider just a few of these to illustrate what might happen as a result of a blanket resistance to devaluation. When foreign currency traded goods prices fall, if insulation works, the exchange rate response will moderate the degree of price fall for the traded goods sector. If the terms of trade also fall, depreciation reduces the impact of the consequent decline in real income on demand. Targeting the exchange rate when it wants to depreciate, in these circumstances, deprives the economy of this cushioning influence of floating rates. It is most unlikely that this source of depreciation can readily be sorted out from other sources. Reliable information on export and import price movements is available with a lag of over two months and perhaps twice that time might be needed to guess at the direction of any trend.

On the other hand, if depreciation is due to a rise in saving, there will be pressure on the real exchange rate to devalue and on output to fall. Suppose the economy is in an expansionary phase of the trade cycle so that this reduction in real demand need not be an adverse occurrence. Depreciation of the real exchange rate can take place through a depreciation of the nominal exchange rate and/or a fall in home goods prices. Holding the nominal exchange rate fixed would imply that home goods prices should fall. Monetary policy would be required to turn the boom into a recession.

For an economy pursuing an inflation target, there are two cases in which a decision to resist depreciation may be valid. One is where the source of depreciation is a domestic monetary expansion and the other is where insulation fails. In the monetary policy case, it is the monetary expansion which is the cause of the problem and the depreciation is incidental. The inflation target might have been raised or the monetary stance might have been aimed at generating recovery from a recession. Perhaps the monetary expansion was a mistake. In any case, it is monetary conditions which should be examined and changed if necessary. Without detailed knowledge of the source of any shocks and the structure of the economy, the only way to avoid confusing these issues is to target inflation directly. Targeting it through the nominal exchange rate may then deprive the economy of the insulating effects of depreciation and may well complicate or prevent other adjustment processes.

So if the exchange rate floats and insulation works, there is no need, in principle, to achieve desired inflation outcomes through the exchange rate. Domestic

30. The elements of the list are not necessarily comprehensive or mutually exclusive.

monetary conditions and price movements would be the variables to watch and respond to. Exchange rates may be thought to have a role in this process in that, unlike prices which can only be observed with a lag, they are immediately observable. However, as the above discussion makes clear, inflationary conditions are only one of the many factors which may be moving them. Further, like prices, these other factors are also usually observable only with a lag. There would seem to be considerable room for error in this procedure.

On the other hand, if price insulation does not work, foreign price movements, and the exchange rate would need to be monitored. Consider the case of a terms of trade deterioration due to a fall in foreign currency export prices, where foreign currency import prices remain the same. As shown in Section 5.2 incomplete insulation results in *downward* pressure on the domestic price index. Depreciation in this case is not inflationary. For this to occur the insulation response would have to work to an excessive degree! By contrast, a terms of trade improvement coming solely from export prices may appreciate the exchange rate somewhat, but still implies additional inflation. Thus, it would then be even harder than if insulation worked fully to know how to interpret the inflationary significance of exchange rate movements. As noted in the previous section, policy would either have to accommodate this or to attempt to induce further appreciation while offsetting any contractionary effect from this policy on aggregate demand.

The recent New Zealand experience is of considerable interest because it embodies a particular method of using the exchange rate to reach an inflation target. The Reserve Bank of New Zealand (RBNZ) has been empowered to concentrate almost exclusively on achieving an inflation outcome in the chosen range of 0 to 2 per cent. It has elected to reach this goal by using monetary policy to affect the nominal exchange rate. The mechanism is described in Grimes and Wong (1992). Omitting some of the details, the equilibrium level of the CPI is supposed to be given by:

$$CPI_t^e = g(TWI_t, P^*_{X_t}, P^*_{M_t}, R_t, W_t) \tag{30}$$

where R is labour productivity, * refers to measurement in foreign currency and other symbols have obvious meanings or have been defined previously. Deviations in the right-hand side variables will give rise to deviations in the CPI from equilibrium. Specifically:

$$\Delta CPI_t = g(\Delta TWI_t, \Delta P^*_{X_t}, \Delta P^*_{M_t}, \Delta R_t, \Delta W_t, CPI_{t-1} - CPI^e_{t-1}) \tag{31}$$

Here CPI^e is the equilibrium value of the CPI. Forecasts of the right-hand side variables generate forecasts of the inflation rate. Notice that terms of trade movements are implicitly incorporated in (31). The implementation of the inflation policy is, in the authors' words, such that:

> Given these forecasts, a range for the exchange rate can be derived that is consistent with the maintenance of 0-2% inflation ... Monetary policy is generally implemented with the desire to keep the exchange rate consistent with the conditional range [Grimes and Wong 1992, p. 5].

The first thing that should be noticed about this approach is that it implies a belief that insulation does not work, for if insulation works the procedure is not necessary. To see this, notice that in the context of the model of Section 4, it is possible to formulate an equation based on floating rates with an almost identical form to (31), that is:

$$d\psi = (a_X + a_M)de + a_X ds + a_M dq + a_N dp \tag{32}$$

In (32) the *dp* term (change in non-traded goods prices) replaces the wage and productivity variables of (31). Ignoring the possible relationship between the exchange rate and foreign currency trade prices, it might be possible to find plausible values of the coefficients of (32). However, this overlooks the relationship between exchange rates and foreign trade price movements. Suppose there is a rise in the foreign currency price of exports. If insulation were to operate, the appropriate price index equation would not be (32) but:

$$d\psi = -\beta(ds - dq) + dm = dm^* \tag{33}$$

where dm^* is the change in the money supply excluding monetary accommodation to terms of trade shocks. If insulation did work, monetary policy designed to appreciate the exchange rate ($dm < 0$) would then be in addition to the automatic appreciation response and would add an unnecessary degree of deflation to the system. Add a term $d\varepsilon$ to (33) to account for all the other factors held constant by the theory, so that:

$$d\psi = dm^* + d\varepsilon \tag{34}$$

Monetary policy would then involve operating to offset these other shocks. This process would not need to take exchange rates or foreign currency prices into account. The terms of trade would enter through its real income and hence demand effects and is one of the sources of disturbance in $d\varepsilon$. This appears quite different to the New Zealand approach.

Hence it may be that their system is based on the belief that insulation is incomplete in which case (25) applies and is also analogous to (31). Writing this with a disturbance term it is:

$$d\psi = de + \alpha ds + (1 - \alpha)dq + d\varepsilon \tag{35}$$

where the exchange rate change is insufficient for insulation. Given the inflation target, one function of monetary policy would then be to ensure a sufficient exchange rate response to provide offsetting appreciation when foreign currency prices rise.[31] There would also need to be a way of counteracting the effects of this monetary restraint on interest rates and aggregate demand. The RBNZ has no mandate to do this and, in any case, may not have the instruments.

Compensating for an incomplete insulation response would probably be only a minor part of the anti-inflationary operations of the Bank. The main task would be likely to be offsetting the impact on the index of the many disturbances which are lumped into $d\varepsilon$. To do this, monetary policy would be used to achieve the appropriate change in e and so achieve an inflation target. But there may well be more to the process. Using (36), monetary constraint should affect both the exchange rate and the price of home goods, the former effect reducing the rise in traded goods prices and the latter the rise in non-traded goods prices. Formally, for $dq = ds = 0$:

$$d\psi = (a_X + a_M)de + a_N dp = dm^* \quad \text{as} \quad de = dp = dm^* \tag{36}$$

However, if non-traded goods prices adjust with a lag, exchange rate appreciation and monetary restraint will need to be greater than that shown in (36) to achieve the required inflation target. This has the potential to cause a decline in aggregate demand and output. As noted, this is not a responsibility of the RBNZ.

To illustrate this, suppose there is a rise in private saving which is not observed by the authorities. This is not entirely unrealistic because saving is notoriously difficult to measure and there is a substantial lag in the availability of the national income data on which it is based. This shift will depreciate the real exchange rate so there also may well be pressure on the nominal exchange rate to depreciate. A monetary response to prevent this from affecting traded goods prices would add to the contractionary effect of the fall in aggregate demand which the increased saving implies.

The philosophy of the New Zealand approach suggests that the Bank's response would be that these real consequences will be taken care of by flexibility in the system. Such a view is consistent with the adoption of an almost exclusive inflation target in the first place. If this is so, it is somewhat surprising that at certain points, their method of inflation control appears to involve a lack of faith in price flexibility and market clearing. Thus, if the system was fully flexible, insulation could be expected to be complete. The relevant formula would not be (31), but (34), the latter excluding exchange rate targeting and foreign currency price effects. If, as suggested above, that lack of flexibility of domestic goods prices is

31. When foreign currency traded goods prices fall it would be necessary to produce the additional depreciation to provide complete insulation. The possibility exists that (partially) insulating depreciation could be mistaken for an inflationary effect and resisted by monetary constraint.

a reason for targeting the exchange rate, this also implies reservations about how well the real economy would cope with the consequences of anti-inflationary monetary policy.

It is likely that the very narrowness of the target band for inflation forces the RBNZ to manipulate the exchange rate to achieve outcomes in the band. If a variety of sometimes large real and monetary shocks impinge on the system, large changes in the exchange rate can be engineered to achieve the target, while the alternative of setting interest rates or monetary magnitudes with a direct inflation outcome in mind is less likely to achieve a tightly specified inflation outcome. The potential costs in such an exchange rate targeting approach is that real magnitudes may have to vary in the course of achieving the nominal target, unless there is considerable flexibility in the system. This is illustrated in a recent episode. In the second half of 1992, the New Zealand 90-day bill rate averaged 6.25 per cent. Through November and December, the TWI fell towards 53, a level that the markets inferred was the Bank's 'lower limit', in the existing circumstances, for achieving the targeted inflation zone. However, in order to offset the tendency for the TWI to depreciate below 53 it was found necessary to cause the 90-day bill rate to rise to almost 8 per cent and then to 9.5 per cent. Subsequently, the bill rate fell to the 7.5 to 7.25 per cent range. Under its present Act, the level of economic activity is not a primary concern of the RBNZ. Nevertheless, this increase in the real rate could hardly be regarded as desirable for an economy in the early stage of recovery from a long recession. The necessity to hold interest rates, for some time, at higher than previous levels to preserve a given nominal exchange rate, suggests that some form of change in the fundamental determinants of exchange rates occurred. It is this type of pressure, difficult to forecast or even appraise except with hindsight, which has frequently forced devaluation in pegged rate systems.

To summarise, exchange rate targeting to achieve particular outcomes would not seem necessary if insulation is complete. If it is not, targeting the exchange rate appears to provide a practical approach to achieving inflation targets. However, it involves the danger that depreciation may sometimes be resisted when it is a necessary adjustment for the economy. Also, it may well require real variables to alter so as to reach the inflation target. Of course, it shares this feature with other approaches to achieving tightly specified inflation targets, such as (34). But it involves the additional difficulty that inflationary and non-inflationary exchange rate depreciation have to be distinguished if policy responses are to avoid introducing further undesirable real effects. Fortunately Australia's experience with floating rates to date appears to suggest that foreign price insulation works.

5.4 The Form of the Target

The final question has to do with the form of the inflation or other target in an open economy with a floating rate subject to terms of trade shocks. Here it will be assumed that insulation works. Firstly, using the model of Section 4, the relationship between the inflation rate measured by changes in the index ψ, foreign currency price movements, the non-traded goods inflation rate and the terms of trade movements is given by:

$$\dot{\psi} = (a_X\delta_M - a_M\delta_X)(\dot{s} - \dot{q}) + \dot{p} \tag{37}$$

where δ_M, δ_X are the price elasticities of excess demand for imports and exports respectively, they sum to unity and are positive if goods are gross substitutes. Note that the coefficient in the first set of brackets in (37) is indeterminate in sign. To see the reason for this, suppose there is a rise in the foreign currency price of exports. The exchange rate will produce an insulating appreciation, partly offsetting the rise in export prices, so that in domestic currency terms, these prices still rise. As foreign currency import prices have not changed, the domestic currency prices of importables will fall. Hence, for a given $\dot{p}$, the price index may change in either direction. The usual way of specifying the target is in terms of the price index of consumption, in which case it might take the form $\dot{\psi} = 0$. It follows from (37) that the price of non-traded goods must then move whenever there are changes in the terms of trade to offset that part of foreign currency price changes against which it is impossible for a floating rate system to insulate. To get a feeling for the magnitude of these effects suppose there is a 10 per cent fall in the terms of trade and that each of the elasticities are equal to 0.5. If for example, $a_X - a_M = -0.2$, then to keep the index constant, non-traded goods prices would need to fall by 1 per cent. While these numbers might seem small, every so often, fluctuations in the terms of trade are quite large. For instance, the annual rate of change of the terms of trade to the March quarter 1973 was 26 per cent and to March 1989 was 16.3 per cent. Offsetting the effects of terms of trade movements would require periodic disequilibrium in the non-traded goods sector to affect the appropriate price adjustments.

The alternative is to regard the inflation rate of non-traded goods prices as the target. There would then be fluctuations in the consumption goods inflation rate produced by the terms of trade and these would have their source in exchange rate movements. It would be necessary then for monetary policy to accommodate terms of trade fluctuations to the extent required to prevent the price of non-traded goods from changing. This would have the advantage that it would be consistent with maintaining real equilibrium in that market. Particularly when inflationary expectations are low, a real target of this form which included the inflation target, might seem preferable to following a policy which required periodic disequilibrium.[32] On the other hand, there would then be periodic shifts in the general price index. The non-traded goods price will not be straightforward to identify in practice so that the price target might have to be the price index. In that case, the potential for disequilibrating effects in the non-traded goods market needs to be recognised.

Finally, the main merit in an approach which seeks to establish and maintain equilibrium in the non-traded goods market is that it has value for both the case where insulation works and where it is likely to be partial. As can be seen from Sections 4 and 5, equilibrium in this market means that relative prices involving non-traded goods are relatively stable and this is an important condition for insulation. However, if insulation is incomplete, the choice is between attempting to achieve low inflation or importing foreign price shocks and establishing real equilibrium. A policy which aims at equilibrium in the non-traded goods market can encompass reasonable outcomes both for the case in which insulation works and in which it does not.

6. Macroeconomic Policy and the Float

Three major macroeconomic policy issues pertaining to the exchange rate since the float, and not treated elsewhere, are the subject of this section. They are:

- policy with respect to the substantial depreciations of 1985 and 1986;
- the current account and the exchange rate; and
- the policy of sterilised intervention in the foreign exchange markets.

Before considering these issues in detail it is useful to examine the settings of fiscal and monetary instruments in the 1980s. Table 1 records data for the federal budget balance, corrected for inflation, and the average real 90-day bill rate.[33] An estimate of the stance of fiscal and monetary policy is made from these data for each period.

With the economy in recession in 1982/83, the early years in the table show both instruments at expansionary settings. With the recovery, this changed towards a contractionary stance of monetary policy. However, both because of the 1986/87 slowdown and the October 1987 stock market crash, the monetary stance was eased in 1987/88. The tighter fiscal stance in the latter part of the decade was directed at reducing the current account deficit. Monetary policy was tightened

32. Domestic goods market equilibrium would presumably help the maintenance of low inflation expectations because of the absence of excess demand in the labour and product markets.

33. The inflation corrected budget deficit estimates come from Makin (1990).

substantially in 1988/89 and 1989/90. Accompanying these policies for much of the 1980s, wages policy was aimed at limiting rises in real wages and, as discussed later, at facilitating the effects of depreciation.

Fiscal expansion is likely to appreciate the nominal and real exchange rates, and monetary expansion is likely to depreciate it. The effect of both together on exchange rates is then ambiguous in general. However, fiscal contraction and monetary expansion are both thought to work towards producing real depreciation. This policy mix could, in theory, be used to effect a real depreciation in an attempt to reduce a current account deficit and, if the combination were right, the level of output could remain unchanged.[34] Krugman (1991) points out that this approach was suggested by Johnson (1958) as a way of engineering a real depreciation. Table 1 shows that the only time it was tried in Australia was (inadvertently) in 1987/88. Whether the 'policy' worked is discussed in Section 6.2.

Table 1: Fiscal and Monetary Settings

	Real Fiscal Balance (% of GDP)	Fiscal Stance	Real Interest (% p.a.)	Monetary Stance	Investment Growth (% p.a.)	Trade Balance (% of GDP)
1982/83	-1.8	+	3.2	+	-11.1	-2.0
1983/84	-3.1	+	4.5	+	2.8	-1.4
1984/85	-2.5	+	7.4	-	9.2	-2.0
1985/86	-1.2	.	8.5	-	4.1	-3.2
1986/87	1.2	-	7.1	.	-1.4	-1.7
1987/88	3.2	-	4.6	+	5.5	-0.6
1988/89	3.2	-	8.7	-	11.7	-2.0
1989/90	3.9	-	10.4	-	-0.7	-2.0
1990/91			7.0	.	-9.4	-0.1
1991/92			6.0	+	-8.1	0.3

Of course, the real exchange rate will come under a variety of influences apart from policy changes. For instance, rises in investment are usually associated with cyclical upswings and falls with downswings. The growth rate of total (public and private) real investment is shown in the second last column of Table 1. Substantial falls in investment in the recession of 1982-83 were followed by rapid growth. The

34. This assumes wage adjustment that allows output effects from monetary policy, which seems valid for this period, given the operation of the Accord.

1986 recession is evident from the fall in investment at that time and again this was followed by rapid growth. It does not seem reasonable to ascribe all these changes to macroeconomic policies. Increased investment, unrelated to the stance of monetary policy, could be expected to increase real output and appreciate the real exchange rate.

6.1 Depreciation in 1985-86

While there can be many causes of nominal and real exchange rate depreciation, it is fair to say that the topic is often examined as if it can be analysed independently of its causes and of the other economic circumstances of the time. Between December 1984 and December 1986 the TWI fell by about one-third. Figure 10 shows a significant real depreciation for some, but not all, measures of the real exchange rate. A variety of interpretations were placed on this substantial nominal depreciation. One was that markets were testing the 'viability' of the fairly recent decision to float and another was that the desired depreciation would adjust the current account deficit to a lower level. The 1986 RBA *Annual Report* stated, with appropriate qualifications about timing, J curve effects and the need for other policies to reduce expenditure, that:

> The exchange rate depreciation during 1985 seemed large enough to promise a major diversion of spending from imports to domestically-produced goods; it was also expected to stimulate exports [p. 6].

It was argued in Section 4 that the nominal depreciation appeared to be a response to the falling foreign currency export and import prices and the terms of trade deterioration of the period. In that case, real depreciation would be limited and the effect on the trade balance would be minimal.[35] Recalling the formula for these real exchange rate changes ((19) and (20)), the real export-based exchange rate should *appreciate* and that for imports should *depreciate* when foreign currency trade prices fall with export prices falling more than import prices. Figure 10 shows that the export-based index hardly depreciated at all, while the import-based index showed more substantial and sustained depreciation. This suggests that there may well have been both a real depreciation and an insulation response in the exchange rate adjustment. The expectation that the depreciation would assist the trade balance may not have been entirely misplaced.

The trade deficit (goods and services balance) did fall through 1986-87 (Figure 12 and Table 1). Although this probably had much to do with the slowdown of investment and output induced by the high real interest rates of the

35. In the context of trade balance adjustment, using the models of Section 4, 'real depreciation' means a change in relative prices which would reduce the trade balance. It can be shown that a linear combination of the export and import-based real exchange rates must depreciate for the trade surplus to rise.

time (Figure 7), it is possible that some portion of the nominal depreciation could have been part of a process of current account adjustment. However, just as it was shown in Section 5.3 to be incorrect to assume that any depreciation is inflationary, it is also inappropriate to suppose that all nominal depreciations have the potential to raise net exports. For that reason, the widespread expectation that the 1985-86 devaluations would do this should have been backed up by analysis both to determine its causes and to ascertain if these causes were compatible with a reduction in the current account deficit.

The other interesting feature of the episode was the wages policy that accompanied the devaluation. The authorities argued at the time that the price effects of the devaluation should not be allowed to flow through to money wages and this principle was accepted and put into practice by the wage-fixing authorities. Why might such a policy have been advocated? As has just been noted, it is not possible to discuss this issue adequately without making some proposition about the cause of depreciation. While investment grew strongly in the calendar year 1985 it fell in 1986 so that one cause of the depreciation in 1986 may have been the fall in investment. Assume that this was the case and also make the most extreme assumption that wages were fully indexed. Using the model of Section 2 and the further assumption of fully indexed wages, the effect of a fall in investment is shown in the Appendix, Part B, to be a depreciation of the real exchange rate and a fall in output, so that the trade deficit falls. In a system with at least two goods, fixing the real wage in terms of a price index does not fix real wages costs in terms of the home good. Variations in the relative price of the home good allow variations in real wages costs and hence output and the trade balance. However, an argument for less than full indexation could be made on the grounds that it would help offset the fall in real output induced by the fall in investment.

Further, by itself, a reduction in real wages is shown in the Appendix to depreciate the real exchange rate and increase output, but nevertheless reduce the trade deficit. Given the persistently high rate of unemployment in the 1980s, it follows that the attempt to induce a fall in real wages could be justified independently of any trade balance effects, but it must also be observed that real wage restraint must have helped to increase the intensity of the subsequent boom of the 1980s. The proposition that knowledge of the causes of depreciation is needed before any conclusions can be drawn about its effects or the need for policy is again confirmed. Finally, although wage restraint is one method of reducing a trade deficit, it is surely preferable to relate wages policy to conditions in the labour market.[36]

36. While it is not appropriate to discuss this here, it would be inappropriate to overlook the need for greater flexibility in Australia's labour markets.

None of this denies the proposition that exchange rate flexibility can help to counter real wage inflexibility. However, it is not just real *wage* flexibility that floating rates can compensate for in a world of nominal contracts and sunk costs.

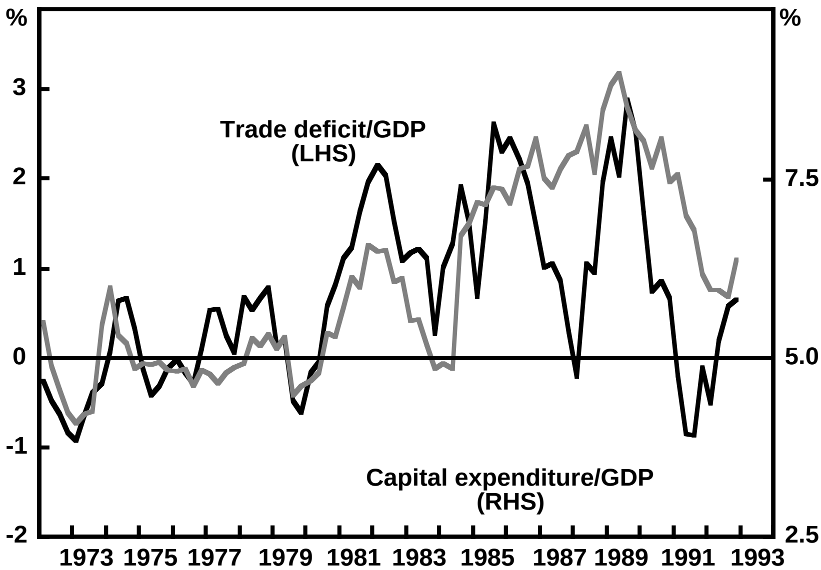
Another aspect of wages policy is the question of the relationship between real wages and the terms of trade. It is customary to claim that a terms of trade fall should result in a fall in real wages. The prices of exportable goods fall and prices of importable goods rise relative to an average of other prices. Aggregate real income must fall, so a presumption is often made that as wages are a large share of GDP, the real wage will fall. However, such a presumption may be unfounded. Equilibrium real wage movements will depend on the factor intensities in the various sectors and cases can be constructed where wages would rise. Suppose exportables are heavy users of resources, but use little labour and the import competing sector is labour intensive. The exportables sector will release only small quantities of labour, while the importables sector must bid labour from the non-traded goods sector. In these circumstances, the outcome could be only a small real wage fall, or even a rise. Further, if real wages fall with a deterioration in the terms of trade they should rise with an improvement. If it is to be based on the underlying fundamentals of the labour market, wages policy should be implemented for both rises and falls in the terms of trade.

The lesson for policy is that there are many reasons for nominal depreciation in a floating exchange rate system. Unless the cause is known, it cannot be inferred that nominal currency depreciation will inevitably lead to real depreciation, nor can the real and nominal effects of the depreciation or the need for ancillary wage policy be properly understood. So far, this discussion has largely disregarded the effect of the depreciation on the current account deficit. This is the topic of the next section.

6.2 The Exchange Rate and the Current Account

Australia's current account deficit averaged 4.5 per cent of GDP in the 1980s. Because this ratio had traditionally been of the order of 2 to 3 per cent, the increase which started at the end of the 1970s stimulated interest both in the causes of this change and in the possibility of either its automatic or policy-induced reversal. Indeed, these questions became a major policy preoccupation of the 1980s. It is by no means clear that it was in the best interests of the economy for the deficit to be reduced. Nevertheless, because of the policy interest in this eventuality at the time, it is worth documenting the exchange rate aspects of policies which were followed. It is preferable to concentrate on movements in the trade balance (goods and services balance, Figure 12, Table 1) as the net income item in the current account is to a large extent historically determined and need not respond in any simple way to changes in exchange rates. The discussion here will

Figure 12: Goods and Services Deficit and New Capital Expenditure
(per cent of GDP)



focus on an attempt to understand the role of the real exchange rate in any process associated with movements in either the trade deficit or policy in relation to it.

The proximate causes of the trade deficit are real exchange rates, domestic and foreign income and, at one remove on the other side of the income-expenditure identity, the determinants of investment, saving and the fiscal deficit. One salient aspect of the behaviour of the Australian trade balance is that it appears to track the fluctuations in GDP, though with a lag. The recessions of 1982-83, 1986 and 1990-92 all have their counterparts in low or negative values of the trade deficit. In turn, the GDP fluctuations are similarly related to investment, interest rates and foreign real activity. The other interesting feature of the performance of the trade balance is its increase at the start of the 1980s and its recent move to lower levels.

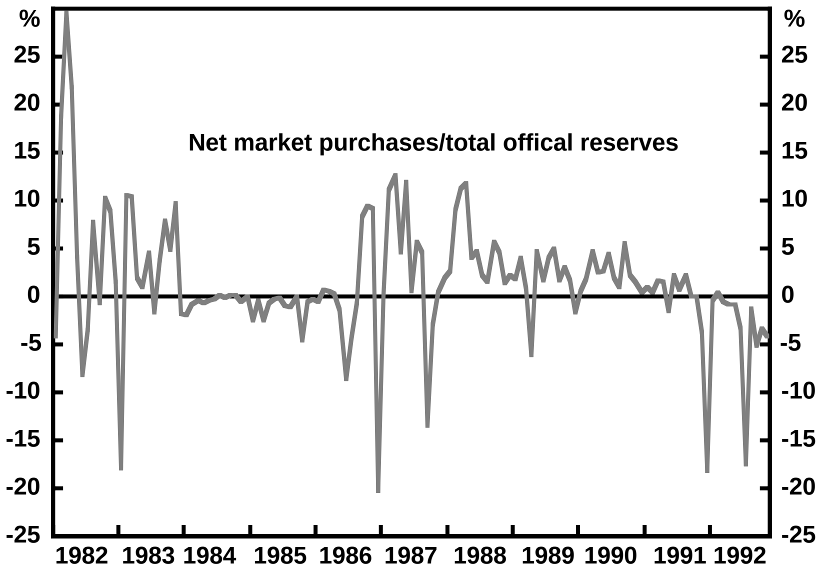
As suggested above, it would seem that fluctuations in investment have had much to do with movements in the trade balance. Investment is notoriously more volatile over the economic cycle than other elements of GDP. Figure 12 illustrates total new capital expenditure and the goods and services deficit, both as a percentage of GDP. There is a reasonably close relationship between the two series until late 1986 when the goods and services deficit fell sharply and the new capital expenditure ratio continued to increase. The divergence of the two series from this time can be explained by the reduction in the fiscal deficit which was then occurring. It is interesting that the upward shift of the trade deficit at the start of the 1980s coincides with the investment boom of that time. These data suggest that much of the movement in the trade balance and also the current account has been due to changes in investment. They also support the proposition that the reduction in the fiscal deficit in the second half of the 1980s initially contributed to a fall in the trade deficit, but that this effect was offset in 1988-89 by a further surge in investment.

Various macroeconomic policies in the 1980s were directed at reducing the current account deficit and the trade deficit. In particular, the high interest rates of 1985-86 and 1988-89, in part, were designed for this purpose as was the move to fiscal surpluses in 1986/87. There has been some discussion over whether tighter monetary policy, because it tends to appreciate nominal and real exchange rates, would have the effect of reducing the trade deficit. The outcome would seem ambiguous, because while appreciation increases the deficit, real income is adversely affected, thereby reducing the deficit. Some have argued that the appreciation effect will dominate, so that the deficit should rise. However, in practice, the trade deficit has *fallen* after periods of tight monetary policy, the fall in activity appearing to be the main factor involved. Tighter fiscal policy should depreciate the real exchange rate and reduce the trade deficit. It would appear from the data behind Figure 12 and Table 1 that this effect was masked by the rise in investment in the 1988-90 period.

Krugman (1991) has recently argued that the United States' current account deficit in the 1980s responded with a lag to real exchange rate movements, increasing when the rate appreciated in the first part of the 1980s and later falling after it had depreciated. The combination of tighter fiscal and easier monetary policies which, in theory, is one way of bringing this about was used in Australia in 1987, but was followed by a *rising* trade deficit. The usual explanation for this is that the rise in investment in these years offset any effects of the move to fiscal surplus. In Australia's case, there does not appear to be any simple discernible relationship between trade deficits and real exchange rates. This is highlighted by the fact that the trade deficit fell in the latter part of the 1980s while measures of the real exchange rate either appreciated or were steady. Indeed, given the multiple causes of trade deficits, the connection between trade balances and real exchange rates need not be strong. Manufactured exports grew very strongly in the latter half of the 1980s and it is quite possible that this could have resulted in a falling trade deficit accompanied by an appreciating real exchange rate.

Recently, the trade deficit has been significantly lower than for most of the 1980s. However, it is difficult to say whether this is part of an adjustment to a lower level or the consequence of the severity of the 1990-92 recession. Indeed, the search for an automatic or policy-produced adjustment process in Australia's case is often based on the notion that current account deficits are intrinsically

Figure 13: Net Market Purchases/Official Reserve Assets



undesirable.[37] The alternative view is that private sector borrowing or lending abroad in a world of mobile financial capital is part of a beneficial process of real capital accumulation which is not confined by national boundaries. As such, the timing of any adjustment process depends on the forces underlying the supply and demand for capital and is unlikely to be easily predicted.

6.3 Exchange Market Intervention

It was demonstrated earlier that the overall policy of the RBA with respect to reserves could be rationalised as one of retaining the option to revert to a pegged or heavily managed exchange rate system if desired. This seems to be confirmed by the fact that the ratio of official reserve assets to GDP has been held reasonably steady since the float (Figure 9). However, the RBA has an active policy of sterilised intervention in the foreign exchange market and this is of interest not only because it might imply that the exchange rate has not floated reasonably freely, but also because the motives for and effects of intervention are part of exchange rate policy. It would appear that for the most part the intention is to smooth market fluctuations, in which case the essentials of floating may be preserved. However, it must be asked why smoothing is necessary, how successful it has been and whether there are other motives for intervention.

37. Of course, distortions and externalities need to be corrected for current account deficits, or any other aspect of a growth process to be ideal.

The RBA reports monthly net market purchases of official reserve assets and Figure 13 shows the volume of these expressed as a percentage of total official reserve assets. Intervention was relatively minor in the two years following the float. However, with the dollar depreciation in 1985-1986, there were several months of extraordinary levels of sales. Indeed, intervention to support the $A shows up as a relatively small number of large isolated purchases. On the other side, sales of Australian dollars can be seen to involve much smaller amounts in any one month and relatively steady levels compared with purchases. Sales in the second half of the 1980s are greater than purchases, which is consistent with the accumulation of reserves to sustain a steady ratio to GDP. The picture then, is of asymmetrical intervention such that, at certain times, action to offset potential depreciation was regarded as critical. Appreciation, on the other hand was given a different treatment or accorded a different priority.

The size of official reserves appears such that unless elasticities of supply and demand for foreign currency are particularly high, a sufficient stock is available to influence $A exchange rates significantly in any short period, though the stock would not appear adequate for any sustained intervention.[38] However, the Bank's policy is to sterilise the effects of intervention on the money supply. Such action will entirely offset any impact on the market if domestic and foreign bonds are perfect substitutes. Sterilised intervention will have an effect on the price of foreign exchange only to the extent that foreign and domestic bonds are imperfect substitutes. Despite this, it is still possible for sterilised intervention to affect the exchange rate through mechanisms other than its impact on foreign currency demand and supply. Firstly, the market may take intervention to signal that unless the exchange rate moves in the direction the Bank desires, there may be a change in monetary policy to enforce the desired move. If the object of the Bank is to smooth fluctuations, it might be that by the time the threat is to be made credible, the market has moved of its own accord in the direction required. Hence, there may well be a tendency for rates to move initially in the direction implied by the intervention. This effect would suffer from a lack of credibility in cases in which rates consistently moved in the 'wrong' direction following intervention and no monetary substantiation was forthcoming.

Secondly, the Bank may possess superior information to that of the market. In that case depending on the nature of the information, sterilised intervention might have a short-run or even a long-run effect on nominal exchange rates by signalling to the market the direction of effect which the exclusive information might have

38. Thus in 1992, the average level of reserves was about 1.25 times the average daily turnover in the foreign exchange market against the $A. The *Bulletin* for May 1993 states that: 'In April 1992, trading in Australia accounted for only 45 per cent of the total turnover in Australian dollars (p. 5)'.

on exchange rates. The intervention which took place in January 1992, one of the biggest purchases of $A since the float, is of interest in relation to this.

> The market, however, became very unsettled early in 1992 in the lead-up to the Government's Economic Statement. This period was peppered with rumours of an impending fiscal expansion and perceptions of the Government favouring a lower exchange rate.
>
> The Bank believed the market was reacting over this period to fears about future policy directions that were not well based. It was also concerned that unwarranted falls in the exchange rate would limit the scope to lower interest rates in support of the recovery. In trade weighted terms, the dollar had already fallen 8 per cent from its September peak and, while that could be absorbed, any further sharp falls would weaken confidence and threaten a resurgence of upward pressure on prices.
>
> To help steady the market the Bank became a heavy buyer of Australian dollars throughout January; for the month as a whole purchases amounted to $4.3 billion. This intervention was successful in calming the market. After the Economic Statement was released at the end of February, the exchange rate recovered its December quarter levels [Reserve Bank of Australia 1992, p. 21].

In this period, the Bank was presumably using its superior knowledge of what would be in the Economic Statement to prevent *unfounded* rumours affecting the Australian dollar's value. Apart from any effect on the value of the currency in the short run, their operations could be interpreted as sending a signal that the market's fears about the forthcoming Economic Statement were unwarranted.[39] Where the bank has superior information it would seem better to use it directly to prevent the market moving in the 'wrong' direction. With politically sensitive information, this may well be impossible.

The view of many economists has been that sterilised intervention has had little or no effect on exchange rates.[40] In a study that does not distinguish between sterilised and non-sterilised intervention, Dominguez and Frankel (1990) differentiate between the portfolio and the signalling channels of effect on exchange rates. The former is the traditional market mechanism and the latter an expectations effect whereby the intervention of the central bank signals inside information about future monetary policy.[41] In a study of the $A/DM rate they find evidence in favour of both effects, but for the response to be large, the intervention needs to have been made public. 'Secret' intervention appears to have had a small and, in some periods insignificant impact on the exchange rate studied.

39. Two other interesting aspects of this quote are worth noting in passing. Firstly, the belief that (future) fiscal expansion will *depreciate* the exchange rate (see Section 6.3) and secondly, the suggestion that exchange rate policy should be used for anti-inflationary purposes.

40. See the studies reported in Rogoff (1990).

41. In the case cited earlier, it was fiscal policy that was signalled.

It has sometimes been suggested that sterilised intervention can have an influence on the *equilibrium* levels of exchange rates. One case in which something of this sort might be achieved is that of ‘speculative bubbles’. Bubbles are unstable paths of market variables whose individual steps might be rational, but which have become based on a forecast of market fundamentals which proves to be incorrect. The essence of bubble paths is that, at their commencement, market fundamentals are hard to appraise. The bubble bursts once the deviation from market fundamentals becomes apparent.[42] In such circumstances, intervention may have an effect on the level of exchange rates beyond the short run if it shifts them to paths more in line with fundamentals. In this case, it would be necessary for the Bank to have a much better perspective on fundamentals than the market. In any case, Flood and Hodrick (1990) claim that econometric tests have not yet demonstrated the presence of bubbles.

There are several reasons why intervention may encounter pitfalls. Firstly, although it sounds eminently reasonable to have a policy of smoothing of exchange rate fluctuations, the possibility exists that fluctuations of value to the economy may at times be prevented. For instance, it has become conventional to regard exchange rates as having the potential to overshoot equilibrium. However, overshooting may well have a valuable role. Dornbusch’s (1976) original demonstration of the concept has exchange rates adjusting to a monetary shock in a way that overshoots equilibrium because prices are assumed to be sluggish. However, this adjustment is necessary to maintain equilibrium in the money market and is, therefore, of value to the economy. It is not enough simply to observe that an exchange rate response appears exaggerated. Something further than the impression of overshooting is needed to justify intervention. The other type of problem has to do with market fundamentals. If the fundamentals are different from those which the Bank has in mind, the resulting intervention, or monetary policy, may impose costs on the economy. For instance, a rise in the propensity to save is likely to lead to currency depreciation. If this is undetected, policy to prevent the depreciation could inhibit the adjustment of the current account deficit which would be the counterpart of a rise in saving.

In short, the clearest case for sterilised intervention would seem to be where the authorities possess superior information to that of the private sector. The instance referred to in the above quote is a good example of the Bank possessing information that could not be made available, but was relevant to the private sector. However, in cases where information can be made available, doing so directly, rather than signalling through intervention, would appear far preferable. The

42. See Blanchard and Fischer (1989, Ch. 5) and Flood and Hodrick (1990) for a survey of bubble behaviour and Gaber (1990) and White (1990) for appraisals of the potential for bubbles in practice.

alternative involves signals which may be misread. Because the evidence suggests that secret intervention is a good deal less effective than a more open approach it would seem preferable to give a degree of publicity to intervention operations.

Despite the above qualifications, there do not seem to have been any obvious cases in which intervention has been harmful and the process is said to have made money so that the taxpayer has not been required to finance it. If it helps to sustain confidence that the market is reflecting fundamentals, its contribution would seem valuable. In these circumstances there do not seem grounds for discontinuing sterilised intervention, provided it is conducted with an awareness of the possible pitfalls. In any case, it is monetary policy which is the instrument that has the potential to deliver serious problems, as well as major benefits.

7. Conclusions

The paper has concentrated on a number of inflation related issues, in particular, the capacity of a floating exchange rate to insulate the economy from foreign price shocks, the consequences if this does not work, the role of exchange rate targeting in anti-inflationary policy and the appropriate goal for inflation policy. In addition, the relation between wages policy and the depreciation, between the exchange rate and the current account and the role of exchange market intervention have also been discussed.

Since the float, the Australian economy appears to have independently generated its own monetary conditions and inflation rate. This and other evidence strongly suggests that the float has involved a reasonable degree of monetary independence and that insulation has worked. Moreover, in addition to the standard mechanism of the exchange rate moving to provide insulation from foreign price shocks, another influence appears to help absorb these shocks. This is the phenomenon of ‘pricing to the market’ which enables the smoothing of domestic price movements in importables and exportables.[43] If there is a reasonable degree of price insulation there is no need for the authorities to target the exchange rate, for instance by resisting depreciation, for anti-inflationary purposes. On the other hand, when there are significant inflationary foreign price shocks and insulation is incomplete, inflation will be imported. Reversing this without producing excess supply is likely to be a difficult problem for macroeconomic policy. Alternatively, to the extent that insulation allows some proportion of foreign currency price increases to affect domestic prices, this could be accommodated in the interest of sustaining domestic real equilibrium. For this and other reasons, the pursuit of equilibrium in the market for non-traded goods would seem a worthwhile strategy. Besides its

43. The study by Dwyer, Kent and Pease (1993) finds that in the contemporaneous quarter, pass-through is about 50 per cent, but that it is close to complete after one year.

intrinsic benefits, it could also mean a reasonable degree of stability of the price of non-traded goods when insulation works or when foreign price shocks are absent. When there is significant foreign price inflation and insulation does not work, it is a viable alternative to price stability and disequilibrium.

In the Australian context it has often been argued that wage restraint needs to accompany depreciation in order for the latter to have the effect of reducing the current account deficit. This was particularly so in 1985-86 when it was thought that the depreciation then had the role of reducing the trade deficit. However, because of the falls in foreign currency traded goods prices and the terms of trade at the time, it would appear that at least some of the nominal depreciation was an insulating response to these shocks. In any case, it is argued that even with indexed wages, a depreciation which is a response to some factor likely to change the current account, such as the fall in investment in 1986, would reduce the trade deficit. That is not to say that real wage restraint would not do the same. Moreover, the persistently high rates of unemployment at the time provided sufficient grounds for real wage restraint. Hence, it would seem that the source of any depreciation needs to be known before any conclusion can be drawn about its effect on the current account or about the need for any accompanying policy. Further, while Australia's wage fixing remains centralised it would seem preferable to relate wages policy to conditions in the labour market.

There does not appear to have been any simple relationship between real exchange rate movements, however measured, and the trade balance in the past decade. Fluctuations in investment, fundamental shifts in the fiscal balance and improvements in manufactured exports appear to explain what happened to the trade balance. Indeed, the weak trend towards a lower trade deficit has occurred despite all measures of the real exchange rate appreciating or remaining steady between 1986 and 1990.

Intervention in the foreign exchange market is often criticised by economists on the grounds that it is likely to have little or no effect if it is sterilised, as is the case in Australia. However, there is evidence that it can have an impact if it signals the credible possibility of a future change in monetary policy or if it conveys other information known to the Bank but not to the market. The heavy intervention in January 1992, when the market apparently became unsettled about the forthcoming Economic Statement is a case in point. However, as the exchange rate performs the role of a flexible link with the rest of the world it is not clear that smoothing *per se* is needed. As is often said, there is no such intervention in other markets, like the stock market. The possibility exists that where markets are thought to lose sight of fundamentals, intervention can shift the path of the exchange rate to one more soundly based. However, the authorities would need to have a better view of the fundamentals than the market, which in times of uncertainty might be hard to achieve. The $A has not yet been floating for 10 years. Provided that the private sector continues to believe it has a role, there may be grounds for persisting with sterilised intervention.

Finally, the topic is large and a number of interesting and important issues have not been covered. In particular, apart from foreign currency traded goods price shocks, the tendency for the economy to experience similar growth cycles to other OECD countries and the role of the exchange rate mechanism in this process has been omitted. Also, the way in which terms of trade shocks contribute to expansionary or deflationary episodes has only been touched on.

Appendix

A. Interest Parity and Insulation

Suppose uncovered interest parity holds in the model of Section 4, so that:

$$i = i^* + \dot{e} \tag{A1}$$

where it is assumed that there are rational expectations, so that actual and expected exchange rate movements coincide. The interest parity condition can be rearranged as:

$$\begin{aligned} i &= (i^* - \dot{\Psi}^*) + (\dot{e} + \dot{\Psi}^*) \\ &= (i^* - \dot{\Psi}^*) + (\dot{e} + ø_X \dot{s} + ø_M \dot{q}) + (\dot{\Psi}^* - ø_X \dot{s} - ø_X \dot{q}) \end{aligned} \tag{A2}$$

where $ø_X$ and $ø_M$ are the insulation coefficients from (12) and the · is the time derivative of a variable. If insulation works this reduces to:

$$i = \rho^* + (\dot{\Psi}^* - ø_X \dot{s} - ø_X \dot{q}) \tag{A3}$$

where ρ^* is the foreign real interest rate. The condition for there to be no effect on the domestic interest rate is that the foreign real interest rate is independent of foreign currency trade price movements (the Fisher effect) and that the foreign inflation rate is equal to an average of the inflation rates of foreign currency for the traded goods. Otherwise, foreign inflation would tend to change interest rates.

B. Wages, the Current Account and Depreciation

Two questions are raised in the text. Firstly, will depreciation be ineffective in reducing a current account deficit if wages are fully adjusted to a price index? Secondly, what is the effect of a fall in real wages on the current account?

Suppose depreciation is caused by an exogenous fall in investment and suppose that nominal wages are fully indexed so that:

$$W = \omega I = \omega[aP + (1 - a)eP^*] \tag{A4}$$

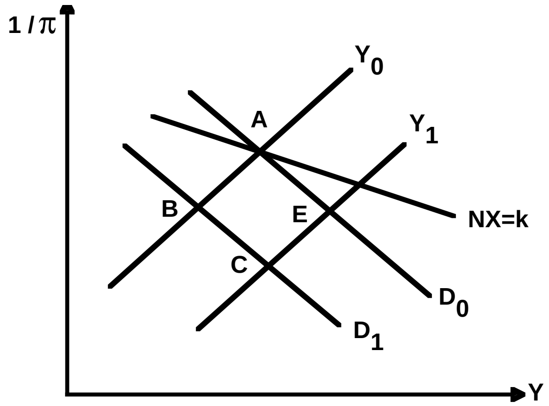
where I is a price index with weights a, 1-a; and ω is the real wage. The real wage cost per unit of output of the traded goods is then:

$$W/P = \omega[a + (1 - a)eP^*/P] \tag{A5}$$

Incorporating (A7) in the standard output supply function yields:

$$Y = Y(\underline{\pi}, \underline{\omega}) \tag{A6}$$

Figure A1



where π is the real exchange rate. Using the model and symbols of Part A, the effect of a changes in parameters which might affect the real exchange rate can be analysed in terms of the output of the home good and its relative price $1/\pi$. The demand curve for the home good D (from (2) to (5)) is negatively sloped and the supply curve Y is positively sloped in Figure A1. Depreciation of the real exchange rate will be produced by factors which shift the demand curve to the left and/or the supply curve to the right. An exogenous fall in investment produces a leftward shift in the D curve, moving the economy to B and so reducing output and depreciating the real exchange rate. This occurs *even with wages fully indexed*. The reason is that real wage costs per unit of output of the home good vary with the relative price of the home good, from (A6), even though the real wage in terms of the price index remains unchanged. Action to prevent wages rising fully with prices can be represented as a rightward shift of the supply curve, bringing the economy to C, which produces additional depreciation of the real exchange rate and limits the fall in output. In this case, an argument for restricting the adjustment of wages would be that it will help offset the fall in real output.

The $NX = k$ curve in Figure A1 is the locus of values of the relative price of home goods for which the trade surplus has a constant value k. It can be shown to have a negative slope and to be flatter than the demand curve. It follows that, *even with fully indexed wages*, the fall in investment and the real depreciation it induces (the move from A to B) produces a lower current account deficit.

Now, consider the effect of a reduction in the real wage measured in terms of the price index. In this model this will produce a fall in the trade deficit. A fall in the real wage ω, other things constant, results in a move from A to E and so a reduction in the trade deficit. Hence an argument can be made for reduced real wages as a way of reducing the trade deficit. Incidentally, this also produces depreciation and higher output.

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Discussion

1. David Gruen

John Pitchford has been thinking and writing about the Australian exchange rate and macroeconomic policy for a long time and this paper reflects his longstanding interest in the area. I always find his papers interesting and stimulating. As a good example, I have spent a lot of time in the past few years trying to decide what I think about Pitchford's 'consenting adults' view of the current account. But more of that shortly. Suffice it to say that while I don't always agree with him, his arguments always lead me to think harder about my own positions.

Pitchford's paper on The Exchange Rate and Macroeconomic Policy in Australia, covers a lot of ground and in my comments, I can only discuss some of the key ideas. I want to focus particularly on policy issues raised in the paper and, at the risk of oversimplifying, I'll discuss five issues central to this topic. In each case, I'll express the issue as a question, give what I think is Pitchford's answer to the question and then give my reaction to his answer.

1.1 Which Exchange Rate Regime, Fixed or Floating, is Preferable for Australia?

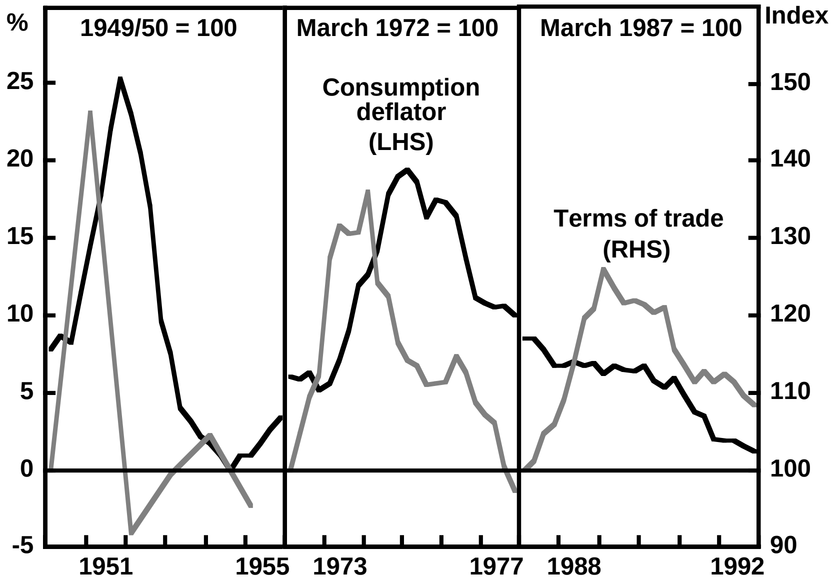
Pitchford's answer to this question is clearly 'floating'. Being a commodity exporter, Australia's terms of trade are subject to big swings. A floating nominal exchange rate allows the real exchange rate to adjust without big (and costly) changes in domestic inflation. It also allows Australia to insulate itself from general foreign inflation. For Australia, a floating rate is preferable in theory and has worked well in practice.

My response to this view is that I also think a floating exchange rate regime is clearly preferable for Australia, and Figure 1 illustrates one of its advantages. It shows Australian consumer price inflation in the aftermath of three large, but temporary, increases in Australian export prices. As Figure 1 shows, the domestic inflation response was strikingly different in the two earlier fixed-rate episodes than in the final floating-rate one. While the exchange rate regime is not the only difference between these episodes, the capacity of a floating rate to appreciate in response to a favourable export price shock helped the Australian economy avoid a blow-out in domestic inflation in the late 1980s.

1.2 Should Public Policy be Concerned About the Large Build-Up of Australia's Net Foreign Liabilities Over the Past Decade?

I include this question not only because Pitchford discusses it, but also because

Figure 1: Terms of Trade and Inflation



it has been so central to the Australian debate about the external sector and the behaviour of the exchange rate.

Pitchford's answer to the question is most definitely 'no'. While distortions and externalities should be corrected, 'borrowing or lending abroad by the private sector in a world of mobile financial capital is part of a beneficial process of real capital accumulation which is not confined by national boundaries - the timing of any adjustment process depends on the forces underlying the supply and demand for capital and is unlikely to be easily predicted' (see Section 6.2).

My response to this is that I hope he is right. Australia's current account deficit over the 1980s averaged 4.8 per cent of GDP and net external debt increased from under 10 per cent to about 40 per cent of GDP. At the very least, this stock of debt makes the Australian economy more vulnerable to unexpected adverse export price shocks and/or changes in sentiment by the foreign holders of this debt. A sudden drop in foreign demand for Australian assets would normally be reversed by a fall in the Australian dollar ($A). But asset markets do not always work that way, and it is possible that such a sudden drop would instead require a rapid fall in the current account deficit that would only come about with a severe domestic recession.[1] While it is hard to estimate the likelihood of such a 'hard landing', it is not so implausible that it should be dismissed out of hand.

1. Gruen and Grattan (1993) provide more detail on this and related reasons for concern about the build-up of Australia's foreign debt.

1.3 Does the Floating Exchange Rate Mostly Give Appropriate Relative Price Signals to the Traded and Non-Traded Goods Sectors of the Economy?

Pitchford acknowledges that econometric evidence has been very destructive of *all* theoretical exchange rate models. But even over short time spans (say, a year), he repeatedly argues that exchange rate changes have macroeconomic causes - for example, exogenous changes in investment, saving, fiscal or monetary stance. I conclude that his answer is 'yes'.

My response to this is that, in the long-run, exchange rates do respond to changes in the macroeconomy (e.g., inflation or productivity differentials between countries, terms of trade). But over horizons relevant to the business cycle and to efficient resource allocation in the economy, the evidence strongly suggests that exchange rates are sometimes (often) subject to swings and bandwagon effects that defy explanation even *ex post* as a rational market reaction to macroeconomic fundamentals. The quarter-to-quarter volatility of floating rates also defies explanation and probably has efficiency costs because it induces a significant option value to waiting to invest in the tradeables sector (Dixit 1989). So, I'd change the answer to 'no' - the market sometimes sets the exchange rate at an inappropriate level. It would be nice to know the economic cost of these misalignments.

1.4 Should the Reserve Bank Engage in Sterilised Foreign Exchange Market Intervention?

Pitchford's answer to this is 'perhaps', though I sense that he is uneasy with the idea: 'the clearest case for sterilised intervention would seem to be where the authorities possess superior information to the private sector - where (this) information can be made available, doing so directly, rather than signalling through intervention, would appear far preferable. The alternative involves signals which may be misread' (see Section 5.3).

Pitchford does, however, argue that 'there do not seem to have been any obvious cases in which intervention has been harmful and the process is said to have made money so that the taxpayer has not been required to finance it. If it helps to sustain confidence that the market is reflecting fundamentals, its contribution would seem valuable. In these circumstances there do not seem to be grounds for discontinuing sterilised intervention, provided it is conducted with an awareness of the possible pitfalls' (see Section 6.3).

My answer to the question is 'probably yes'. Pitchford discusses the possibility of rational speculative bubbles, but is sceptical of their relevance. I agree. To quote Michael Mussa (1990, p. 13), rational bubbles require 'not only that (foreign exchange market participants) are sometimes crazy, but that they are systematically, calculatingly, and fanatically insane' which fits rather uneasily with the idea that they are also rational.

Rather than being justified by the existence of rational bubbles, the strongest argument for sterilised intervention is the apparent importance of foreign exchange participants who trade on noise, on charts or using feedback rules (like 'stop-loss' orders). It is hard to see how these participants' actions have any social benefit and so separating them from some of their money is probably welfare enhancing.

As Michael Artis reports in his paper at this Conference, international evidence on sterilised intervention is still mixed, but some recent evidence suggests that 'since 1984, all but one of the major turning points in the trajectory of the [US] dollar exchange rate coincide with episodes of intervention'. A similar statement is also true for Australia. The Reserve Bank was a net buyer of Australian dollars when the currency was near its all-time low in 1986, and a net seller two years later when the $A was at its subsequent high point. While this sterilised intervention may or may not have had a lasting impact on the level of the $A, it was certainly profitable. Since the 1983 float, the realised trading profits from sterilised intervention have been about $A 500 million.

1.5 Should Monetary Policy be Used to Influence Current Account Outcomes?

I conclude with this question because, like question two, it has been central to the Australian debate. Many, including Pitchford in his paper, argue that tight monetary policy in the second half of the 1980s was at least partly directed at reducing the current account deficit.

Pitchford's answer is 'no'. A current account deficit is not intrinsically bad. Distortions or externalities relevant to private saving or investment should be tackled directly. Similarly, the government fiscal deficit should be judged on its own merits rather than in terms of its impact on the current account.

I agree that monetary policy should not be used to influence current account outcomes. A defense of tight monetary policy in the second half of the 1980s can and should be based on two grounds. Firstly, domestic inflation was more than double the OECD average and, uncontroversially, the Reserve Bank wanted to reduce it. Secondly, Australia was experiencing a tremendous speculative boom with an asset price bubble and a surge in domestic demand which threatened to spill over into higher goods price inflation and a collapse of the Accord with the trade union movement.

Finally, let me apologise to John for putting words into his mouth. But I have no doubt that he'll get a chance to defend himself.

References

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2. General Discussion

The discussion following the Pitchford paper largely focused on the following two issues:

- the benefits of fixed versus floating exchange rates; and
- the rationale and effectiveness of sterilised foreign exchange market intervention.

There was widespread, though not universal, acceptance of the proposition that, for Australia, a floating exchange rate was superior to a fixed rate. The opposing view was that a floating exchange rate did not provide enough discipline on the monetary authorities, who would always deliver too high an inflation rate. This view was held by a very small minority of participants. Given large swings in Australia's terms of trade and investment, real exchange rate flexibility was important. Floating nominal exchange rates permitted rapid changes in real rates, as opposed to their more painful adjustment via relative price levels in goods markets. Because of rigidities in goods and labour markets, real exchange rate adjustments forced through price levels that often entailed large and undesirable output adjustments.

Fixed exchange rates were also seen as undesirable for Australia, because there is no logical currency against which to fix. Even if such a currency could be identified, it was argued that fixing the exchange rate as an efficient anti-inflationary mechanism has generally met with limited success in those countries where it has been tried. Where success has been achieved in reducing inflation, the output cost does not seem lower than in those countries with floating exchange rates which have also reduced inflation.

In the discussion on foreign exchange market intervention, it was noted that, since the floating of the $A, the Reserve Bank's intervention had generated considerable profits. These profits stand in contrast to the large losses made by central banks attempting to defend fixed exchange rates. In general, it was thought that informational inefficiencies in the foreign exchange market created the possibility of profitable official intervention. It was, however, important that the central bank not try to defend unrealistic policy settings and maintain an exchange rate away from its fundamental equilibrium value. This would have left open the possibility of large foreign exchange losses incurred by the central bank.

Some participants argued that if the authorities set clear ultimate policy targets, the exchange rate would be self-equilibrating and, as a result, there would be no need for foreign exchange market intervention. On the rare occasions when the market lacked direction or confidence in the ability of the authorities to achieve the ultimate policy objectives, the central bank could reaffirm its intentions by changing interest rates. In most cases, these changes should only need to be short-lived. In contrast, other participants argued that, on occasion, sterilised foreign exchange market intervention could provide some direction to the market that would remove the need for changes in interest rates. This mechanism was viewed favourably by those who thought that participants in the foreign exchange market did not have rational expectations and were predisposed towards fads. It was argued that the 'little stick' of intervention was sometimes superior to the 'big stick' of changing interest rates. It was important, however, that the market viewed the little stick as credible. There was little support for the proposition that sterilised foreign exchange market intervention could alter the exchange rate permanently.

Finally, the history of Australian monetary policy over recent years, and in particular, the link between monetary policy and the current account, was discussed. It was argued that in the late 1980s monetary policy was aimed at controlling the strong growth in domestic demand. This growth threatened to lead to an increase in inflation that was thought to be undesirable. Consequently, monetary policy was tightened. This tightening slowed domestic demand growth and this, in turn, resulted in an improvement in the current account. Monetary policy was responding to domestic demand and potential inflation and not to the current account itself.

The Role of the Exchange Rate in Monetary Policy – the Experience of Other Countries

Michael Artis

1. Introduction

In the past 15 years we have seen two significant episodes of exchange rate targeting, each very different in character and in their proximate objectives. One is the phase of exchange rate targeting inaugurated by the Plaza Accord in September 1985; the other is the system of exchange rate targeting inaugurated by the establishment of the European Monetary System (EMS) in 1979.

The former had as its proximate objective the correction of a substantial misalignment – that is, it had a real exchange rate or competitiveness objective. A decline in the nominal US dollar ($US) exchange rate was pursued as a means of reducing the real value of the $US to retrieve American competitiveness. The 'system' consisted of unannounced soft-edged broad bands, recentred at intervals. The EMS, by contrast, has come to be associated with the control of inflation through the maintenance of preannounced narrow band nominal exchange rate targets. In this system, recentring to accommodate relative inflation was, after an initial phase and until the events of 1992, discountenanced and played down.

Despite these differences in the proximate objectives of the two systems, monetary policy has been strongly implicated in both. The reason is fairly obvious: the principal instrument of monetary policy is the interest rate, and exchange rates respond to actual or expected interest rate changes. However, in the instance of the nominal exchange rate target, the motivating rationale depends on a view of the transmission mechanism of monetary policy and on acceptance of the 'credibility model' of monetary policy, ingredients not present in the real exchange rate targeting arrangements of the 'Group of Five' (G5) nations.

In the first section of the paper we take up the issue of the real exchange rate targeting approach we identify with the G5 experiment and discuss some problems with it. In this connection we also examine the fundamental equilibrium exchange rate (FEER) 'blueprint' associated with Williamson (1985a). Then we look at the theory of nominal exchange rate targeting and go on to examine the EMS experience.[1] Successful exchange rate systems seem to have produced monetary

1. This distinction, between real exchange targeting and nominal exchange rate targeting, is also drawn by two of the authors Williamson (1993) and Corden (1993) in the recent *Economic Journal* symposium on the subject.

discipline and preserved patterns of competitiveness from progressive distortion. The collapse of unsuccessful systems seems, correspondingly, to have been associated with failure on one or other account. How, if at all possible, can the right balance be struck in conditions of high capital mobility? The debacle of the EMS has caused some to argue that either the completely fixed rate system represented by monetary union or a fairly free float dominate attempts at heavily managed exchange rates. This is the question for the concluding section.

2. Real Exchange Rate Targeting

The so-called Plaza Accord of the G5 launched in September 1985 was aimed at securing a controlled decline of the $US and the restoration of US competitiveness. Both features were desired - that is, a decline in the $US, but one that avoided the contingency of the 'hard landing'.[2] Although the episode encouraged the belief that a new phase of sustained global economic cooperation and policy coordination was at hand, the rationale offered by Kenen (1989) seems more compelling. He described the episode as a 'one-off' exercise in 'regime preservation'. His interpretation was that the misalignment of the $US was threatening the maintenance of liberal trading arrangements in the world; it was therefore necessary to secure agreement to let the $US fall. Kenen's suggestion that the Accord and what followed were motivated by what was essentially a single and limited objective helps explain the short life of the new arrangements. More generally, analyses of international policy coordination tend to stress the costs of continuous cooperation and suggest a bias in the direction of limited-objective episodes (Artis and Ostry 1986).

Implicit in the process set up at the Plaza were assumptions that nominal exchange rate changes lead reliably to real rate changes, that intervention in foreign exchange markets 'works' and that the authorities have adequate policy instruments to target exchange rates with at least some degree of success. One of the themes of the Plaza process was that fiscal policy changes would be involved, a reining back of the US budget deficit being complemented by fiscal expansion elsewhere. The precise exchange rate targets and the size of tolerated deviations from them were not announced at the time. The account by Funabashi (1989), however, supplies a good deal of *ex post* detail about the negotiations associated with the Plaza process.

2. The 'hard landing' scenario was described in detail by Marris (1985) who has subsequently argued that part of his purpose in doing so was to lend force to the call for the kind of cooperation that ensued with the Plaza process (Marris 1991).

2.1 Chronology

Funabashi points out that the Plaza Accord was anticipated by a G5 meeting in January 1985, which led to substantial foreign exchange market intervention in February of that year. The $US had already begun to depreciate well before the Plaza meeting in September of that year, but the communiqué issued after that meeting noted that 'some further orderly appreciation of the main non-dollar currencies against the dollar is desirable'. According to Funabashi's account, the order of magnitude upon which the meeting agreed for the further appreciation of the non-$US currencies was in the 10 to 12 per cent range - an amount already achieved by the end of October! He also notes that although shares in foreign exchange market intervention were clearly agreed there was no clear decision on the coordination of monetary policy. However, in the markets, 'the agreement was interpreted as having eliminated the likelihood that the Federal Reserve Board would tighten reserve conditions in response to rapid monetary growth' (Funabashi 1989). There was a G5 meeting in London in January 1986 to take stock of developments since the Summer and coordinated interest rate cuts were accomplished in the wake of the oil price declines in March 1986. From this point on, the implications for monetary policy began to be felt more strongly, especially in the two main countries concerned - Japan and Germany, the former reluctantly acquiescent and the latter resistant to the demands falling upon them. By the time of the May 1986 Tokyo Summit, the $US had fallen considerably. The scope of the coordination exercise was increased significantly, involving a G7-wide 'indicators' exercise and a discussion of exchange rate targets. At the same time a more focused G2 (United States-Japan) effort was underway, involving the Baker-Miyazawa agreement of October 1986 and, in January 1987, 'reverse intervention', in which the Federal Reserve intervened to sell yen as the $US had by that time fallen strongly against it.

At the Louvre meeting in February 1987, the participating countries agreed that the fall in the $US had been accomplished and defined the new task, in the words of the communiqué, as that of stabilising rates 'around the current levels'. According to Funabashi's account there was a serious discussion at this time of a formal 'target zone' arrangement, with an inner band of plus or minus 2.25 per cent and an outer one at plus or minus 5 per cent. But, while this seems to have provided Chancellor Nigel Lawson with the opportunity to target the pound sterling/deutschemark exchange rate, that choice, in itself, reflected other considerations besides the Louvre imperative.

The worldwide stock market crash in October 1987 seems to have effectively marked the public end of the Plaza 'episode', partly because in terms of timing, difficulties with the coordination process seemed themselves responsible for the crash, and also partly because the crash focused different concerns. Whilst the objectives of coordination were reaffirmed in a soothing communiqué in December 1987, and concerted intervention has continued to take place at intervals subsequently, the public perception is that the distinctive G5 endeavour ended at about this time.

2.2 Was the Outcome as Desired?

Viewed as an exercise to restore US competitiveness and to reduce the US balance of payments deficit without the trauma of a '$US crash', the episode might well be taken to have been a successful example of policy coordination.

Figures 1 and 2 show, respectively, that the depreciation of the real effective $US rate since 1985 - however measured - has been substantial, and that there has been, subsequently, a clear turnaround in the US balance of payments deficit with corresponding changes in the external accounts of Germany and Japan. Earlier impatience with the slowness of the turnaround has been revealed for what it was - impatience. In substantial degree, the contributions to Bergsten's (1991) review of the period suggest that the basic theory of international adjustment has survived well.[3] However, it is less than clear how much of what is satisfactory about the outcome should be attributed to the Plaza process itself, rather than to other factors. There is the point that the $US was already falling, ahead of the Plaza agreement itself and, in fact, had gone the whole distance initially desired within a month of that agreement. There were substantial shocks during the period - the fall in oil prices in 1986, the stock market crash and German reunification. Also, there are some doubts about the way in which the process was made effective.

2.3 Instruments and Implications for Monetary Policy

The rhetoric of the Plaza process laid great emphasis on the *combined* use of three instruments of policy - intervention in the foreign exchange markets, monetary policy and fiscal policy. One seemingly very important finding to emerge from recent studies (see Catte *et al.* (1992a, 1992b)) of the Plaza episode is the significance attached to foreign exchange market intervention. Prior to this, the conventional wisdom of both academics and policy makers was that intervention *per se* (sterilised intervention) could not be important, except for any signals it might convey about monetary policy (that is, about unsterilised intervention), a

3. This is in contrast with the concluding remarks in that volume by Paul Krugman who notes *inter alia* that: 'The general verdict, then, must be that the international adjustment process has worked, in both meaningful senses: that is, it has worked acceptably, and it has worked about the way conventional wisdom thought it would'. This comment implies that the literature on 'pricing to market' and hysteresis effects, to which Krugman himself subscribed (Baldwin and Krugman 1989), may have less to contribute to an understanding of the adjustment process in the 1980s than appeared at first sight.

Figure 1: Real Effective US Dollar Exchange Rate Indexes
(1985 = 100)

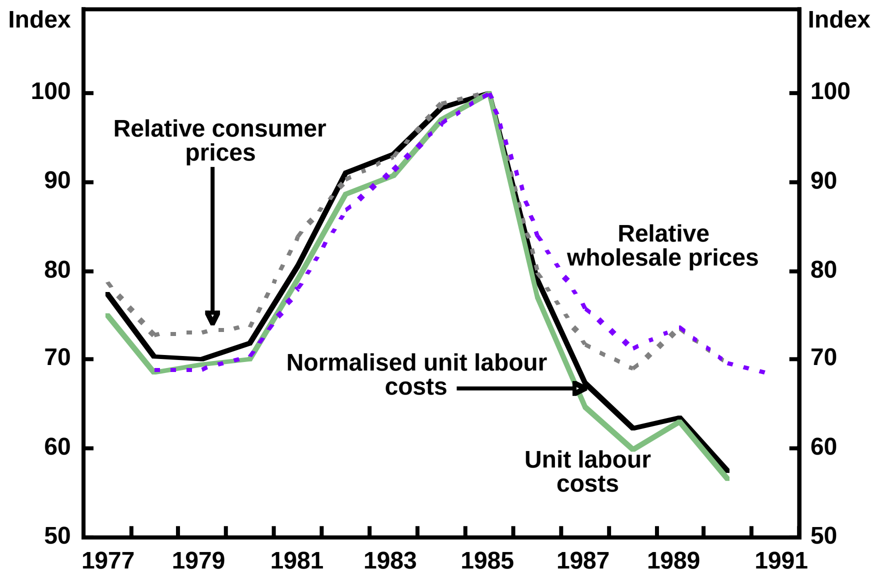
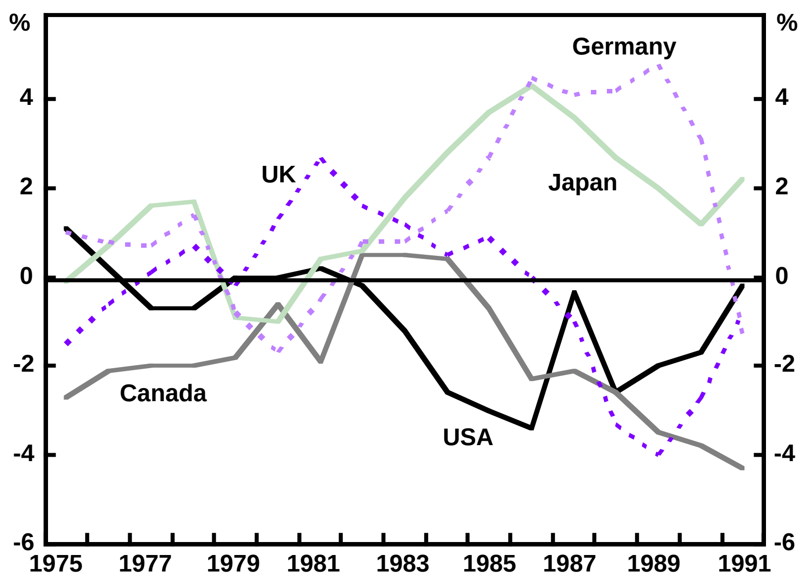


Figure 2: Current Account Balance - per cent of GDP
(excluding exceptional financing)



caveat that came to be treated as rather unimportant. This followed from the demonstration that if assets of different currency denominations are perfect substitutes, then sterilised intervention could not change the exchange rate, and also from a general presumption that 'perfect substitutability' would not be a bad characterisation of G5 currency-denominated assets (Obstfeld 1983). Mussa (1981) supplied the qualification about the possible signalling role of intervention. At the same time, the Jurgensen Report (1983), which was inspired by the Versailles Summit, conveyed a similar message to policy makers. By contrast, the more recent studies of intervention suggest that, since 1984, all but one of the major turning points in the trajectory of the $US exchange rate coincide with episodes of intervention and that over half of the episodes of concerted intervention (involving at least two of the G3) since 1984 were definitely successful, with the remainder registering temporary success. As Williamson (1993) notes, this 'new view' of the effectiveness of intervention sits better with theories that give much room in short-run exchange rate determination to fads and bubbles, than with theories which emphasise the fundamentals; for, in the former case, it is possible to argue that the markets have very little to go on and thus may be 'given a steer' by official intervention. It would also be wise to concede, though, that studies of this period are as yet few and do not amount to a consensus. (For example, the study by Kaminsky and Lewis (1993) arrives at fundamentally pessimistic conclusions about the usefulness of intervention. Although intervention has information content, these authors find that the signal is actually *perverse*.)

Nevertheless, sterilised intervention was not sufficiently effective to avoid pressures arising on monetary policy.[4] Among the criticisms of this policy episode are, in fact ,the following points: that fiscal policy was relatively unresponsive to the demands of coordination, putting 'too much' of the burden on monetary policy; that the distribution of this burden was essentially decided in the interests of the United States; and that overall monetary policy was probably too lax, prolonging the life of the global stock market 'bull run' and making inevitable at some point a stock market crash of the kind that did, in fact, eventuate. The crux of the argument is the following simple point. The proximate determination of the exchange rate is a function of *relative* interest rates. (Following the Plaza Accord, to ensure that the $US fell, but not too fast, US interest rates needed only to lie below rates in Germany and Japan by a judicious margin.) But this does not determine the *absolute* level of interest rates. (This was left to the United States.) For domestic reasons, the United States wished to see low interest rates at home; it left other countries to determine the exchange rate. Funabashi (1989) is very

4. To the extent that the intervention works because it is a signal of future monetary policy it is not going to be a complete substitute for such policy. If the signalling is to be credible, it will have to be followed up by the actions that it foreshadows.

revealing in this regard. Commenting on US policy through 1986, he says ‘The Fed used monetary policy to stimulate the US economy or at least to keep it buoyant but it did not burden monetary policy with exchange rate management. Instead it used coordination of monetary policies - more accurately, the monetary policies of others - to keep the dollar from dropping precipitously’ (Funabashi 1989, p. 57). It is arguable that the absolute level of interest rates to which this led, at least in Japan, was undesirably low, prolonging the overvaluation of the stock market. Also, it seems that it was conflict with Germany over the level of interest rates (with Germany’s policy concerns pointing to higher levels than implied by US policy concerns) that led, proximately, to the crash.

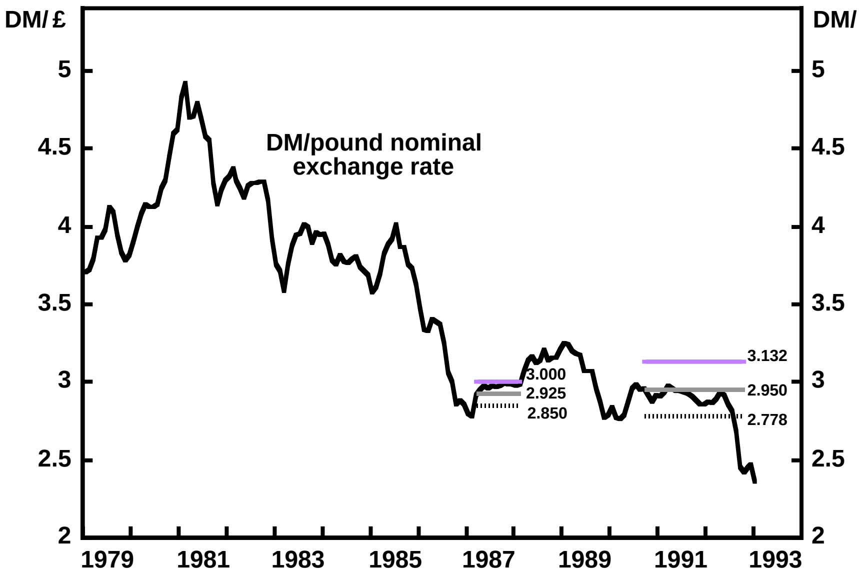
In the United Kingdom, the episode was used by Chancellor Lawson as cover for an experiment in ‘shadowing’ the DM, presumably designed as a way of showing that full-blown membership of the Exchange Rate Mechanism (ERM) could be easily managed. ‘Unofficially’, it was made clear that the UK authorities were targeting the deutschemark (DM) to a ceiling of 3DM to the pound. The policy is unmistakable in the data (see Figure 3).[5] At this time there were gathering signs of inflationary pressure in the United Kingdom, which would have suggested increases in interest rates; yet sentiment was very favourable towards the pound and maintaining the exchange rate below the ceiling meant foregoing such increases. The incident can be recognised as a forerunner of the ‘excess credibility’ problem (see below) experienced by some other ERM countries in the late 1980s and early 1990s. After about a year, the policy was abandoned in the face of mounting inflationary pressure and the exchange rate rose through its erstwhile ceiling.[6] The Plaza episode may have been successful in its major objectives and sterilised intervention appears to have been an important and effective part of the policy toolkit. However, there were monetary implications, especially for countries other than the United States, which do not seem to have been so obviously desirable. Admittedly, in the case of the United Kingdom, the monetary consequences were essentially self-made, a product of a substantial ‘hardening’ of the Plaza-Louvre process rather than of the process itself.

Whilst participants in the coordination process inaugurated by the Plaza Agreement refrained from issuing publicly stated exchange rate targets and bands, the process involved was recognisably of this genre. This is one reason why it is interesting to examine the choice of target exchange rate more formally;

5. The policy was in effect for nearly a year - from March 1987 to January 1988. The first set of bands shown on Figure 3 take the unofficial ceiling of 3DM to the pound sterling and show the central parity and lower limit that would be implied by a ‘narrow band’ ERM membership. The second set of bands, for comparison, shows the position during the period of formal ERM membership, with 6 per cent bands.

6. It is not correct, however, to place all of the blame on monetary policy (i.e. the decision to target the exchange rate), as fiscal policy could have been used to keep down demand; but it was not.

Figure 3: Deutschemark/Pound Nominal Exchange Rate



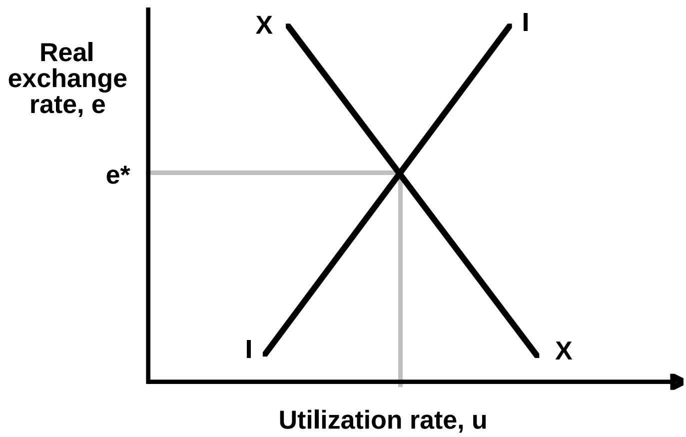
another reason why this is of interest arises quite naturally from the partial collapse of the ERM in September 1992. Was this the consequence of destabilising and destructive speculation? Or was the crisis revelatory of fundamental disequilibrium? How can we recognise when an exchange rate is away from its equilibrium?

3. Williamson's FEERs

The academic 'blueprint' closest to the spirit of the G5 intervention was that produced by Williamson (Williamson 1985a; Edison, Miller and Williamson 1987; Miller and Williamson 1987). His proposals centre around the suggestion that a 'fundamental equilibrium exchange rate' (FEER) should be identified and targeted within a 'soft-edged' band. The FEER is that rate of exchange which is consistent over the medium term with internal and external balance. Clearly this is a real rate of exchange. The FEER is, in principle, a trajectory, or exchange rate path. Expressed in nominal terms, any given FEER trajectory would need to be adjusted additionally for relative inflation.

Clearly, identifying such a rate is far from being a straightforward task in principle: Williamson emphasises that a broad error band (plus or minus 10 per cent) must be associated with his estimates. In the simplest settings, internal balance is independent of the real rate of exchange, but in rather open economies this is not likely to be the case (Wren-Lewis *et al.* 1990). In the diagram (Figure 4), for example, a Layard and Nickell (1985) 'battle of the mark-ups' view of inflation

Figure 4: Determination of the Fundamental Equilibrium Exchange Rate (FEER)



makes the internal balance schedule (*II*) slope up from left to right in exchange rate-utilisation space. The external balance schedule (*XX*) slopes down from left to right for obvious absorption-elasticity reasons. The FEER is located at the point of intersection of the two schedules.

The FEER suffers from hysteresis. If the actual exchange rate is not at its FEER value then the balance of payments (given internal balance) will differ from that implied in the calculation of the FEER. However, this in turn, implies a different external debt and debt-service trajectory from that implied in the original calculation, so the FEER should be recalculated.[7] To be concrete, suppose that the exchange rate is appreciated relative to the FEER - then the FEER should be devalued relative to its original value in order to protect the external account from the increased volume of debt-service payments otherwise implied. Artis and Taylor (1993a) have expressed this problem in analytical terms, simulated it on historical data and derived some 'rule of thumb' adjustments that can be made to take care of it. The problem, whilst real, seems to be a manageable one.

Another problem with the FEER is the assignment issue. Since the FEER itself is a real rate, a potential criticism would be that it accommodates inflation. In the full blueprint, Miller and Williamson circumvent this criticism by adding an additional target, for nominal domestic demand. Then (real) interest rates and intervention target the FEER, whilst fiscal policy is used to target the nominal

7. Actually, the position is a little more complicated than this. *XX* is a schedule of external balance (constant current account balance) so it is deviations of the economy from this schedule which involve different debt service obligations and so give rise to hysteresis. See Artis and Taylor (1993a).

demand objective. In a symmetric system, this still leaves it open for the collective of participant countries to target a global price level by coordinating their national nominal demand targets. Whilst logically complete, the assignment may be criticised on the grounds that in practice the required flexibility of fiscal policy does not exist: thus practical implementation of such a scheme (as in the G5 experience) would simply lead to over-emphasis on monetary policy.

Finally, though termed the 'fundamental' equilibrium exchange rate - echoing the Bretton Woods provision for exchange rate adjustment in circumstances of 'fundamental disequilibrium' - it is clear that there is a normative edge to the concept of the FEER which some critics, such as Frankel (1987) find oppressive. The point is that the estimates of internal balance from which the FEER is derived are constructed as medium-run sustainable positions. This deliberately 'rules out' the use of discretion by governments to follow temporarily unsustainable policies. In his reconstruction of the logic of the Bretton Woods system, Williamson (1985b) is absolutely clear that it was a virtue of that system that commitment to exchange rate stability ruled out irresponsible policy, and it is equally clear that this virtue is intended to be embodied in the FEER blueprint.[8] Significantly, in simulations of the world economy with FEERs in place and Williamson-Miller policy assignments, Currie and Wren-Lewis (1988) found that the US fiscal 'experiment' of the 1980s was essentially wiped out. However, recent events in the EMS found analysts looking for a concept of the equilibrium rate of exchange against which to measure desirable adjustments and the FEER is much the best articulated measure.

4. Nominal Exchange Rate Targeting

Basic analytics indicate that there are a limited number of nominal variables that might in principle serve as 'nominal anchors', in the sense that success in stabilising them would imply success in stabilising the price level. They include the nominal wage, the money supply, the nominal exchange rate and prices directly (the 'Antipodean anchor'). Well-known policy episodes correspond to each of these. In simple models, the exchange rate is the dual of the money supply: the monetary implications of exchange rate targeting supply are very clear in this case. The exchange rate target implies the endogenisation of monetary policy. Even in models where one-to-one correspondence fails, the general spirit of the implication still holds: while the exchange rate target prevails it will not be possible to execute an independent monetary policy (except in the case where sterilisation is feasible - an important issue in the case of the EMS, as discussed below).

8. In recognition of the normative character of the FEER, Artis and Taylor (1993a) have redescribed it as the DEER, or 'desired equilibrium exchange rate'.

Nominal exchange rate targeting may be followed in a variety of forms, from 'strong' to 'weak' and in a variety of political contexts. Outright commitment to a nominal peg is nearly always hedged by a band around the central rate; this 'strong form' exchange rate targeting may take place on the basis of go-it-alone commitment to a peg against a basket or a single currency - an alternative is that commitment takes place inside an exchange rate union of participating countries (the EMS example). Motivating economic arguments here have commonly invoked the 'credibility model' of economic policy, to the point where the exchange rate peg is conceived of as a way of 'importing the credibility' of the central bank of the currency against which the peg is maintained. How this can be better than alternative ways of earning credibility is one of the issues reviewed below.

By 'weak form' exchange rate targeting we mean, for want of a better phrase, situations in which the exchange rate is viewed as an important conditioning variable on monetary policy responses, although there may be no public (or perhaps even private) target for it. Weak form targeting seems to be a common practice amongst countries which have tried and found wanting either a monetary targeting style of policy or a strong form exchange rate target.

A standard result in the literature on the relative merits of monetary and exchange rate targeting is that each regime is uniquely vulnerable to certain types of shock. As shocks alternate over time, the optimal policy may be a switching regime; the change from a monetary target to an exchange rate target in Switzerland in 1978 is a well-known example. The weak form exchange rate targeting regime is a generalisation, where the response to monetary target overruns may be conditionalised on the exchange rate. This is, in effect, what occurred in the United Kingdom in the early to mid-1980s as Prime Minister Margaret Thatcher's monetarist experiment was relaxed in the face of the unprecedented appreciation of the pound sterling. More recently (as discussed below), it has become more fashionable to emphasise the direct targeting of inflation using the central bank's policy instrument (an interest rate): but such a policy may be prosecuted (as currently in the United Kingdom) in the context of concern for the evolution of both the money supply and the exchange rate.

It might be expected that studies of the transmission mechanism of monetary policy would emphasise the role of the exchange rate. After all, one natural way of justifying exchange rate targeting would flow from a picture of that transmission mechanism as $m \rightarrow e \rightarrow y, p$ with the link between m and e being uncertain and 'fuzzy'. Then exchange rate targeting simply cuts out the 'unreliable' part of the transmission mechanism. We attempted to investigate this issue, using measures of linear feedback developed by Geweke (1982, 1984). The results, which are reported in full in Appendix A, appear distinctly disappointing for those of the view that the exchange rate is a significant part of the transmission mechanism of monetary policy.

In what follows below, we take a look at weak form exchange rate targeting of the type described above, as exemplified discontinuously over recent years in the United Kingdom. Then we examine the situation of participants in the ERM of the European Monetary System.

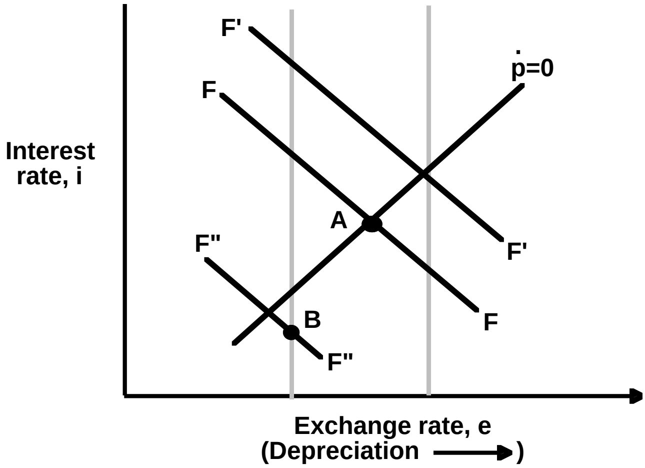
5. 'Weak Form' Nominal Exchange Rate Targeting

The practice of considering the exchange rate to be an important conditioning variable for counter-inflationary policy stems from the basic mark-up model of pricing and the view that nominal wages tend to adjust for price changes. Then it is easy to show that a nominal devaluation of the exchange rate will tend to feed into increases in domestic wages and prices. Of course, this is a price level adjustment rather than inflation *per se* (except in the case that the devaluation itself is continuous), but from the short-run policy view involved here, the distinction may be uninteresting. With a view to completeness and clarity, though at some risk of being obvious, we spell out the basic mark-up model and illustrative simulations in Appendix B.

Given the view that nominal interest rate adjustments can have significant effects on demand independent of their effects on the exchange rate, and thus influence prices (both through excess demand impacts in the labour market and by changing the mark-up), a trade-off emerges between interest rate adjustment and exchange rate changes. If the exchange rate appreciates, interest rates can fall, consistent with an unchanged inflationary pressure. If the exchange rate depreciates, then interest rates must be raised to preserve the same counter-inflationary stance of policy. This account of matters gives privilege to the interest rate as the monetary policy instrument, which is the way central bankers tend to think about the problem. These considerations can be usefully presented in a diagram (Figure 5) in interest rate-exchange rate space.[9] The exchange rate is measured as the number of units of domestic currency per unit of foreign currency, so an increase indicates a devaluation. Then the schedule $\dot{p} = 0$ indicates an iso-inflation objective line. The more devalued the currency, the higher the interest rate needs to be to prevent the inflation rate rising. An appreciated currency allows the central bank to ease interest rates. Points to the right and below the schedule represent points of relative inflation, points to the left and above indicate relative deflation.

9. As far as I know, this diagram was first presented by Walter Eltis, then Director of the National Economic Development Office, to explain Chancellor Lawson's policy stance in the period before the episode of shadowing the DM.

Figure 5: The Exchange Rate in Counter-Inflationary Monetary Policy



The schedule *FF* is a foreign exchange market schedule, assumed to slope down from left to right, so that a high interest rate is associated with an appreciated exchange rate and a low one with a depreciated rate. A shift in foreign exchange market sentiment - say, a reaction to unfavourable news - would shift *FF* to a position like *F'F'*. If interest rates are not raised this would lead to inflation. Staying on $\dot{p} = 0$ requires interest rates to be increased. The diagram can be used to describe the problem encountered by Chancellor Lawson when he decided to 'harden' his policy and to target the DM exchange rate (as described above). The dashed vertical lines represent the bands around the commitment on the exchange rate. Suppose now that the foreign exchange market views the new developments very favourably, or for some other reason moves into the pound sterling. Then *FF* could shift to a position like *F''F''*, and in order to prevent the exchange rate from appreciating through the ceiling, the interest rates will have to be set, as at point *B*, on the 'inflationary' side of $\dot{p} = 0$. Although the exchange rate commitment is intended as a 'hard' counter-inflationary policy, the result here is 'excess' inflation.

The policy of conditioning monetary policy responses on the exchange rate, as opposed to outright exchange rate targeting, has a number of virtues. It avoids the problem of 'excess credibility' just illustrated and it provides no hostages to fortune. It is flexible in allowing the authorities to adjust policy in the light of circumstances, but it is just this which critics will attack. The policy can have no credibility other than what is earned through the results as reflected in the control (or otherwise) of inflation. There is no other nominal anchor. By comparison, the credibility model of economic policy has been a dominant point of appeal in reconstructions of the benefits of participation in the ERM.

6. Participating in the ERM

Until the near-collapse of the ERM of the European Monetary System last year, it seemed possible to describe it as an outstandingly successful arrangement. Certainly, new countries joined it with enthusiasm; Spain in 1989, the United Kingdom in October 1990 and Portugal in 1991. Some countries not eligible for formal membership (Austria and the Scandinavian fringe) also signed up informally by targeting the DM or the ECU. The chief motivation for joining was a belief in the counter-inflationary benefits that could be gained. Economic theory provided some basic building blocks. One can identify three such blocks. Starting with the most basic of all, there is the mark-up pricing model, together with a real wage resistance view of wage inflation.[10] Then, there is the demonstration that, for equal degrees of credibility, an exchange rate target is just as good and probably better than a monetary target for delivering low inflation (Artis and Currie 1981). Finally, there is the credibility model of counter-inflationary policy, such as Barrro and Gordon (1981), which could be interpreted to promise that some differential credibility would attach to an exchange rate targeting strategy, particularly one conducted in the context of an international arrangement. (The differential credibility stems from the visibility of the exchange rate and from the assumption that the 'punishment' for reneging is strengthened in such a context.) The predictions that could be derived from these component assumptions seemed to be borne out in the late 1980s and early 1990s. Exchange rate volatility between ERM member currencies had fallen; no realignments had taken place since 1987 (aside from the 'technical' realignment implied by Italy's decision to move from her 'broad' band (plus or minus 6 per cent) to the ERM narrow band (plus or minus 2.25 per cent) whilst keeping the same 'floor' rate as before). Inflation had fallen and converged, while the dispersion across ERM countries narrowed. All this appeared to result from the fact that whilst the ERM statutes described a symmetric system, the practice had been markedly asymmetric, centring on a low-inflation Germany as the leader or hegemon of the EMS.

We now turn briefly to describe the formal arrangements of the EMS and its practical evolution.

7. Formal Provisions of the EMS

The heart of the EMS is the exchange rate mechanism. Participation in the mechanism obliges a country to maintain its bilateral parity against other participants within pre-agreed bands around a central rate. Formally this obligation falls on both sides, that is, equally on the strong and on the weak currency country.

10. Alternatively viewed, this is a natural rate assumption with some inertia in prices and wages. See Appendix B.

Credit is provided to support intervention in the foreign exchange market very short term facility (VSTF); in 1987, when the original (1979) provisions were amended following the so-called Basle-Nyborg agreements, the credit lines were extended to foreign exchange market intervention within the bands (so-called ‘intra-marginal’ intervention) and the repayment period was lengthened. The impression of symmetry was further strengthened by the ‘invention’ of a unit of account (the ECU), in which exchange rates could be expressed and credits denominated. The existence of the ECU made possible the design of the ‘divergence indicator’; when a country’s ECU rate departs from its central parity by an amount that represents a shift against other currencies of 75 per cent of the 2.25 per cent permitted deviation,[11] then a presumption falls on that country to take diversified corrective action.

Such action could include measures of fiscal and monetary policy, intervention and a realignment of the central parity of the currency.

8. Practical Evolution

In practice, the EMS evolved as an asymmetric system, with Germany as the leader and the DM as the anchor currency. A proximate explanation for this is that the leading policy concern of the 1980s was that of inflation. The conversion of the EMS to an asymmetric system emphasising counter-inflationary policies was gradual. In the early years, there were many realignments and in that period the EMS behaved somewhat like a crawling peg. This gave way after around 1983 (the year of the ‘Mitterand U-turn’) to the asymmetric model.

A stylised description of how the asymmetry and the counter-inflationary bias of the EMS worked out in practice would emphasise the following features. Firstly, Germany typically abstains from all intra-marginal intervention and aims to sterilise the consequences of obligatory, marginal, intervention (Mastropasqua, Micossi and Rinaldi 1988). Secondly, realignments became a matter for multilateral decision (Padoa-Schioppa 1983), with a bias towards ensuring that exchange rate devaluations ‘underindex’ on cumulative relative price differentials (Padoa-Schioppa 1985). Thirdly, the divergence indicator fell into desuetude (it would have been contrary to the counter-inflationary objective to have insisted that the low inflation leader should expand). Thus, on this stylised view, Germany pursued her own monetary policy where other countries, by contrast, were in the position of accepting the German lead. Any difficulties they might have had in doing so were reduced (for those countries which had them) by the use of capital

11. Because the ECU itself is a composite currency, the amount by which a country’s ECU rate changes before causing the divergence indicator to ‘flash’ depends on the weight of the currency itself in the ECU.

exchange controls (France and Italy).[12] The decision to phase out those controls, followed by their gradual and eventual total removal, marked the beginning of a new phase in the history of the EMS, that of the so-called 'New EMS'.

The outstanding characteristic of the 'New EMS' is that, up until the crisis of 1992, realignments ceased to take place.[13] This outcome is in contrast to the suggestion emanating from the Basle-Nyborg discussions, to the effect that in the new conditions of greater capital mobility, smaller and more frequent realignments would be called for. The suggestion was that destabilising speculation could be avoided if realignments were adopted in timely fashion and came in amounts less than the band width of the currency concerned, so that the market rate would not be disturbed. In this way, the 'one-way bet' would be avoided. Some analyses see this as the fatal mistake which led to the debacle of 1992.

It is this last period and the events leading up to that debacle that are of greatest interest and they will occupy the remainder of the paper.

9. The 'New EMS'

The policy apprehension at the start of the period designated the 'New EMS' was not at all like the immediate outcome. The tone of the debate at that time was that the removal of capital controls would expose the follower countries to sharper policy pressures: policy dilemmas - whether to follow Germany or to attend to domestic objectives - would be more acute. It did not seem accidental that the revival of pressure for a move to European Monetary Union, within which framework countries could *share* decision making with Germany, came about at this time. Meanwhile, if speculators sensed that the policy makers were facing sharper policy dilemmas, they would test the System's ability to hold exchange rates constant. A symposium in the May 1988 issue of *The European Economy* is symptomatic: one author took the view that the new conditions warranted wider bands, others that exchange controls should be reinstated. It was easy to agree that realignments that were small enough to be accommodated within the bands and thus without disturbing the market rate were to be encouraged; and that more cooperation between the monetary authorities of the EMS countries would be necessary. Driffill (1988) argued that with suitable combinations of domestic policy discipline, interest rate policy coordination and 'small' realignments the EMS should be capable of surviving without exchange controls.

12. Realignments afforded a further kind of 'opt-out'. Whilst the 'German leadership hypothesis' is the accepted view of the way in which the EMS worked and is supported empirically by studies like that of McDonald and Taylor (1991), there are critics, notably Fratianni and von Hagen (1992). McKinnon (1993) affords a neat contrast of the 'rules of the EMS game' as in the 'Spirit of the Treaty' and as practised in the Greater Deutschemark Area.

13. With the exception of the Italian adjustment referred to above.

The EMS did, in fact, survive without realignments until 1992. Exchange rates could still have been quite volatile within the bands; or exchange rate stability could have been bought at the expense of increased interest rate volatility. In fact, it seems that volatility of both exchange rates and interest rates continued to decline (Artis and Taylor 1993b). On the other hand, a slowing down in the reduction of inflation and its convergence seemed to become obvious.

A policy perversity exhibited itself in particular cases (Italy for a while, Spain more noticeably) which gave rise to Alan Walters' famous description of the System as 'half-baked'. Whilst a sizeable dispersion of inflation still persisted, the credibility of the exchange rates was tending to bring about a convergence of nominal interest rates. This suggested that real interest rates might be lower in the higher inflation countries than in the low inflation countries - a perverse ranking. Giavazzi and Spaventa (1990) called this 'excess credibility', presumably because the exchange rate credibility is not consistent with divergent inflation: at some point in the future, the exchange rates would need to be changed to correct the cumulative misalignments (Miller and Sutherland 1991). A transitory problem may nevertheless be one of serious magnitude for policy makers over a significant period of time. This is how it appeared in this case.

A very simple model of the 'Walters Critique' may be set out in the following way:

$$\dot{\pi} = \delta D \tag{1}$$

$$D = y - \bar{y} \tag{2}$$

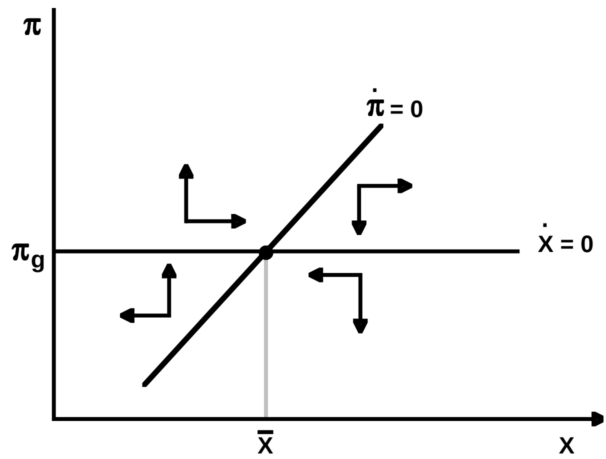
$$y = \alpha_0 - \alpha_1 \rho - \alpha_2 X - \alpha_3 Z \tag{3}$$

$$\delta, \alpha_1, \alpha_2, \alpha_3 > 0$$

Equation (1) specifies that inflation (π) will accelerate in the presence of excess demand. Otherwise it will proceed at its core (inertial) rate. Excess demand is specified in equation (2) whilst equation (3) shows aggregate demand as inversely related to the real interest rate (ρ), the real exchange rate (X) and a vector of other policies, suitably scaled, Z. The country is small relative to Germany. The real exchange rate is measured relative to the DM and equilibrium is where $y = \bar{y}$, $\pi = \pi_g$ (German inflation) and the real exchange rate is at its equilibrium value ($\bar{X}$). The nominal exchange rate is assumed to be fixed.

In Figure 6 the horizontal line drawn at $\pi = \pi_g$ is also the schedule corresponding to $\dot{X} = 0$ where the real exchange rate is not changing, as prices in Germany and the 'home country' are rising at the same rate. The schedule $\dot{\pi} = 0$ is a schedule of zero excess demand. If nominal interest rates are forced, by 'excess credibility' to German levels, then a rise in inflation will reduce real interest rates and raise

Figure 6: The Walters Effect



excess demand. To offset this, the real exchange rate must rise. So the $\dot{\pi} = 0$ schedule would slope forward, as shown. This system is not stable (see Appendix C); but if nominal interest rates rise by more than the inflation rate, insuring that real rates rise with inflation, the system can be stabilised. The system, of course, can always be 'made stable' even in the presence of excess credibility, if 'other policies' (Z) are used so as to exert deflationary pressure as inflation rises.

The systemic performance of the 'Walters Version' of this model, however, is not borne out in the empirical results quoted in Table 1. The hypothesis is that the ranking of countries by inflation should be negatively correlated with the ranking by real interest rates in the 'New EMS' period. What the table shows is that this correlation *is* significantly negative for the 'Old EMS', but positively correlated (not always significantly) for the 'New EMS'. Different sample separations are used, to accommodate the arbitrariness of dating the switch in regime. (The exclusion of Denmark simply dramatises the results.) The negative correlation for the 'Old EMS' is, in fact, not surprising when the presence of capital exchange controls is borne in mind. Such controls broke the arbitrage nexus between onshore and offshore markets and enabled interest rates to be held at 'artificially' low levels. Whilst the Walters problem does not appear to have been of systemic significance according to these results, it nevertheless seems clear that for certain countries (notably Italy and Spain) excess credibility was a real problem It was a contributor to the overvaluation revealed by the events of September 1992.

Table 1: Kendall's Rank Correlation τ

	79:4 -82:12	83:1 -91:12	79:4 -84:12	85:1 -91:12	79:4 -86:12	87:1 -91:12
ERM 6 countries including Denmark	-0.60(b)	0.73(b)	-0.47	0.73(b)	-0.07	0.47
ERM 5 countries excluding Denmark	-1.00(a)	0.60	-0.80(b)	0.60	0.00	0.40

Notes: (a) Indicates rejection of the null hypothesis at 1%.

(b) At 5% and at 10% (one-sided test), where H_0 is zero correlation and H_1 is negative or positive correlation depending on the sign of τ.

(c) ERM 6 is France, Germany, Netherlands, Belgium, Italy and Denmark. Denmark was omitted in ERM 5 owing to doubts about the comparability of the data.

10. The September 1992 Crisis

The September 1992 crisis, which saw Italy and the United Kingdom forced to float freely and also brought about devaluation of other currencies led to a period of currency instability inside the EMS (Table 2). Nearly every currency was 'attacked' and only four survived - the French franc, the Dutch guilder, the Danish Kroner and the Belgian franc. Why did these currencies survive and what does the crisis hold in store for the future of the EMS?

Table 2: The Crisis and After
(exchange rate devaluations in the ERM from September 1992)

1992	
September 12th	Lira devalued by 7 per cent
September 16th	Pound sterling floated
September 17th	Lira floated Peseta devalued by 5 per cent
November 22nd	Peseta devalued by 6 per cent Escudo devalued by 6 per cent
1993	
January 30th	Irish pound devalued by 10 per cent
May 13th	Peseta devalued by 8 per cent Escudo devalued by 6.5 per cent

The proximate events to set off exchange rate pressures were, as is well-known, the negative Danish referendum rate on EMU and the unemphatic French referendum result (the so-called 'petit oui'). The 'fundamentals' had not moved suddenly beforehand to precipitate the crisis.

There seem to be two main explanations. In one, the argument is that the fundamentals had gone wrong for several major currencies and that some smaller currencies were likely to be implicated as a 'domino effect' in the consequent correction (for example, the Irish pound would likely need to be devalued in the face of a devaluation of the pound sterling, and similarly the escudo, in the case of the peseta). In this argument, the timing of the collapse has to be assigned 'minor' significance. The misalignment of fundamentals is a cumulative process and had already reached a critical point. Any sign that governments might not be so keen to defend central parities would have sparked a crisis. In the alternative explanation, the precipitating events are crucial, in that they reveal a distinct probability of an alternative equilibrium. The fundamentals are endogenous.

There are also two other factors to be considered explicitly: the role of the German unification shock on the one hand; and the role of the Bundesbank on the other.

Let us look at these factors immediately. The unification shock, particularly given the way in which Germany chose to handle it (involving a large fiscal expansion and tight money) was a textbook case of an asymmetric shock requiring a real appreciation of the DM. This could be accomplished in one of two ways: without a nominal appreciation of the DM by relative deflation outside Germany; or, with a nominal appreciation to assist the process. The difficulty of the relative deflation requirement is that Germany's inflation aversion sets a low ceiling to the absolute rate of inflation in Germany, thus forcing a particularly low inflation requirement on other countries. The Bundesbank reportedly offered the prospect of a general realignment to her EMS partners. Why was the offer not accepted? A proximate answer appears to lie in a combination of over-adherence to the credibility model and a classic cooperation problem. The credibility model was seen as requiring that no nominal devaluations should be undertaken. However, a *general* realignment could have been presented in such a way as to minimise the loss of credibility. But since one country, France, vigorously refused to contemplate such a realignment, other countries were, in effect, forced to consider only the possibility of individual exchange rate depreciation. This maximised conflict with the credibility requirement and so the option of pre-emptive realignment was abandoned.

A second important issue here is the role of the Bundesbank. It is readily observable that where the Bundesbank chose to pledge its commitment to defend the French franc/DM rate, that rate survived. Simply put, since no-one has more

DM than the Bundesbank such a commitment is bound to defeat even determined and well-financed speculators. A literal reading of the EMS statutes suggests, however, that a commitment to infinite intervention at the margins is an important part of the system, something which *all* participants can rely on. The speculative crisis has drawn attention to the fact that in the early days of the EMS the Bundesbank obtained an assurance from the German Government that it could be released from such an obligation if the commitment should appear to undermine the Bundesbank's ability to maintain stability of the currency domestically. No-one knows whether this escape clause was invoked during the crisis - or was about to be invoked, which is really all that is necessary.[14] However, reflection clearly suggests that no central bank could afford to accept an obligation of unlimited intervention against weak currencies. This would be to run the risk of not only underwriting the inflationary impulses of a weak currency country, but of importing those impulses via a continuous increase in the money base and thereby increasing prices. Under the operating conditions of an earlier decade these issues were not so obvious. Capital controls and realignments kept them at bay. At higher absolute levels of inflation the need for individual countries to accept stabilisation packages was usually more obvious. Most intervention was intra-marginal and the Bundesbank did not participate in this type of intervention.

The combination of overvaluation, discrepant policy cycle and 'domino effect' goes a long way - arguably sufficiently far - towards explaining the crisis.

Figures 7, 8 and 9 illustrate the argument with respect to competitiveness. It seems clear that cumulative inflation differentials, combined with an absence of nominal exchange rate adjustment, produced overvaluation in the lira and peseta. At least, if these currencies were locked in at the 'right' exchange rate earlier, that exchange rate had become overvalued by 1992. However, this does not go far enough. The position of Ireland does not seem to be explained by overvaluation. Here, two other factors must be brought in. The first is the 'domino' effect. Trade with the United Kingdom is sufficiently important for Ireland that a sizeable pound sterling devaluation must create a presumption that the Irish pound is overvalued. (The domino argument goes for the Portuguese escudo also.) The second factor, important also for the United Kingdom, is the 'policy cycle factor'. A country that maintains its competitiveness by deflationary policies may increasingly be suspected of nearing the point at which its commitment to peg its currency will be abandoned. The UK Government had understood that pegging to the DM could introduce policy conflict but its appreciation of the extent of such conflict was too

14. There is absolutely no *published* record that the Bundesbank did other than carry out its intervention obligations to the letter. Analysts of the Italian case in particular, however, have drawn attention to the 'signals' sent out by Chancellor Kohl's visit to the Bundesbank on 11 September.

Figure 7: Cumulative Inflation Differentials
(March 1987 = 100)

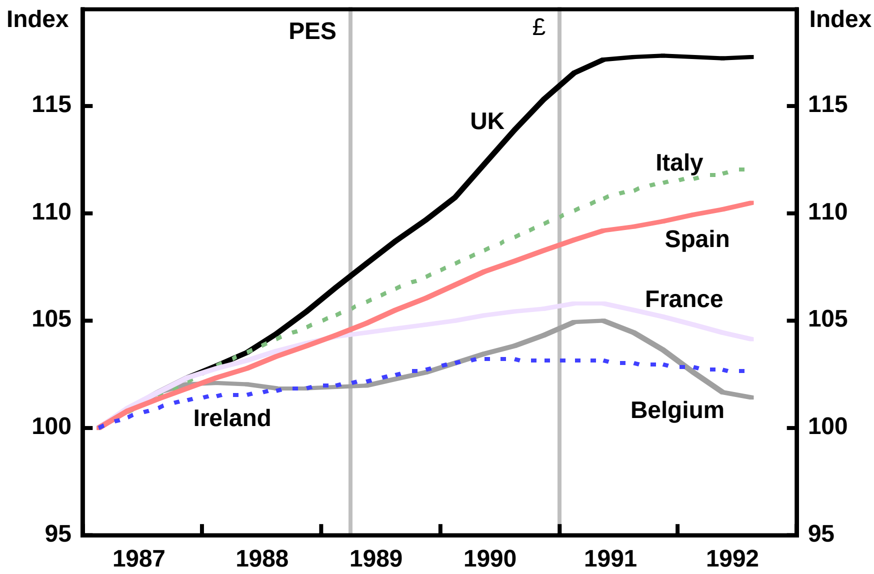
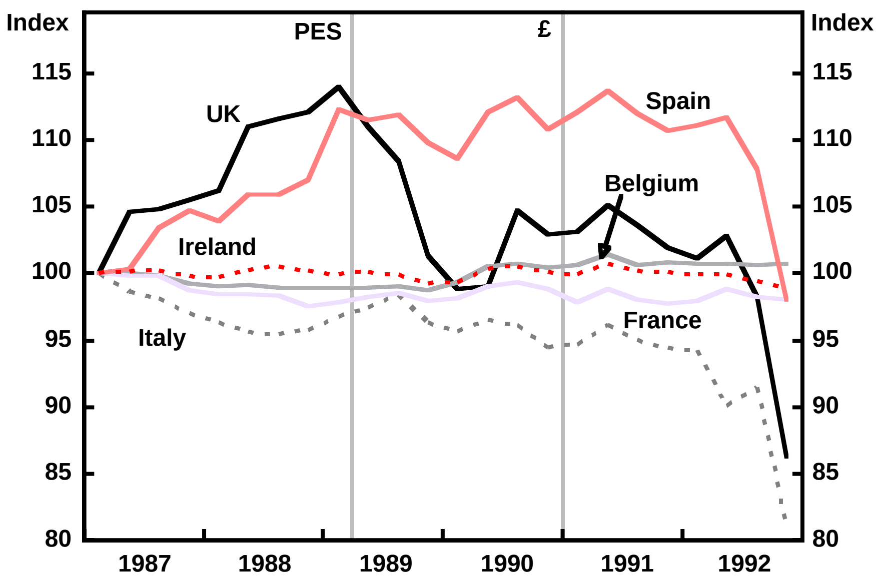
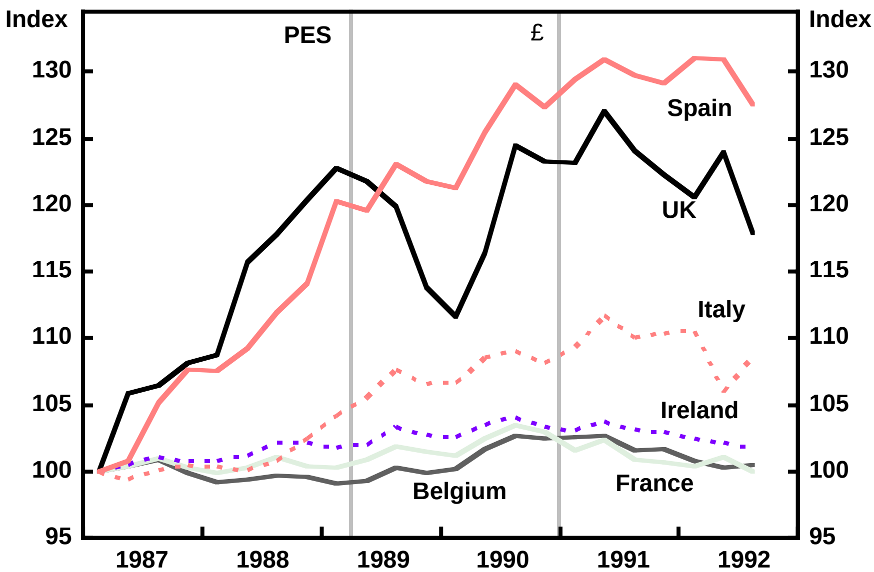


Figure 8: Nominal Exchange Rates versus the Deutschemark
(March 1987 = 100)



sanguine. In its 1991 restatement of the Medium Term Financial Strategy it stated that: ‘There may be occasions when tensions rise between domestic conditions and ERM obligations, with domestic conditions pointing to interest rate levels either higher or lower than those indicated by ERM obligations’. The problem is, of course, that when a devaluation is in the offing, the choice is not between an interest rate at German levels and an interest rate at lower levels, but between a rate which is quite possibly a multiple of the German rate and the more desirable lower rate.[15] In fact, United Kingdom interest rates were maintained well within the ‘credibility bands’ (see Figure 10)[16] until the edge of the crisis was reached, though it is noticeable that the rate is slipping towards the floor value from before

Figure 9: Real Exchange Rates[(a)] versus the Deutschemark
(March 1987 = 100)

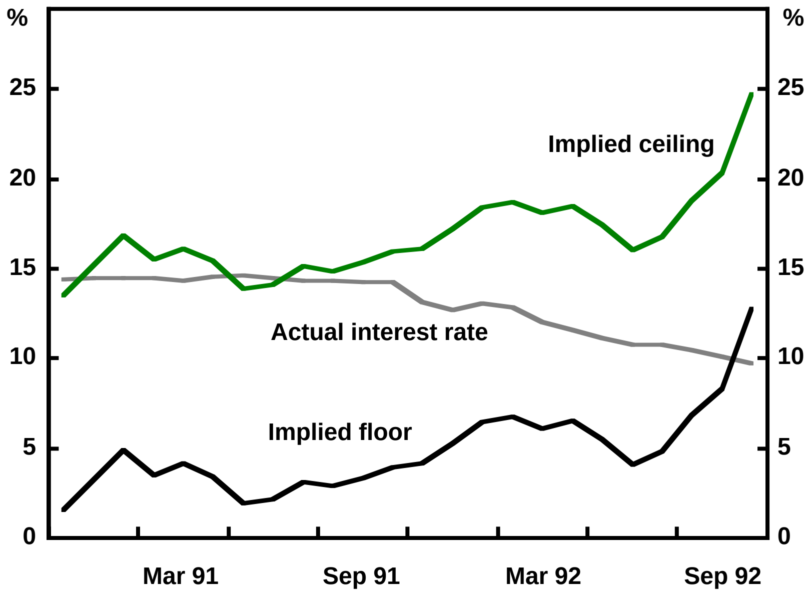


Notes: (a) Inflation adjusted using consumer prices.

15. The trade-off is particularly sharp when, as appears to be the case for the United Kingdom, the economy is substantially a ‘floating rate economy’ where debt contracts are commonly determined at a variable interest rate.

16. The credibility bands are computed by assuming that the maximum exchange rate depreciation/appreciation is represented by the official ceiling and floor around the ERM central parity against the DM. Notice that, strictly speaking, because the ERM commitment is multi-bilateral, it was not always the DM that appeared to be proximately the hardest currency.

Figure 10: Interest Rate Credibility Bands: United Kingdom



the beginning of 1992. The continued rise in unemployment in the United Kingdom increasingly made it appear that the commitment could be shaken.[17] Something of the same kind could also be said for Ireland. For the United Kingdom, also, it is important to note that the best available estimate of the fundamental equilibrium rate suggested that the DM parity was some 20 per cent overvalued upon entry (Wren-Lewis *et al.* 1990).

The combination of overvaluation, domino effect and asynchronous policy cycles can account, it would seem, for the major devaluations and crisis casualties. The problem, from this point of view, is more in explaining why the system had been so stable while these misalignments were building up.

The suggestion put forward by Eichengreen and Wyplosz (1993) attempts to tackle this issue. They argue that the system was essentially one of multiple equilibrium. Their argument is that the convergence criteria in the *Maastricht Treaty* and the anticipation of an early move to EMU maintained in speculators' minds the probability that governments would pursue highly disciplined policies. Once the Danish and French referendum results undermined this assurance, the probability that countries would pursue less disciplined policies became real. A

17. As Figure 10 shows, interest rates *fell* during 1991-92 before the crash, but unemployment rose, so that 'domestically desired' interest rates were in effect falling faster than actual rates.

successful raid on a currency would force that currency off the EMU track and make it more likely that discipline would be relaxed. Forward-looking exchange rate fundamentals are, in effect, endogenous. A successful raid shifts the fundamentals in a manner which 'justifies' the raid.

It seems that the two approaches are, in fact, complementary. The fact is that whilst most currencies were attacked, not all succumbed. For those that did, an explanation based on a combination of over-valuation, policy cycle and domino effects makes good sense. But clearly there is a 'timing problem'. The multiple equilibrium approach helps rationalise the timing but does not explain why not all currencies were successfully attacked.

11. The Sequel: A Two-Tier Solution?

In the minds of many observers the crisis of 1992 has underlined the relevance of a 'two-tier' sequel. An inner group (Benelux, France, Germany and Denmark) may narrow their margins and may proceed directly to EMU under the Maastricht 'two-tier' clause. An outer fringe may maintain wider margins and a slower timetable for participation in EMU.

There are two points of interest worth commenting upon in such a potential solution. Firstly, there is the issue of how far the Bundesbank is capable, under present conditions, of maintaining its 'own' monetary policy, let alone providing adequate leadership. Broad consideration of the extent of currency substitution within the inner tier and the difficulties of sterilisation in open capital markets provide reminders that substantial doubts must exist in both respects.[18] The second point of interest is that the setback experienced by the outer fringe of countries - including the destruction of their stock of credibility - does not yet seem to have significantly lessened their commitment to exchange rate targeting. This must underline the findings of Honkapohja and Pikkarainen (1992) to the effect that the attachment to 'fixity' of the EMS countries owes more to political than economic factors. The long stop is that the achievements of the EC in dismantling protectionism between member countries require some kind of real exchange rate stability. With appropriate arrangements for flexible adjustment this has so far been seen as creating a bias in favour of nominal fixity. Nevertheless, in the immediate future, exchange rate promptings are going to be less insistent in influencing the conduct of monetary policy than they have been in the recent past for this group of countries. There is certainly scope for improvement in the conduct of monetary policy; whether it will be realised has to remain another question.

18. These issues have been raised by the International Monetary Fund (IMF) in its *World Economic Outlook* for May 1993.

Appendix A: The Transmission Mechanism of Monetary Policy in a Causal Framework

A.1 Introduction

The nature of the transmission mechanism of monetary policy and its stability remain important issues for investigation. In a number of countries, the 1980s witnessed a process of liberalisation which might have been expected to alter the characteristics of the transmission mechanism. Artis (1992) represents an attempt to comment on this issue by examining the stability of measures of unconditional linear feedback connecting monetary variables to output and prices (Geweke 1982, 1984). Covering the United States, the United Kingdom, Italy, France and Germany, that study found less evidence of disturbance to some of these relationships than might have been expected.

Accordingly, in this Appendix, an attempt is made to carry the analysis further. By focusing on measures of *conditional* linear feedback (also introduced by Geweke (1984), it should be possible to identify some characteristics of the transmission mechanism - for example, whether money affects prices *via* the exchange rate or in some other way.

Two important restrictions on the nature of this exercise can be stated as follows. Firstly, the measures that are used presume a predominantly causal structure to the monetary process and our interpretation is conditioned accordingly. Secondly, it will become apparent that in effect, what we are doing is translating from statements about the information content of variable x for predicting variable y in the presence of information on variable z to statements about the actual causal structure of monetary processes, in which x may be described as influencing y *through* z (or not, as the case may be). The term 'transmission mechanism' is used here, then, in a precise technical sense, rather as, in a similar way, the term 'causality' has been employed before in related studies.

The methods used to isolate the transmission mechanism rely on an assumption that the underlying data series are stationary and it is usual to find that investigators work with log-differenced time series data for this reason. Thus the relationships estimated resemble the dynamic second-stage equation from the Engle-Granger two-stage cointegration procedure, with the omission of the error-correction term (lagged residual from the first stage cointegration equation). If the variables in question are in fact cointegrated at the first stage, this omission would represent a misspecification of the true relationship. In such situations, as Granger (1988, p. 204) has noted: 'It does seem that many of the causality tests that have been conducted should be re-considered'.

We therefore take care both to check for the precise nature of the stationarity-inducing data transformations required, and to investigate the possibility that our series are cointegrated. Our procedures are, in this respect, similar to those adopted by Stock and Watson (1989).

A.2 Methodology

The methodology employed relies on measures first introduced by Geweke (1982, 1984). In particular, we focus on the concepts of conditional and unconditional linear feedback.

In Geweke's terminology, the *unconditional* linear feedback between any two variables, say x and y, $F_{x,y}$, can be regarded as the sum of feedback from y to x ($F_{y\to x}$), from x to y ($F_{x\to y}$) and the simultaneous feedback between them, indifferently $F_{x.y}$ or $F_{y.x}$. The F measures are themselves generated as the log ratios of conditional variances, so that:

$$F_{y\to x} = \ln\left\{\mathrm{var}\left(x_t \middle| x_{t-i}\right)/\mathrm{var}\left(x_t \middle| x_{t-i}, y_{t-i}\right)\right\} \tag{A1}$$

for $i = 1...p$, where var $x_t|x_{t-i}$ is the forecast variance of x_t when only information on x_{t-i} is used, and var $x_t|x_{t-i}, y_{t-i}$ indicates the forecast variance of x_t when information on both x_{t-i} and y_{t-i} is available.

$F_{x\to y}$ is defined similarly, as:

$$F_{x\to y} = \ln\left\{\mathrm{var}\left(y_t \middle| y_{t-i}\right)/\mathrm{var}\left(y_t \middle| y_{t-i}, x_{t-i}\right)\right\} \tag{A2}$$

Finally, letting the index j run from $0...p$, instantaneous feedback can be defined as:

$$F_{x.y} = \ln\left\{\mathrm{var}\left(x_t \middle| x_{t-i}, y_{t-i}\right)/\mathrm{var}\left(x_t \middle| x_{t-i}, y_{t-j}\right)\right\} \tag{A3}$$

In practice, it is not required to constrain the index of lag length on the 'own' variable to be the same as that on other variables, and in the results to be reported below, we standardise at 18 months for the 'own' lag whilst experimenting with alternative lag lengths on other variables.

The bivariate (x, y) relationships involved in the linear feedback measures introduced above may be conditioned on third (and more) variables. Suppose, for example, that information on variable z was thought to be relevant to predicting x and that it was desired to investigate the additional value of information on y for predicting x. Then the measure of *conditional* linear feedback:

$$F_{y\to x|z-} = \ln\left\{\mathrm{var}\left(x_t \middle| x_{t-i}, z_{t-i}\right)/\mathrm{var}\left(x_t \middle| x_{t-i}, z_{t-i}, y_{t-i}\right)\right\} \tag{A4}$$

would be appropriate.

Comparison of the unconditional and conditional feedback measures provides evidence which we can interpret as illuminating the transmission mechanism. If, for example, $F_{y \to x}$ is significant at some lags but $F_{y \to x|z-}$ is not, then we could say that at those lags y is causing x 'through' z. Or, it might turn out that both $F_{y \to x}$ and $F_{z \to x}$ are significant and that $F_{y \to x|z-}$ and $F_{z \to x|z-}$ are not significant. In this event, we would not be able to distinguish the elements of the transmission mechanism and it might be appropriate to provide measures of the 'composite' feedback $F_{y,z \to x}$ to mark this fact.

The Geweke measures are, by construction, positive. They are assumed to be asymptotically distributed as χ^2. Mittnik and Otter (1989) report Monte Carlo results suggesting that the incidence of Type 1 error (wrongly rejecting, in this case, the absence of linear feedback) is satisfactorily low (and lower than that of an alternative procedure they consider). It is worth noting that the point estimate of the F measures can be construed as a measure of 'strength of effect', so that the bigger is the value, the bigger is the effect.

Successful inference depends on the data employed being rendered stationary. In this context, recent work has drawn attention to the need to test for the unit root properties of the data and the possible influence of time trends (Campbell and Perron 1991). The example of Stock and Watson (1989) is followed in this instance, as discussed further below.

It is possible that the series under examination might exhibit cointegration. Then, the feedback measures identified above would be misspecified if this were not taken into account. Therefore, we need to check for the presence of cointegrating vectors in our data set. As it so happens, cointegration is not a property of our data set, so to that extent these considerations remain hypothetical.[19]

A.3 The Data

In Artis (1992), monetary relationships were studied, using the measures of unconditional feedback described above for five countries: the United States, the United Kingdom, France, Germany and Italy. Limited reference was made to conditional feedback measures in that paper, where the main focus was on the stability of monetary relationships through the 1980s. Particular attention was paid to the issue whether some definitions of the monetary aggregates were more robust than others. Whilst a number of disturbances were identified, in line with the findings of other investigations such as Blundell-Wignall, Brown and Manassé (1990), it was possible to conclude *ex post facto* that for every country there was at least one monetary aggregate stably related to either output or prices

19. Of course, it is always possible that subsets of the variables of interest *would* cointegrate in the presence of additional, unexplored, variables not included in the data set.

or both. An additional and perhaps more surprising conclusion was that the exchange rate (effective rate definition) could not be found to be related to other variables (except instantaneously with the interest rate).

In this paper we focus on those monetary aggregates which appear, on the basis of the earlier study, to have a stable relationship with other variables, with the objective of tying down the transmission mechanism involved. In other respects also, the data set for this study is smaller than for the earlier one. In particular, the country sample has been reduced to four by the exclusion of Italy.[20]

The data employed are monthly, drawn predominantly from the IMF's *International Financial Statistics* data tape (with supplementation from national sources for the United Kingdom) for the period 1970:01 to 1990:09 (in the case of France, a shorter data period for the money supply definition used here restricts the sample to 1978:01 to 1990:09). As the methods used are 'greedy' for observations, high frequency data seemed desirable, the more so in a study of the transmission mechanism of monetary policy, much of which might be expected to work out in the 'short term'. The data are seasonally adjusted at source, except for prices which have a seasonal component, necessitating the use of seasonal dummies (not reported) in the regressions. Real activity (y) is represented by industrial production, prices (p) by retail prices, exchange rates (e) by effective rate indices and interest rates (i) variously by the treasury bill rate (UK), federal funds rate (US), the money market rate (France) and interbank deposit rate (Germany). Money (m) is M0 in the United Kingdom, M2 in the United States and France, M1 in Germany.

It is well known that many macroeconomic time series contain unit roots (Nelson and Plosser 1982). In Table A1 we report the results of a screening of our data set for the presence of unit roots in the data generating processes. The regressions test for up to two unit roots by examining both levels and first differences and likewise investigate for the significance of time trends up to the second order. The first two columns of results present Dickey-Fuller t statistics for the absence of a unit root in the levels of the data (data are in logs). The regressions were run with up to four and up to six lags (first and second columns); the null of a unit root is not rejected in any case. The test statistics in columns three and four (again differentiated by whether four or six lags are allowed) on the other hand, indicate wholesale rejection of the null of a second unit root, with the partial exception of prices (inflation). Here, it can be seen that rejection is marginal. When four lags are included rejection occurs at the 5 per cent level or better everywhere. But when six lags are incorporated, the null is not rejected for either the United States or France, although rejection occurs at the 1 per cent level for Germany and

20. The original study employed only one measure of money in the Italian case whereas three measures were examined in each of the other cases.

at the 5 per cent level for the United Kingdom. Stock and Watson (1989) report similar ambiguities in their examination of US (wholesale) price data, noting problems associated with the first oil price shock. The last two columns in the table report the t statistics on the constant term ('drift') and on the time trend in the regressions (with six lags) of the first difference of the variables concerned. For the United States, the United Kingdom and France (but not for Germany), money growth has a significant trend whilst the same is true for inflation in Germany, the United Kingdom and France. In these instances it appears appropriate to work with de-trended data in the subsequent investigations. Interest rates, exchange rates and output appear well characterised as having a single unit root with no drift.

Table A2 tests for cointegration among the series, including all possible pair-wise cointegrations (except for those involving the exchange rate)[21] and the multivariate cointegrations *y*, *m* and *i* and *p*, *m* and *i*. The Dickey-Fuller tests on the residuals of these regressions accept the null of no-cointegration. However, it therefore appears that borrowing notation from Stock and Watson (1989), we may characterise the data generating processes as:

$$
\begin{aligned}
\Delta i_t &= \Delta\rho_t \\
\Delta y_t &= \Delta\eta_t \\
\Delta m_t &= \alpha_{m0} + \alpha_{m1}t + \Delta\mu_t \quad \text{(USA, UK, France; Germany, } \alpha_{m1}=0\text{)} \\
\Delta p_t &= \alpha_{p0} + \alpha_{p1}t + \Delta\pi_t \quad \text{(UK, France, Germany; USA: } \alpha_{p1}=0\text{)} \\
\Delta e_t &= \Delta\varepsilon_t
\end{aligned}
$$

where $\Delta\rho_t$, $\Delta\eta_t$, $\Delta\mu_t$, $\Delta\pi_t$, and $\Delta\varepsilon_t$ are mean-zero stationary processes.

A.4 Hypotheses and Results

In a textbook model of monetary policy, the central bank is the monopoly issuer of 'high-powered' or base money, for which the public and the banking system have an assured (and somewhat interest-inelastic) demand. The central bank can use its monopoly power to regulate the terms - a short-term interest rate - on which base money is made available to the system. In a deterministic setting of this type, monetary policy can be described, with indifference, as the setting of the amount of base money available, or as the setting of 'the' short-term interest rate through which the central bank regulates the supply of base money. In fact, central bankers often seem to prefer to describe their activities in terms of the setting of 'the' interest rate, possibly on the grounds that alternative methods of rationing base money are not often in evidence and because they attach greater value to smoothing interest rates than to smoothing monetary base. However, in general,

21. Cointegration tests on the exchange rate were limited in view of the unfavourable evidence obtained.

stochastic analysis of the type introduced by Poole (1970) illustrates the circumstances under which monetary or interest rate targeting might be preferred. As is well known, if the demand for money is relatively unstable, this approach suggests the superiority of taking the interest rate as the immediate target (instrument) of policy; provided that it feeds back on a nominal variable, such a policy need not have the disastrous consequences indicated by Sargent and Wallace (1975). (See McCallum (1981) and Edey (1990)). There is a suggestion in the literature that during the 1980s, the central banking authorities of the developed countries have converged on a view that monetary policy is best conceived of as a matter of setting 'the' short-term interest rate with respect to achieving objectives in price and output directly (Batten *et al.* 1990). In this story monetary aggregates are by-passed. An explanation might be the unsettling experience of the effects of financial liberalisation on the behaviour of the monetary aggregates in some countries. An alternative view is that, in fact, the focus on a narrow set of interest rates unduly restricts the perception of what monetary policy can (and does) do. The monetarist literature of the 1960s is full of suggestions to this effect.

These considerations underlie two of the principal issues to be investigated in the rest of this paper. They are these: is there evidence that money is important for output and prices? And, if so, is that importance fully accounted for by the significance that money has for interest rates and the importance of interest rates for prices and output? These questions can of course also be asked of the data *in reverse*. That is, we can ask whether interest rates are stably related to output and prices and whether, if so, that relationship can as well or better be accounted for by the effect of interest rates on money, and of money on output and prices.

Descriptions of the transmission mechanism of monetary policy generally go further, to indicate how it is that money and/or interest rates affect prices and/or output. For example, it is often argued that in an open economy, the exchange rate is a major 'channel of effect' of monetary policy; whilst some form of Phillips curve remains a standard feature in the transmission of monetary actions, which impact on real output, to prices. The concepts of unconditional and conditional causality can also be brought to bear on these issues.

A.4.1 Money and Interest Rates: Output

Tables A3 to A6 provide the necessary information to analyse the money/interest rate-output relationship. Table A3 gives the unconditional feedback measures for money and output. As can readily be seen, the money-output feedback appears to be highly significant at all but the shortest lag for the United Kingdom, significant at all lags for France, and more weakly for the United States. In the case of Germany, the feedback essentially appears only significant at the longest (12-month and more) lags.[22] 'Reverse' causality is prominent and highly significant at all lags for France, and is quite significant for the USA. Instantaneous feedback is present, but mainly only at the 10 per cent level of significance, in the USA, but not elsewhere.

The feedbacks in Table A4 are not so pervasive. Interest rate-output feedbacks are significant at some lag for every country. But in Germany, it is only detectable at the longest (24-month) lag at better than 5 per cent levels of significance. In France, the feedback is significant at such levels only at the 18-month and 24-month lags; in the United Kingdom, the feedback is significant at nearly all lags but not strongly so. In the United States, the feedback is strongly significant at 18 and 24 months, and is significant at the 5 per cent level also at 12 months.

Table A5 then shows that the relationship between interest rates and money - perhaps, not so pervasive as might be supposed. In general, little significant feedback, either from interest rates to money or in the reverse direction, is evident in either the United Kingdom or France, though instantaneous feedback can be found for the United Kingdom at all lags at the 5 per cent level of significance. In Germany and more especially the United States, on the other hand, the feedbacks are by contrast pervasive and strong.

When the money-output and interest rate-output feedbacks are conditioned on the 'other' variable, as in Table A6, some interesting results emerge. To start with, for the most surprising case, the United Kingdom, what is revealed is that the powerful money-output feedback is not weakened when conditioned upon the interest rate. In the language of the transmission mechanism, the importance of money for output - which is clear at all lags except the shortest - does not depend upon an interest rate 'channel of effect'. Indeed, if anything, the opposite is the case. Insofar as the interest rate is important for output, it is through money: for, when the conditional feedback is computed, the significance of the former feedback disappears. The results for France are in a similar mould. Here, also, the money-output feedback is important and its significance is not notably weakened when conditioned on the interest rate.

The results for the United States confirm a more Keynesian view of the transmission mechanism. Here, conditioning the money-output feedback on the interest rate removes its significance, whilst conditioning the interest rate-output feedback on money serves to sustain its significance.

The money-output feedbacks for Germany are somewhat less pervasive than elsewhere; but conditioning on the interest rate does not weaken them.

22. Stock and Watson (1989) found that de-trending money growth revealed stronger money-output links than were apparent otherwise. Krol and Ohanian (1990), however, found that this effect was US-specific and was not a feature of data for other countries in their sample.

On this basis, one country in the sample - the United States - exhibits a Keynesian transmission mechanism; but two - the United Kingdom and France - clearly do not, whilst the fourth country, Germany, also falls into the second rather than the first camp.

Do these findings for the transmission mechanism in respect of output apply equally to prices? Tables A7 to A9 provide the relevant evidence on this question.

A.4.2 Money and Interest Rates: Prices

Table A7 shows that it is only for the United Kingdom that a significant money-prices feedback can be detected, although 'reverse' causality (prices to money) is present everywhere. Nor is the absence of feedback the consequence of overlooking the presence of a long-run cointegrating relationship - for we have already tested for this (Table A2) and found an absence of bivariate cointegration between money and prices. The UK money-prices feedback, moreover, remains significant when conditioned upon the interest rate (Table A9). Table A8 shows, however, that interest rates are important for prices in every country (in Germany only at the longest lag), including the United Kingdom. Moreover, in Table A9, it appears that when these interest rate-prices feedbacks are conditioned on money, they remain significant (with the striking exception of the United Kingdom).

On this basis then, our conclusion is that the transmission mechanism of monetary policy works through the interest rate for prices (except in the United Kingdom) and through the money supply for output (except in the United States). We do not find any general cases where it is impossible to tell money and interest rates apart, perhaps a somewhat surprising finding.

A.4.3 The Phillips Curve

The results in Table A10 enable us to consider whether money (see Table A8) or interest rates (see Table A9) have their effects on prices 'through' the Phillips curve - that is, whether or not the relevant feedback, when conditioned on output, tends to disappear.

In fact, the United Kingdom is the only case where a significant money-prices feedback was detected. The strength and significance of that feedback is not altered by conditioning on output, suggesting on this interpretation that the Phillips curve is not an important part of the transmission process.

In Table A9, however, many instances were reported in which a significant interest rate-prices feedback was detected. Turning then to Table A10, it can be seen that only in the United States is there a strong output-prices feedback; so it is not too surprising to find that for this economy conditioning for the interest rate-prices feedback on output causes the feedback to weaken in significance considerably. The Phillips curve effect is important. For France and the United Kingdom, this same form of conditioning does not remove or significantly change the quite strong interest rate-prices feedbacks to be found in those countries. In the case of Germany, the feedback is much less pervasive to start with.

A.4.4 The Exchange Rate

During the 1980s, many countries discovered the role of the exchange rate in the monetary transmission mechanism. Disinflating through adherence to an external standard rather than through maintaining an internal standard became the norm, especially in Europe. It therefore seemed worthwhile investigating the position of the exchange rate in the transmission mechanism. Tables A11 to A13 illustrate this. The results shown are disappointing. The predominant significant relationship is an instantaneous one involving the interest rate with the exchange rate. There is little evidence of exchange rate effects on output (Table A12) or on inflation (Table A13). The main exceptions are the exchange rate feedback to prices in France, less significantly in Germany and the United States. Also, the role of the exchange rate in the transmission mechanism of monetary policy does not appear to be strong.

It could be argued that the effect of nominal exchange rates on output ought to be expected to be weak and that a real exchange rate would be a more appropriate concept to investigate; and regarding prices, it could be argued that a more appropriate transformation would be (e+p*), the domestic price equivalent of foreign prices. Limitations of time prevent the investigation of these claims. But it is not obvious that it is inappropriate to use the nominal exchange rate given the techniques used here.

A.5 Conclusions

The results obtained provide evidence that the transmission mechanism of monetary policy varies from one country to another in our sample. This may be due in part to our prior selection of particular (and different) monetary magnitudes for study in the different cases. This given, the study provides strong support for the conception of monetary policy as setting interest rates to hit targets for prices directly rather than through money (with the United Kingdom as a prominent exception). On the other hand, we have evidence that money is important for real output; only in the United States is it appropriate to say that this effect is mediated ‘through’ the interest rate. It also appears that it is only in the United States that the Phillips curve is an important part of the transmission of monetary actions (on interest rates) to prices.

The suggestion that in an open economy the exchange rate provides a significant part of the transmission mechanism of monetary policy received little support from the techniques (and data definitions) used here.

Two caveats should be repeated. Firstly, the techniques and interpretations offered appeal essentially to an assumption of causality in the processes concerned. Yet it may be that the evidence we have, for example, of interest rates feeding back to prices at quite long lags is influenced by central bank inflation predictions and reaction functions in setting interest rates. Secondly, the term ‘transmission mechanism’ has been used in a technical way; confronted by our evidence that M0 causes changes in output (and prices) in the United Kingdom in a way that is not significantly connected to the interest rate, central bankers would be likely to argue that this ‘cannot be’ a correct description of their policy, which is to supply M0 ‘on demand’ at the given interest rate. M0 must be a proxy for some other variable that is ‘really doing the work’. This may very well be, but for the moment it is unproven, and may well remain unprovable.[23]

23. For the case in question, supplementary regressions were run conditioning on retail sales data, on the grounds that retail sales might be the key demand variable which is ‘really doing the work’. The conditioning was however completely unsuccessful, leaving the strong and significant leads of money over prices and output intact.

Results

Table A1: Tests for Unit Root and Time Trends

		Unit root tests				t statistics for a regression of ΔX on:	
	Series	DF(Z)[a]	DF(Z)	DF(ΔZ)[a]	DF(ΔZ)	Drift	Time
United States	*y*	-3.28	-3.21	-5.29**	-4.78**	0.80	-0.25
	m	0.21	0.16	-4.97**	-4.84**	4.04**	-2.66**
	p	-0.93	-1.14	-3.86*	-3.10	2.46**	-1.29
	i	-2.33	-2.11	-7.47**	-7.35**	1.02	-0.91
	e	-1.43	-1.43	-5.64**	-4.87**	0.14	-0.33
United Kingdom	*y*	-2.57	-2.49	-7.04**	-6.21**	0.25	0.09
	m	-0.54	-0.68	-5.45**	-4.09**	3.61**	-2.57**
	p	-0.53	-1.06	-4.90**	-3.78*	2.69**	-1.72*
	i	-2.76	-3.29	-5.66**	-5.38**	0.15	-0.04
	e	-2.09	-2.16	-6.77**	-5.90**	-1.40	1.06
France	*y*	-2.92	-3.31	-7.12**	-5.05**	1.04	-0.59
	m	0.25	0.09	-5.34**	-4.50**	3.47**	-3.24**
	p	0.41	-0.47	-3.73*	-2.82	2.88**	-2.21*
	i	-2.56	-2.55	-6.16**	-5.33**	0.22	-0.17
	e	-2.02	-1.91	-5.18**	-5.37**	-0.14	-0.04
Germany	*y*	-2.06	-2.17	-6.73**	-5.59**	0.57	-0.07
	m	-2.18	-2.24	-5.41**	-4.51**	2.71**	-1.36
	p	-0.78	-0.48	-6.73**	-5.99**	-5.59**	-4.49**
	i	-2.49	-2.31	-8.47**	-6.26**	-0.61	0.64
	e	-2.30	-2.20	-7.19**	-5.68**	-1.71*	-1.04

Notes: Significant at the 1% level (**) and 5% level (*). All statistics are based on regressions with six lags except (a) which has four lags. DF(Z) and DF(ΔZ) refer to the Dickey-Fuller t statistic computed for the level (Z) and the first difference (ΔZ) in a regression including a constant and a time trend (Fuller 1976, p. 373).

Table A2: Tests for Cointegration

System	Engle-Yoo (Z) United States	United Kingdom	France	Germany
$y = \alpha_0 + \alpha_1 i$	-0.66	-1.31	-1.43	-0.30
$y = \alpha_0 + \alpha_1 m$	-3.01	-2.08	-0.60	-2.14
$y = \alpha_0 + \alpha_1 i$	-0.67	-1.49	-1.97	-0.39
$y = \alpha_0 + \alpha_1 m + \alpha_2 i$	-2.86	-2.15	-0.59	-2.13
$p = \alpha_0 + \alpha_1 i$	-0.75	-1.41	-0.76	-1.09
$p = \alpha_0 + \alpha_1 m$	-1.91	-2.33	-0.95	-1.71
$p = \alpha_0 + \alpha_1 m + \alpha_2 i$	-2.49	-2.28	-1.73	-1.39
$p = \alpha_0 + \alpha_1 y$	-2.50	-1.78	-2.14	-1.82
$e = \alpha_0 + \alpha_1 i$	-1.45	-1.77	-0.99	-1.28

Note: Engle-Yoo refers to the Engle-Yoo (1987) Augmented Dickey-Fuller tests with four lags.

Table A3: Money - Output Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta m \rightarrow \Delta y$	0.150+	0.142*	0.103*	0.096*	0.092**	0.058**
	$\Delta y \rightarrow \Delta m$	0.207**	0.142*	0.089+	0.081*	0.067*	0.053**
	$\Delta m - \Delta y$	0.016+	0.016+	0.018*	0.017+	0.017+	
United Kingdom	$\Delta m \rightarrow \Delta y$	0.253**	0.199**	0.134**	0.127**	0.077**	0.008
	$\Delta y \rightarrow \Delta m$	0.115	0.084	0.039	0.037	0.035	0.005
	$\Delta m - \Delta y$	0.003	0.009	0.007	0.007	0.005	
France	$\Delta m \rightarrow \Delta y$	0.400**	0.289**	0.235*	0.222**	0.168**	0.160**
	$\Delta y \rightarrow \Delta m$	0.416**	0.372**	0.308**	0.267**	0.228**	0.146**
	$\Delta m - \Delta y$	0.000	0.001	0.003	0.004	0.005	
Germany	$\Delta m \rightarrow \Delta y$	0.225**	0.205**	0.110*	0.059	0.053+	0.007
	$\Delta y \rightarrow \Delta m$	0.144	0.102	0.083	0.074+	0.038	0.005
	$\Delta m - \Delta y$	0.003	0.002	0.003	0.005	0.006	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '$\rightarrow$' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A4: Interest Rate - Output Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta i \rightarrow \Delta y$	0.225**	0.160**	0.116*	0.073+	0.040	0.026
	$\Delta y \rightarrow \Delta i$	0.280**	0.262**	0.226**	0.184**	0.163**	0.157**
	$\Delta i - \Delta y$	0.114**	0.108**	0.109**	0.104**	0.083**	
United Kingdom	$\Delta i \rightarrow \Delta y$	0.161+	0.137*	0.090+	0.77*	0.049+	0.006
	$\Delta y \rightarrow \Delta i$	0.089	0.075	0.060	0.036	0.021	0.005
	$\Delta i - \Delta y$	0.008	0.008	0.010	0.009	0.005	
France	$\Delta i \rightarrow \Delta y$	0.211**	0.149*	0.058	0.031	0.024	0.016
	$\Delta y \rightarrow \Delta i$	0.129	0.094	0.075	0.063	0.056+	0.014
	$\Delta i - \Delta y$	0.001	0.001	0.001	0.001	0.001	
Germany	$\Delta i \rightarrow \Delta y$	0.217**	0.087	0.048	0.047	0.039	0.029+
	$\Delta y \rightarrow \Delta i$	0.106	0.091	0.078	0.076*	0.059*	0.021
	$\Delta i - \Delta y$	0.000	0.001	0.001	0.000	0.001	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A5: Money - Interest Rate Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta m \rightarrow \Delta i$	0.146	0.119+	0.095*	0.088*	0.082**	0.055**
	$\Delta i \rightarrow \Delta m$	0.361**	0.330**	0.298**	0.284**	0.262**	0.190**
	$\Delta m - \Delta i$	0.034**	0.028*	0.026**	0.027*	0.025*	
United Kingdom	$\Delta m \rightarrow \Delta i$	0.137	0.088	0.074	0.070+	0.060*	0.050*
	$\Delta i \rightarrow \Delta m$	0.150+	0.101	0.066	0.033	0.015	0.009
	$\Delta m - \Delta i$	0.012	0.021*	0.023*	0.023*	0.021*	
France	$\Delta m \rightarrow \Delta i$	0.306*	0.257*	0.097	0.052	0.016	0.011
	$\Delta i \rightarrow \Delta m$	0.240	0.158	0.115	0.055	0.053	0.007
	$\Delta m - \Delta i$	0.017	0.017	0.016	0.018	0.012	
Germany	$\Delta m \rightarrow \Delta i$	0.226**	0.161**	0.090+	0.086*	0.080**	0.054**
	$\Delta i \rightarrow \Delta m$	0.446**	0.323**	0.290**	0.249**	0.229**	0.218**
	$\Delta m - \Delta i$	0.020*	0.018*	0.015+	0.011	0.008	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A6: Money, Interest Rate - Output Causality

		Measure of linear feedback (lag, number of months)					
	Feedback	24	18	12	9	6	3
United States	$\Delta m \to \Delta y$	0.150+	0.142*	0.103*	0.096*	0.092**	0.058**
	$\Delta m \to \Delta y/\Delta i$	0.093	0.081	0.059	0.051	0.044	0.017
	$\Delta i \to \Delta y$	0.225**	0.160**	0.116*	0.073*	0.040	0.026
	$\Delta i \to \Delta y/\Delta m$	0.176*	0.099	0.061	0.041	0.015	0.005
	$\Delta m \cdot \Delta i \to \Delta y$	0.338**	0.241*	0.167*	0.126+	0.103*	0.065*
United Kingdom	$\Delta m \to \Delta y$	0.253**	0.199**	0.134**	0.127**	0.077**	0.008
	$\Delta m \to \Delta y/\Delta i$	0.228**	0.189**	0.128**	0.124**	0.058*	0.001
	$\Delta i \to \Delta y$	0.161*	0.137*	0.090+	0.077*	0.049+	0.006
	$\Delta i \to \Delta y/\Delta m$	0.147	0.128+	0.068	0.062	0.033	0.013
	$\Delta m \cdot \Delta i \to \Delta y$	0.390**	0.327**	0.203**	0.189**	0.114**	0.013
France	$\Delta m \to \Delta y$	0.400**	0.289**	0.235*	0.222**	0.168**	0.160**
	$\Delta m \to \Delta y/\Delta i$	0.472**	0.358**	0.264**	0.233**	0.157**	0.143**
	$\Delta i \to \Delta y$	0.211**	0.149*	0.058	0.031	0.024	0.016
	$\Delta i \to \Delta y/\Delta m$	0.448**	0.336**	0.078	0.045	0.038	0.014
	$\Delta m \cdot \Delta i \to \Delta y$	0.916**	0.625**	0.321*	0.274*	0.193*	0.165**
Germany	$\Delta m \to \Delta y$	0.225**	0.205**	0.110*	0.059	0.053+	0.007
	$\Delta m \to \Delta y/\Delta i$	0.282**	0.264**	0.100*	0.045	0.036	0.002
	$\Delta i \to \Delta y$	0.217**	0.087	0.048	0.047	0.039	0.029
	$\Delta i \to \Delta y/\Delta m$	0.221**	0.146**	0.043	0.040	0.027	0.020
	$\Delta m \cdot \Delta i \to \Delta y$	0.453**	0.351**	0.159+	0.100	0.079	0.032

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '$\to$' indicates feedback from left-hand side variables to right-hand side variables.
(c) '$\cdot$' indicates feedback from left-hand side variable to right-hand side variables conditional on right-hand side variables.

Table A7: Money - Inflation Causality

		Measure of linear feedback (lag, number of months)					
	Feedback	24	18	12	9	6	3
United States	$\Delta m \rightarrow \Delta p$	0.096	0.058	0.042	0.033	0.026	0.018
	$\Delta p \rightarrow \Delta m$	0.235**	0.209**	0.128**	0.106**	0.049+	0.036*
	$\Delta p - \Delta m$	0.007	0.007	0.012*	0.014+	0.011	
United Kingdom	$\Delta m \rightarrow \Delta p$	0.213**	0.181**	0.138**	0.129**	0.093**	0.021
	$\Delta p \rightarrow \Delta m$	0.173*	0.148*	0.105*	0.053	0.045	0.022
	$\Delta p - \Delta m$	0.000	0.000	0.000	0.000	0.000	
France	$\Delta m \rightarrow \Delta p$	0.209	0.119	0.087	0.022	0.013	0.003
	$\Delta p \rightarrow \Delta m$	0.273+	0.212	0.176*	0.141*	0.119*	0.050
	$\Delta p - \Delta m$	0.014	0.005	0.010	0.010	0.011	
Germany	$\Delta m \rightarrow \Delta p$	0.108	0.083	0.061	0.019	0.007	0.005
	$\Delta p \rightarrow \Delta m$	0.207**	0.184**	0.137**	0.065	0.065*	0.021
	$\Delta p - \Delta m$	0.005	0.003	0.004	0.005	0.002	0.003

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A8: Interest Rate - Inflation Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta i \to \Delta p$	0.239**	0.193**	0.174**	0.157**	0.123**	0.113**
	$\Delta p \to \Delta i$	0.102	0.092	0.075	0.058	0.046	0.027
	$\Delta i - \Delta p$	0.001	0.001	0.000	0.000	0.000	
United Kingdom	$\Delta i \to \Delta p$	0.263**	0.166**	0.113*	0.099**	0.092**	0.063**
	$\Delta p \to \Delta i$	0.116	0.069	0.055	0.040	0.025	0.022
	$\Delta i - \Delta p$	0.001	0.000	0.000	0.000	0.000	
France	$\Delta i \to \Delta p$	0.235**	0.171**	0.100*	0.094*	0.071*	0.035+
	$\Delta p \to \Delta i$	0.219**	0.173**	0.135**	0.102**	0.096**	0.014
	$\Delta i - \Delta p$	0.031**	0.027*	0.028*	0.026*	0.026*	
Germany	$\Delta i \to \Delta p$	0.177**	0.127+	0.070	0.054	0.048	.017
	$\Delta p \to \Delta i$	0.220**	0.172**	0.100*	0.084*	0.073*	0.016
	$\Delta i - \Delta p$	0.028*	0.018*	0.018*	0.018*	0.017+	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '$\to$' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A9: Money, Interest Rate - Inflation Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta m \rightarrow \Delta p$	0.096	0.058	0.042	0.033	0.026	0.013
	$\Delta m \rightarrow \Delta p/\Delta i$	0.119	0.109	0.061	0.047	0.032	0.016
	$\Delta i \rightarrow \Delta p$	0.239**	0.193**	0.174**	0.157**	0.123**	0.113**
	$\Delta i \rightarrow \Delta p/\Delta m$	0.234**	0.244**	0.217**	0.158**	0.128**	0.109**
	$\Delta m.\Delta i \rightarrow \Delta p$	0.351**	0.302**	0.224**	0.184**	0.137**	0.121**
United Kingdom	$\Delta m \rightarrow \Delta p$	0.213**	0.181**	0.138**	0.129**	0.093**	0.021
	$\Delta m \rightarrow \Delta p/\Delta i$	0.202**	0.164**	0.118**	0.114**	0.062*	0.012
	$\Delta i \rightarrow \Delta p$	0.263**	0.166**	0.113*	0.099**	0.092**	0.063**
	$\Delta i \rightarrow \Delta p/\Delta m$	0.249**	0.149*	0.093+	0.077*	0.060*	0.046*
	$\Delta m.\Delta i \rightarrow \Delta p$	0.407**	0.300**	0.200**	0.186**	0.136**	0.024
France	$\Delta m \rightarrow \Delta p$	0.209	0.119	0.087	0.022	0.013	0.003
	$\Delta m \rightarrow \Delta p/\Delta i$	0.365**	0.241*	0.127	0.035	0.028	0.017
	$\Delta i \rightarrow \Delta p$	0.235**	0.171**	0.100*	0.094*	0.071*	0.035+
	$\Delta i \rightarrow \Delta p/\Delta m$	0.636**	0.602**	0.280**	0.277**	0.139**	0.109**
	$\Delta m.\Delta i \rightarrow \Delta p$	0.863**	0.720**	0.349*	0.229+	0.114	0.087
Germany	$\Delta m \rightarrow \Delta p$	0.108	0.083	0.061	0.019	0.007	0.005
	$\Delta m \rightarrow \Delta p/\Delta i$	0.116	0.092	0.074	0.018	0.004	0.004
	$\Delta i \rightarrow \Delta p$	0.177**	0.127+	0.070	0.054	0.048	0.017
	$\Delta i \rightarrow \Delta p/\Delta m$	0.184*	0.136*	0.082	0.057	0.049+	0.020
	$\Delta m.\Delta i \rightarrow \Delta p$	0.292+	0.219+	0.135	0.073	0.054	0.019

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variables to right-hand side variables.
(c) '·' indicates feedback from left-hand side variables to right-hand side variables conditional on right-hand side variables.

Table A10: Output - Inflation Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta p \rightarrow \Delta y$	0.116	0.099	0.085+	0.066+	0.055+	0.041*
	$\Delta y \rightarrow \Delta p$	0.183*	0.135*	0.118**	0.098**	0.068*	0.068**
	$\Delta m \rightarrow \Delta p/\Delta y$	0.107	0.072	0.030	0.017	0.010	0.008
	$\Delta m.\Delta y \rightarrow \Delta p$	0.302*	0.207	0.153+	0.115	0.082	0.079**
	$\Delta i \rightarrow \Delta p$	0.239**	0.193**	0.174**	0.157**	0.123**	0.113**
	$\Delta i \rightarrow \Delta p/\Delta y$	0.185*	0.132*	0.109*	0.094*	0.051+	0.037*
	$\Delta i.\Delta y \rightarrow \Delta p$	0.379**	0.267**	0.238**	0.206**	0.139**	0.127**
United Kingdom	$\Delta p \rightarrow \Delta y$	0.213**	0.176**	0.110*	0.100**	0.071*	0.067**
	$\Delta y \rightarrow \Delta p$	0.177*	0.115	0.075	0.056	0.036	0.003
	$\Delta m \rightarrow \Delta p/\Delta y$	0.224**	0.185**	0.133**	0.129**	0.114**	0.033+
	$\Delta m.\Delta y \rightarrow \Delta p$	0.407**	0.300**	0.200**	0.186**	0.136**	0.024
	$\Delta i \rightarrow \Delta p$	0.263**	0.166**	0.113*	0.099**	0.092**	0.063**
	$\Delta i \rightarrow \Delta p/\Delta y$	0.324**	0.232**	0.177**	0.129**	0.112**	0.086**
	$\Delta i.\Delta y \rightarrow \Delta p$	0.485**	0.346**	0.226**	0.160**	0.128**	0.073*
France	$\Delta p \rightarrow \Delta y$	0.180*	0.105	0.064	0.059	0.032	0.026

	$\Delta y \rightarrow \Delta p$	0.147	0.127+	0.087+	0.085*	0.067*	0.039*
	$\Delta m \rightarrow \Delta p/\Delta y$	0.361**	0.200	0.060	0.013	0.011	0.011
	$\Delta m.\Delta y \rightarrow \Delta p$	0.693**	0.377	0.190	0.119	0.080	0.020
	$\Delta i \rightarrow \Delta p$	0.235**	0.171**	0.100*	0.094*	0.071*	0.035+
	$\Delta i \rightarrow \Delta p/\Delta y$	0.210**	0.152*	0.102*	0.098*	0.080**	0.049*
	$\Delta i.\Delta y \rightarrow \Delta p$	0.370**	0.291**	0.190**	0.141**	0.128**	0.084**
Germany	$\Delta p \rightarrow \Delta y$	0.175*	0.142*	0.109*	0.070+	0.067*	0.055**
	$\Delta y \rightarrow \Delta p$	0.164+	0.115	0.090+	0.049	0.026	0.020
	$\Delta m \rightarrow \Delta p/\Delta y$	0.136	0.103	0.072	0.023	0.019	0.016
	$\Delta m.\Delta y \rightarrow \Delta p$	0.314*	0.218+	0.149*	0.067+	0.024*	0.024**
	$\Delta i \rightarrow \Delta p$	0.177*	0.127+	0.070	0.054	0.048	0.017
	$\Delta i \rightarrow \Delta p/\Delta y$	0.182*	0.131+	0.090+	0.068+	0.061*	0.018
	$\Delta i.\Delta y \rightarrow \Delta p$	0.361**	0.275*	0.184*	0.106	0.074	0.038

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variables to right-hand side variables.
(c) '·' indicates feedback from left-hand side variable to right-hand side variables conditional on right-hand side variables.

Table A11: Exchange Rate - Interest Rate Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta i \rightarrow \Delta e$	0.123	0.093	0.061	0.055	0.040	0.024
	$\Delta e \rightarrow \Delta i$	0.126	0.089	0.055	0.044	0.037	0.026
	$\Delta i - \Delta e$	0.023*	0.024*	0.030**	0.031**	0.034**	
United Kingdom	$\Delta i \rightarrow \Delta e$	0.137	0.120+	0.055	0.044	0.038	0.031+
	$\Delta e \rightarrow \Delta i$	0.158+	0.120+	0.094*	0.066+	0.052+	0.037*
	$\Delta i - \Delta e$	0.185**	0.171**	0.135**	0.142**	0.143**	
France	$\Delta i \rightarrow \Delta e$	0.240**	0.169**	0.071	0.053	0.035	0.017
	$\Delta e \rightarrow \Delta i$	0.129	0.083	0.064	0.039	0.030	0.006
	$\Delta i - \Delta e$	0.043**	0.044**	0.040**	0.034**	0.033**	
Germany	$\Delta i \rightarrow \Delta e$	0.231**	0.122+	0.066	0.059	0.029	0.020
	$\Delta i \rightarrow \Delta e$	0.158+	0.135*	0.113*	0.090*	0.044	0.039*
	$\Delta i - \Delta e$	0.003	0.003	0.001	0.001	0.000	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A12: Exchange Rate - Output Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta y \rightarrow \Delta e$	0.053	0.041	0.029	0.018	0.016	0.009
	$\Delta e \rightarrow \Delta y$	0.125	0.091	0.065	0.038	0.034	0.021
	$\Delta y - \Delta e$	0.019*	0.023*	0.024*	0.028*	0.029*	
United Kingdom	$\Delta y \rightarrow \Delta e$	0.151+	0.119+	0.093+	0.041	0.035	0.009
	$\Delta e \rightarrow \Delta y$	0.109	0.090	0.066	0.057	0.044	0.038*
	$\Delta y - \Delta e$	0.000	0.000	0.000	0.001	0.000	
France	$\Delta y \rightarrow \Delta e$	0.178*	0.100	0.066	0.058	0.022	0.013
	$\Delta e \rightarrow \Delta y$	0.220**	0.196**	0.134**	0.068+	0.017	0.014
	$\Delta y - \Delta e$	0.003	0.006	0.005	0.005	0.005	
Germany	$\Delta y \rightarrow \Delta e$	0.120	0.101	0.079	0.069+	0.046	0.029*
	$\Delta e \rightarrow \Delta y$	0.081	0.068	0.031	0.021	0.020	0.007
	$\Delta y - \Delta e$	0.024*	0.023*	0.024*	0.023*	0.020*	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '→' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Table A13: Exchange Rate - Inflation Causality

	Feedback	Measure of linear feedback (lag, number of months) 24	18	12	9	6	3
United States	$\Delta p \rightarrow \Delta e$	0.163*	0.155*	0.103*	0.088*	0.064	.007
	$\Delta e \rightarrow \Delta p$	0.150+	0.121+	0.101*	0.084*	0.066*	0.029+
	$\Delta p - \Delta e$	0.009	0.009	0.005	0.006	0.010	
United Kingdom	$\Delta p \rightarrow \Delta e$	0.135	0.108	0.027	0.016	0.012	0.011
	$\Delta e \rightarrow \Delta p$	0.078	0.064	0.019	0.009	0.006	0.002
	$\Delta p - \Delta e$	0.002	0.002	0.003	0.003	0.003	
France	$\Delta p \rightarrow \Delta e$	0.181*	0.137*	0.050	0.038	0.027	0.019
	$\Delta e \rightarrow \Delta p$	0.195*	0.153*	0.099**	0.079*	0.034	0.012
	$\Delta p - \Delta e$	0.002	0.002	0.004	0.005	0.003	
Germany	$\Delta p \rightarrow \Delta e$	0.109	0.084	0.043	0.036	0.018	0.013
	$\Delta e \rightarrow \Delta p$	0.141	0.103	0.084	0.082*	0.066*	0.040*
	$\Delta p - \Delta e$	0.002	0.000	0.000	0.000	0.000	

Notes: (a) Significant at the 1% level (**); 5% level (*) and 10% level (+).
(b) '$\rightarrow$' indicates feedback from left-hand side variable to right-hand side variable.
(c) '–' indicates instantaneous feedback between left-hand side variable and right-hand side variable.

Appendix B: The Wage-Price Mark-Up Model

The most basic building block in the view that the exchange rate matters for prices is the traditional mark-up model. This gives prices as a mark-up over costs - in an open economy, wage costs and import costs. The mark-up may vary with demand. Wage costs can also be represented as a mark-up over prices (see the Layard-Nickell (1985) view of inflation as 'a battle of the mark-ups') and this mark-up may also vary with the state of demand.

This set up delivers the following important propositions:

- starting from a given state of demand, a nominal devaluation of x per cent produces a rise in prices and wages of x per cent. Real wages and the real exchange rate are unaffected.
- this is true no matter how small the importance of import costs in the price index.
- in practice there are lags in the adjustment of wages to prices and of prices to costs. For this reason, a nominal devaluation will immediately produce a real devaluation which will wear off over time as prices and wages adjust.
- allowing for demand to change in the experiment, a nominal devaluation will lead initially to a real devaluation and so to some increase in demand. The demand increase will raise mark-ups and may produce a period of real exchange rate appreciation. The length of the adjustment period will be increased.
- all the above is straightforward as an analysis of the responses to a nominal devaluation starting from equilibrium. The implicit 'cause' of such a devaluation is therefore a monetary shock. The nominal devaluation is unnecessary on any real grounds and the price rises ('inflation') that ensue reflect the nature of the shock.
- a real shock would change the equilibrium. Consider a shock which is associated with a devaluation of the equilibrium real exchange rate. This adjustment could be achieved by keeping the exchange rate fixed and allowing domestic wages and prices to fall under the prompting of unemployment and demand declines. As we would be inclined to assume that prices and wages are sticky downwards, it seems that adjustment would be easier if there were a nominal exchange rate devaluation. In this event, an absolute decline in wages and prices need not be called for while adjustment in real wages and the real exchange rate takes place.
- compared with the alternative (fixed nominal exchange rate), nominal devaluation in this case is still 'inflationary' (price rises are needed to facilitate real declines), but it is not inflationary in the sense involved in the case of a money shock. Real wages and the real exchange rate fall, rather than

remaining constant, and the price rises purchase a reduction in the sacrifice ratio, rather than nothing.

- when demand falls and mark-ups decrease, price and wages *ceteris paribus* decline. Is the devaluation-wage-price pass through then reduced? Politicians in the 'outer fringe' of erstwhile ERM devaluers would like to think so. The algebra says not. There is a demand effect which is depressing margins and reducing prices (and wages). But the devaluation will raise prices and wages in the normal way; in fact, in so far as the devaluation raises demand it will tend to reverse the demand effect, and so will raise prices more than normally. However, to the extent that what is happening is a realisation of the real devaluation scenario described above, we might agree to the politicians' use of language.
- below, to complete the account, we append two items. One is a note of the result of interrogating UK macroeconometric models with the question 'How big is the effect of a nominal devaluation on prices and wages and how long does it take?' The second, included at some risk of being obvious, is a reduced form algebraic model borrowed from the European Commission's (EC) Report 'One Market, One Money'. This is a convenient representation of the mark-up approach.

B.1 Macroeconometric Estimates of the Exchange Rate-Wage-Price Pass-Through

The table below (drawn from Artis and Currie (1981)) logs the effect of a *ceteris paribus* 5 per cent nominal appreciation on prices and competitiveness in three United Kingdom macroeconometric models, those of H.M. Treasury (HMT), the National Institute of Economic and Social Research (NIESR) and the London

Table B1: Effects of a 5 per cent Appreciation

		Wholesale Prices			Competitiveness(a)		
Model:		HMT	BB	NIESR	HMT	BB	NIESR
Year	1	-0.9	-2.0	-1.1	-1.7	-3.0	-3.3
	2	-1.7	-2.9	-2.0	-1.7	-1.9	-1.6
	3	-2.6	-3.6	-3.2	-1.2	-1.2	-1.3
	4	-3.1	-4.3	-3.5	-0.9	-0.4	-0.9
	5	-3.6	-4.9	-3.8	-0.7	-0.2	-0.6

Note: (a) Relative export prices.

Business School (represented by the Beenstock-Burns version). By year five much of the initial effect has been eaten up.[24]

B.2 The European Commission Model

The model is representative of the wage-price block of a modern macroeconometric model, and is expressed as follows:

$$w = \delta p^c + (1 - \delta)p^c_{-1} - \theta v \tag{B1}$$

$$p = w \tag{B2}$$

$$p^c = \alpha e + (1-\alpha)p \tag{B3}$$

$$v = \tau(E_{-1}/P_{-1} - 1) \tag{B4}$$

The lower case letters represent rates of growth (Δln). Equation (B1) gives wages as a mark-up on consumer prices with rudimentary dynamics; the mark-up is a function of demand, v. Equation (B2) identifies domestic producer prices with wages (no mark-up) and equation (B3) gives consumer prices in terms of foreign prices (the exchange rate, e) and domestic prices. The demand variations of interest in this context are those due to variations in the real exchange rate, so v is specialised to represent this in (B4).

It is obvious that, for a given level of demand ($v=0$), an x per cent change in E $(e=x)$, must produce a corresponding increase in w, p and p^c. Over the transition path, variations in E/P may in fact occur, affecting the path through v.

Two illustrative simulations of the model are shown in Figures B1 and B2. Figure B1 shows the adjustment of the model to a nominal 10 per cent devaluation on two alternative assumptions about the openness of the economy, as measured by the parameter α. In the highly open economy, α is set at 0.8; in the moderately open economy it is set at 0.2. The other parameters are set as follows: $\theta = 0.3$; $\tau = 0.07$; and $\delta = 0.5$. The initial values of E, P and E/P (the real exchange rate) are normalised to unity. The nominal devaluation is administered by shocking E by 10 per cent. The Figure B1 shows very clearly, that whether the economy is highly or only moderately open, the nominal devaluation initially forces a real devaluation. But, as prices subsequently rise, this is unwound and prices adjust to a level 10 per cent higher than before (right-hand scale) while the real exchange rate declines to its original value of unity (left-hand scale). In the very open economy, however, the adjustment is much faster. The initial adjustment of the real rate is much smaller and is unwound much more quickly. The proposition that

24. The models concerned represent the early 1980s 'state of the art'. However, more recent model vintages embody similar features. See Figure 1 in Church and Wallis (1992).

Figure B1: Nominal Devaluation in a Moderately Open and a Very Open Economy

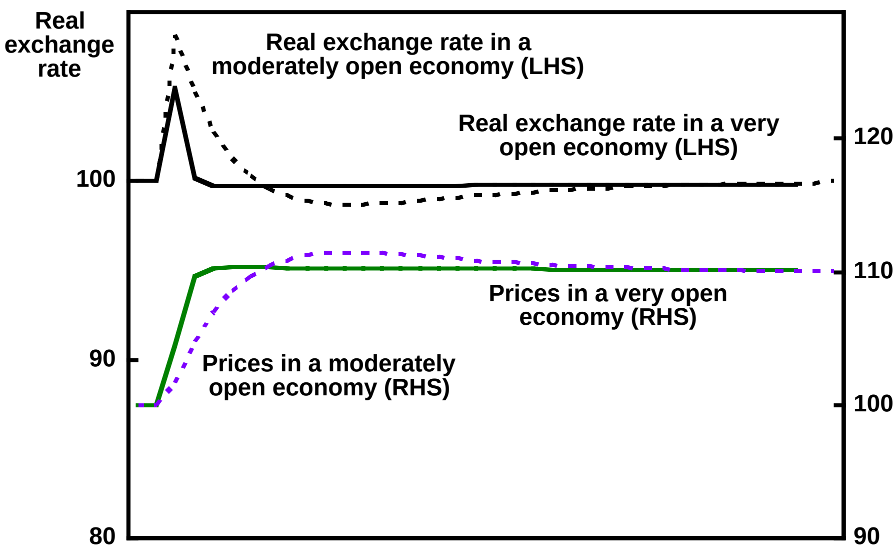
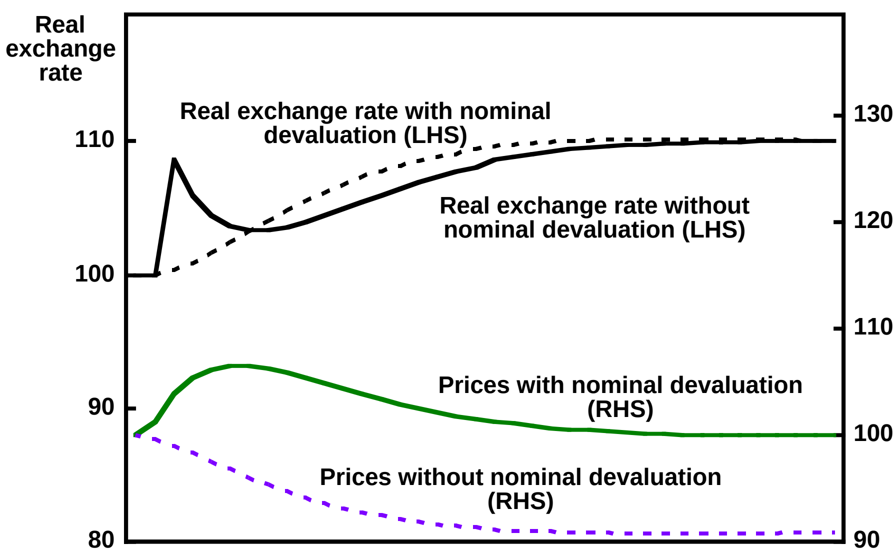


Figure B2: A 10 per cent Real Exchange Rate Depreciation
(with and without a nominal depreciation)



the benefit of being able to change the exchange rate peg declines with openness (for example, Krugman (1990)) is illustrated here.

Figure B2 illustrates the case of a real exchange rate shock. The shock is administered by altering the equilibrium value of the real exchange rate by 10 per cent. Two cases are then considered, one in which the real shock is accompanied by a nominal devaluation of the same amount, another in which the nominal rate is held steady. The long-run result in the first case is that prices (right-hand scale) end up at the same level as they hold at the beginning, with initial inflation followed by deflation. The nominal exchange rate depreciates by 10 per cent as does the real exchange rate. In the alternative simulation the whole of the real exchange rate depreciation is accompanied by a fall in the price level. In the model as simulated there is no asymmetry between price level increases and declines, so downward stickiness is not represented. It is easy to see that if downward stickiness were to be represented, this would rule out, or make very expensive, the adjustment via price level alone. In the limit (if downward price adjustments are treated as infeasible), the real exchange rate shock can only be accommodated by nominal devaluation(s).

Appendix C: The Walters Critique

The system discussed in the text can be set out more formally as below:

$$\dot{\pi} = \delta D \tag{C1}$$

$$D = y - \overline{y} \tag{C2}$$

$$y = \alpha_0 - \alpha_1 \rho - \alpha_2 X - \alpha_3 Z \tag{C3}$$

$$\dot{X} = \pi - \pi_g \tag{C4}$$

$$\rho = i - \pi \tag{C5}$$

$$i = i_g + \beta(\pi - \pi_g) \tag{C6}$$

The additional equation (C6) here serves to describe some possibilities for the nominal interest rate. If $\beta = 0$, the 'Walters case' holds as interest rates are fully convergent on German levels. A rise in relative inflation would reduce the real rate of interest below German levels. With $\beta = 1$, the real rate would be the same as in Germany, with $\beta > 1$, the real interest rate rises with the inflation differential.

The system described by equation (C1) - (C6) has the solution in matrix form:

$$\begin{bmatrix} \dot{\pi} \\ \dot{X} \end{bmatrix} = \begin{bmatrix} \delta\alpha_1(1-\beta) & -\delta\alpha_2 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} \pi \\ X \end{bmatrix} + \begin{bmatrix} B \\ -\pi_g \end{bmatrix} \tag{C7}$$

where $B = \delta[\alpha_0 - \alpha_1 i_g + \alpha_2 \beta \pi_g - \overline{y} - \alpha_3 Z]$

The determinant and trace of the square matrix determine stability (Beavis and Dobbs 1990). Denoting the matrix as A, the values of these are:

$\beta = 0$	$\lvert A \rvert > 0$	
	$tr\,A > 0$	unstable
$\beta = 1$	$\lvert A \rvert > 0$	
	$tr\,A = 0$	unstable
$\beta > 1$	$\lvert A \rvert > 0$	
	$tr\,A < 0$	stable

Thus only when the real interest rate rises with inflation ($\beta > 1$) is the system stable.

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Discussion

1. Hashem Pesaran

Michael Artis has provided us with an interesting and readable account of two important episodes of exchange rate intervention by major industrialised economies over the past decade, namely the Plaza Accord and the exchange rate mechanism (ERM). The first episode is associated with targeting the *real* exchange rate, while the second is associated with targeting the *nominal* exchange rate. The two episodes also differ in their short-term and long-term objectives. The Plaza Accord was primarily intended as a 'one-off' exercise to bring about a real depreciation of the US dollar ($US), while the ERM was intended as a more permanent arrangement.

There is a great deal that can be learnt from a close examination of these two episodes and Artis' paper presents a careful and a sound discussion of some of the main issues. In the case of the Plaza Accord, Artis focuses on two closely related questions. Was the intervention necessary, particularly considering that the $US had already begun to depreciate well before the Plaza meeting in September 1985, and was it effective? Artis' answer to the first question is a qualified 'yes', and as far as the second question is concerned, his answer is in the affirmative if the primary aim of the intervention is taken to be the reduction in the US balance of payments deficit without a hard landing or a 'dollar crash'.

The evidence on the balance of payments adjustment mechanism (again focusing on the US case) suggested that the basic theory of international adjustments has been working, but perhaps not as swiftly as the G5 Governments and some market participants would have liked. Therefore, it could be argued that the adjustments would have taken place even in the absence of the Plaza Accord and the policy coordinations that ensued, and the Accord's effectiveness was confined primarily to enhancing and amplifying market signals rather than to direct foreign exchange and money market interventions. This is the traditional view which needs to be contrasted with the conclusion of the studies by Catte cited by Artis that attributes special importance for the Accord's effectiveness to the foreign exchange interventions carried out under the Accord process.

Whether exchange rate intervention is needed and whether it is likely to prove successful depends largely on how exchange rates are determined, and whether fads and bubbles have important effects on short-term exchange rate movements. Williamson's proposal discussed by Artis attempts to address the issue. The idea is that by identifying (and then estimating) the 'fundamental equilibrium exchange rate' (FEER), it would be possible to establish whether or not intervention was needed, by comparing the prevailing exchange rate with the exchange rate implicit in the FEER. This approach, however, presupposes that the government is more likely to be capable of identifying and estimating the FEER than the market. FEER targeting is also subject to an assignment problem which is not easily resolved. The main difficulty with the FEER is that it leaves the issue of the desired choice of the nominal exchange rate open. The estimation of the FEER is also fraught with conceptual and practical difficulties. Estimates of the FEER are likely to be highly sensitive to the underlying model specification and will inevitably be subject to wide margins of uncertainty. Furthermore, before they can be used in policy analysis they need to be adjusted for the expected inflation at home relative to the levels of inflation abroad, a variable itself dependent on the choice of exchange rate. In short, I am much more sceptical of the value of the FEER in the development of a viable exchange rate intervention policy than Artis seems to be.

Turning to attempts at targeting of the nominal exchange rate, Artis distinguishes between 'strong' and 'weak form' exchange rate targeting. By 'weak form' Artis refers to situations where monetary policy responses are conditioned on the exchange rate without there necessarily being publicly announced targets. Unquestionably, from time to time this type of targeting has been followed in Europe; the prominent example being Chancellor of the Exchequer, Nigel Lawson's policy of setting the rate for the pound by shadowing the deutschemark (DM) exchange rate. However, in practice, the episodes of nominal exchange rate targeting are often difficult to identify, let alone analyse in a satisfactory manner, using publicly available information. The problem is further accentuated by the fact that the durations of such episodes of exchange rate targeting have been relatively short, and therefore difficult to evaluate empirically.

As Artis points out, the rationale behind nominal exchange rate targeting is to bypass the uncertain and 'fuzzy' link that is thought to exist between money (m) and the exchange rate (e), and thus directly link variations in money to real income and prices. In order to investigate the issue of whether the exchange rate is an important part of the transmission process, Artis employs linear feedback measures originally proposed by Geweke for multivariate stationary processes. Although in his analysis Artis is careful to account for the non-stationarity of the various time series under consideration (namely interest rate, i_t, exchange rate, e_t, real income, y_t, money supply, m_t, and prices, p_t), the causality tests reported in Appendix A of the paper are still subject to important statistical problems and the results are often difficult to interpret. The analysis is based on the assumption that i_t, y_t, m_t, p_t and e_t are first difference stationary with no long-run relations existing between them. This does not seem very plausible. It, for example, rules out the long-run existence of money demand equations, for all the five countries under consideration (the United States, the United Kingdom, France, Germany and Italy). The policy regime changes over the period of the study also make the results of the causality tests rather difficult to interpret.

The 'strong form' of nominal exchange rate targeting involves an 'outright commitment' to peg the exchange rate to a single currency or a basket of currencies and lends itself more readily to empirical evaluation than does the 'weak form'. The most prominent example of this type of exchange rate targeting is the exchange rate mechanism of the European Monetary System (EMS). Among the various motivations for the ERM, Artis focuses on the 'credibility model', and the belief in the counter-inflationary effect of pegging the European currencies to the DM. While this has clearly been an important consideration behind the decision of some of the countries to join the ERM, in particular the United Kingdom's decision to join in October 1990, it is important that we do not lose sight of other more basic motivations behind the mechanisms: namely, paving the way for formation of a unified currency block in Europe. The appropriateness of such a system rests on the degree of labour mobility across the different member countries and the extent to which coordination of fiscal policies across the European countries is politically feasible or even desirable. For the monetary union to be successful, some form of regional policy to provide economic aid for regions that are likely to be more adversely affected by unfavourable macroeconomic shocks may also be needed. Without some general political agreements on these important policy issues it does not seem very likely that any unified exchange rate mechanism can survive the speculative attacks that the weak currencies will inevitably be subject to.

Artis goes into some detail discussing the reasons behind the United Kingdom's unceremonial exit from the ERM. He focuses on three main reasons behind the sterling crisis, namely: the overvaluation of the pound sterling; the lack of synchronised policy cycles across the European economies; and the domino effect. While I agree with the general thrust of Artis' reasoning, I found his discussion of the UK interest rate policy in relation to the crisis not altogether satisfactory. He argues that UK interest rates were maintained within the 'credibility' band, until the edge of the crisis was reached. However, the way Artis calculates the credibility band for the United Kingdom relative to German rates ignores the large and persistent interest rate differentials that have prevailed historically between the two currencies. Over the five-year period from 2 January 1985 to 9 October 1990 (just before the United Kingdom's entry to the ERM), three-month UK interest rates were on average about 6.5 per cent higher than the three-month Eurodollar rate on the DM, and this large gap was maintained for much of the period (see Figure 1). The interest rate gap, however, started to decline quite steadily with entry of the United Kingdom into the ERM and for all practical purposes, the gap had disappeared on the eve of the sterling crisis. While some of this decline in the interest rate differential can be attributed to the effect of German unification, and the UK economic downturn, there are still important reasons for expecting interest rates in the United Kingdom to exceed those in Germany over the long run. Bearing this in mind, it is interesting to see how long the current negative interest rate differential (in favour of the United Kingdom) can be sustained (see Figure 1 which shows a lower rate in the United Kingdom than in Germany since the United Kingdom's exit from the ERM). The sterling crisis was more a consequence of the trend decline in the interest rate differential, than the level of interest rates at the time of the crisis.

Figure 1: Three-Month Interest Rates in the United Kingdom and in Germany

(daily observations: 2/1/85 to 28/7/93)

For the ERM or other similar exchange rate arrangements to succeed, a number of important conditions must prevail. Among them I would like to emphasise the following:

- more frequent realignments;
- fiscal policy coordination;
- greater labour mobility;
- making the adjustment mechanisms more symmetric; and
- more reliance on *intra-marginal* interventions.

The 'new' ERM that emerged in the aftermath of the *Maastricht Treaty*, with its emphasis on currency unification, had become too rigid and inflexible to be a viable exchange rate mechanism in a volatile world.

2. Philip Lowe

I found Mike Artis' paper to be a very interesting review and analysis of the Plaza Accord and the European Monetary System (EMS). The paper also provides a useful discussion of the benefits of some form of exchange rate targeting and the monetary policy coordination problems that exchange rate targets can sometimes cause. In my comments this morning I do not want to take issue with the institutional discussion or the review of history presented in the paper - I am sure that others in this room are more qualified than I to do so. Instead, I would like to emphasise a very simple but important point, and one that, at least to my taste, the paper does not make strongly enough - that is, in using the exchange rate as either a 'weak' or 'strong' form target, it is crucial to be able to distinguish between real and nominal shocks. In an economy subject to real shocks, relying on a simple and consistent relationship between the exchange rate and inflation is fraught with danger. This is a lesson that Europe is now learning to its considerable cost, but one that I think has been appreciated, at least for some time, in this part of the world.

With this distinction between real and nominal shocks in mind I would like to touch briefly on three issues: the evolution of the EMS as an anti-inflationary tool, the model that is sketched in the paper and policy implications for Australia.

As Artis points out, the EMS has evolved basically as a mechanism for controlling inflation. Looking at Figure 7 in his paper, this goal seems to have met with mixed success. It shows that French, Irish and Belgian price levels have not diverged from the German level. The Netherlands could also be added to this list of countries. Other countries have fared less well. In Italy, Spain and Portugal, higher rates of inflation than in Germany have led to real appreciation of their currencies. While it is probable that these countries would have had even higher rates of inflation had it not been for the discipline imposed by their exchange rate arrangements, I think that it is correct to conclude that the EMS has met with only qualified success in its goal of controlling inflation in Europe.

This focus on what were supposed to be the monetary benefits of the EMS led certain countries to discount the need for real exchange rate adjustment. In a way, this is understandable, as the central problem facing many nations at the end of the 1970s and into the 1980s was seen to be control of inflation and not the need for real exchange rate flexibility of one European country against another. In addition, many policy makers 'bought', almost unqualified, the conclusions from the theoretical literature on policy credibility. While no doubt life is easier if the public views government policy as credible, I think that policy makers should ask for a considerable refund on their purchase of the credibility story.

The idea was that by fixing the exchange rate, policy makers would guarantee low inflation. In turn, agents would understand this, moderating their wage and price demands. The end result was supposed to be a considerable improvement in the sacrifice ratio - that is, lower output and employment costs for a given reduction in inflation. While the idea was a neat one, it appears to have largely failed to deliver. While this failure reflects many factors, I would briefly like to mention two of these. Firstly, in periods of low to moderate inflation, the most important factor determining the sacrifice ratio is not credibility, but the flexibility of goods and labour markets. European labour markets are not well integrated and they are characterised by significant rigidities. As a result, it is not surprising that their sacrifice ratios remain unpleasantly high. Secondly, in the end, fixing the exchange rate does not guarantee importing low inflation from the anchor country. This can be seen in the experience of southern Europe and also in the experiences of a number of Latin American countries.

While there was nothing inherent in the nature of the system that prevented it adjusting to real shocks, this single focus on monetary factors meant that the system was not able to adjust as it should have to German reunification. To achieve the necessary appreciation of the real value of the deutschemark (DM), other countries have had to experience lower inflation than in Germany. This means running tighter monetary policy than the already tight German monetary policy. With relatively inflexible labour and product markets, this tight monetary policy has probably entailed larger output costs than would have been experienced had the real appreciation of the DM been achieved by nominal appreciation. In some countries, the market believed that governments were unwilling to bear these high costs. As a result, the system cracked. In particular, those countries whose currencies had experienced real appreciation through relatively high inflation found the pressure intolerable.

I would now like to briefly turn to the model of ‘weak form’ nominal exchange rate targeting. The emphasis on monetary factors that underlies the EMS is reflected in the model that Artis presents in the paper. As a vehicle for analysing monetary policy responses to exogenous changes in the exchange rate, I like the model. If exchange rate changes are driven by fads or market dynamics, then it is indeed appropriate to think of the changes as exogenous. However, in many cases, exchange rate changes are endogenous and I would argue that the model is inappropriate and the application of its advice could lead to undesirable consequences.

Artis argues that if the exchange rate depreciates, then the interest rate must be raised to preserve the same counter-inflationary stance of policy. This leads to an upward sloping $\dot{p}$ locus in Figure 5. The logic of this is that higher import prices put upward pressure on the domestic price index that must be offset with tighter monetary policy. If the exchange rate depreciation is exogenous or is in response to expected future looser monetary policy, then this is the correct response.

However, and I think that this is a big 'however', if the exchange rate falls for other reasons, this may well be exactly the *wrong* response. In previous papers we have heard that, for Australia, investment and terms of trade shocks have been important in driving the exchange rate. Suppose investment falls and, as a result, the exchange rate depreciates. Should monetary policy be tightened? The answer is no, it should not. The fall in investment that caused the exchange rate to depreciate, itself puts deflationary pressure into the economy. If the monetary authorities wish to run counter-cyclical monetary policy they should *lower* interest rates, not *increase* them. In Artis's paper this would mean that the $\dot{p}$ locus would be downward sloping, not upward sloping. In this case, simply keying monetary policy off the exchange rate would be inappropriate.

There is, however, a potentially important 'wrinkle' in this story. The fall in the exchange rate for real reasons puts direct and immediate upward pressure on the prices of tradeables. At the same time, the deflationary consequences of the shock that caused the exchange rate to decline are also at work. However, these deflationary forces take considerable time to work themselves through to non-traded goods prices. As a result, the adverse shock is likely to put immediate upward pressure on price indexes, followed later by downward pressure as the negative income effects start to work their way through.

If the country has wage indexation and/or uncompetitive labour markets, the initial inflation impulse from tradeables prices may be fed through into higher wages that could trigger wage-price dynamics that lead to higher inflation. In this case, monetary policy may well need to be tightened when the exchange rate falls. However, if labour markets are deregulated and work reasonably well, this type of situation is unlikely to emerge.

All this is not to say that the exchange rate has no role in the formulation of monetary policy. The question is how the exchange rate gets incorporated into the monetary policy decision-making process. Here, I think that the experience of two countries that are not discussed in the paper is instructive - those countries are New Zealand and Canada. While neither country has an explicit exchange rate target, changes in the exchange rate clearly have a significant impact on monetary policy decisions in both countries. This relationship was evident in Canada late last year and in New Zealand earlier this year. In both cases, downward pressure on the exchange rate was met with significant upward movements in interest rates.

I don't wish to evaluate those episodes, but instead I would like to touch on a couple of potential problems that arise when the market understands that to achieve its inflation objective the central bank is relying heavily on the exchange rate.

In theory, if the market knows that the central bank has a lower bound for the exchange rate, the exchange rate should smoothly bounce off this level. Theory and practice may, however, be a long way apart. It is possible that the market believes that the central bank has not adjusted its target rate in response to some adverse shock. In this case, the central bank may be forced into very large increases in interest rates to prevent continuing downward pressure on the exchange rate. These higher interest rates have adverse effects on the economy. The market knows that the central bank knows this. At this point we have entered a potentially damaging speculative game between the central bank and the market.

The other danger is that if the central bank changes its target rate in response to some adverse shock, the market may be unsure of whether this is a legitimate adjustment, based on fundamentals, or simply an acceptance by the bank of a little more inflation. This uncertainty may make the central bank reluctant to change its target and, if it does change the target, it may damage market expectations.

Where does all this leave us? I think that last year's Conference has some answers for us here. The exchange rate should be used as an indicator of inflationary pressure in the economy along with a whole range of other indicators - these other indicators should provide information on what is happening on the real side of the economy. If the real side is ignored, inappropriate monetary policy can easily be the result. The experience of the European countries is a good example of this. Given that we argue that movements in the exchange rate are a critical part of the adjustment process to real shocks, it would seem inappropriate to establish - either in our own minds, or in the minds of the market - too strong a connection between the exchange rate and monetary policy.

3. General Discussion

The discussion that followed Artis' paper concentrated on the nature and effectiveness of targeting the exchange rate. A number of speakers noted that the effectiveness of an exchange rate target depends crucially on setting it at the 'right' rate. This, in turn, implies an ability to measure the fundamental equilibrium exchange rate (FEER). This is a very difficult exercise, as illustrated by the strong qualifications that accompany the FEER model, and means that exchange rate targeting becomes a very inexact science. However, it was also noted that defining money supply targets was just as difficult.

A number of speakers noted that the issue of whether to target a domestic inflation/money supply variable or the exchange rate needs to be considered in terms of the type of shocks that the economy is likely to experience in practice. Real shocks call for greater exchange rate flexibility. In the end, it was suggested that policy should not irrevocably target a specific variable, but should be flexible enough to respond appropriately, depending on the nature of the shock.

A number of participants suggested what while the EMS was less easily defended on economic grounds, there were strong political factors that provided the main justification for the system. It was also noted that while the EMS may not have improved European countries' sacrifice ratios,[1] it may have delivered them lower inflation that would have otherwise been achievable. This is because most European countries had been forced to adopt policies consistent with the low inflation objective of the German Bundesbank.

One speaker suggested that an exchange rate system could be evaluated on three criteria:

- its ability to adjust to shocks;
- its competence to deal with speculative runs; and
- its ability to allow capital market transactions to proceed in an efficient way.

Historically, exchange rate systems seem to have been unable to deliver all three simultaneously. The Bretton Woods system combined fixed exchange rates with capital controls. This system failed to generate sufficient liquidity in the 1960s and did not cope well with the international shocks of the 1970s. As a consequence, capital markets were opened and major currencies were floated. Subsequently, some countries have tried to fix their exchange rates in this environment because of concerns about exchange rate volatility. The currencies of these countries have been subject to periodic speculative attacks. This has renewed calls for capital controls within the EMS in recent months. The speaker observed that calls for changes to exchange rate regimes appeared to go in broad historical 'circles'.

Another issue that concerned many of the participants was that the savings-investment relationship had not been explicitly considered in the paper. Numbers were quoted which indicated that current account balances seemed to be driven more by the savings-investment relationship than by exchange rate movements. Others stressed that the savings-investment relationship and fiscal policy were key in making the FEER model operational. There needed to be greater coordination of both monetary and fiscal policy if fixed exchange rate systems were to work.

The final area of discussion centred on the 'excess credibility' issue, whereby the removal of capital controls in the second half of the 1980s might have generated nominal interest rate convergence, causing high-inflation EMS countries to have too low real interest rates. This would be a perverse ranking, in the sense that high-inflation countries need higher real interest rates, leading Alan Walters to describe the system as 'half-baked'. Artis' finding that this ranking was not

1. Sacrifice ratios measure the output or unemployment cost of getting inflation down. If the EMS improved monetary policy credibility, it might have been possible to reduce the output costs of getting inflation down. This apparently has not been the case.

observed in the data was argued by some to be beside the point. The freeing up of the financial system was a regime change from one where the inverted Fisher hypothesis held, to one in which the actual Fisher hypothesis held.[2] It should not be surprising that higher inflation countries experienced relatively higher real interest rates in this latter period. The author's conclusion that the Walters critique, notwithstanding the general ranking results, had some relevance for Italy and Spain was also debated by some participants. Countries with high productivity can have relatively low real interest rates, without contributing to accelerating inflation.

It was also pointed out that clear macroeconomic policy conclusions could not be drawn from the Walters critique because the monetary/exchange rate transmission mechanism differed between countries. Thus, for example, UK interest rates on loans are generally floating, while those in Europe are fixed. The United Kingdom also stands apart as a country whose business cycle has been a few quarters ahead of continental Europe's. As such it has been necessary for them to suffer a prolonged recession in order to 'wait for' the European cycle to 'catch up'.

In response to the point that the EMS was flawed in the presence of real shocks, the author made two related observations. Firstly, the EMS countries did not attempt to fix the trade-weighted index, so that the float of the ECU against other major currencies gave the system some insulating properties against common external real shocks. Secondly, real shocks between EMS countries were not common. While German unification had been a very major exception in this regard, it was unlikely to recur.

2. The inverted Fisher hypothesis asserts that real interest rates move inversely with inflation when nominal interest rates are constrained by regulation The Fisher hypothesis asserts that inflation is neutral with respect to real interest rates, because inflationary expectations are fully reflected in nominal rates.

Is There a Currency Bloc in the Pacific?

Jeffrey A. Frankel and Shang-Jin Wei*

1. Introduction

The study of international economic integration - the strengthening of trade and financial links - has acquired a new geographic dimension. Now, we are curious not only about the speed or sequence with which a particular country liberalises trade and financial barriers, but also about whether it chooses to do so preferentially *vis-à-vis* some neighbour countries and not others.

1.1 Possible Regional Groupings

Formal regional economic arrangements have progressed the furthest in Europe. Within the European Community (EC), the *Single European Act* of 1986 resulted in the elimination of most trade barriers by 1992. Most members removed capital controls by 1990 and the European Monetary System (EMS) had succeeded in stabilising exchange rates well enough by December 1991 that the members agreed on ambitious plans for European Monetary Union (EMU). Those plans soon proved *overly* ambitious, but the long-run trend towards integration is nevertheless clear. The next successful project of the EC will most likely be enlargement to include those of the other Western European countries (members of EFTA - European Free Trade Association) who wish to join. There is also talk of eventually including countries from Central and even Eastern Europe.

In the Western Hemisphere, the Canadian-United States Free Trade Agreement took effect in 1989, the countries of the eastern half of South America agreed on plans for a free trade area under the name MERCOSUR in 1990, the moribund Andean Pact removed regional trade barriers in 1991 and the North American Free Trade Agreement (NAFTA) was negotiated in 1992. NAFTA has provisions for

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other countries to join, consistent with the Enterprise for the Americas Initiative proposed by the Bush Administration, with Chile considered first in line. There are no formal monetary or financial arrangements in the Western Hemisphere analogous to the EMS or the prospective EMU. Nevertheless, when a Latin American country like Argentina decides to peg its currency, the US dollar is the currency to which it pegs. Many countries are heavily dollarised *de facto*.

In East Asia and the Pacific, formal regional arrangements are rare. The Australia-New Zealand Closer Economic Relationship, agreed to in 1983, is a potentially useful model in that it includes some important measures such as harmonisation of competition policy that other countries have been profoundly reluctant to consider. Beyond the bilateral level, the only major plans for a Preferential Trading Arrangement (PTA) exist among the Association of South-East Asian Nations (ASEAN), which was slow to get off the ground but which, in 1991, endorsed the idea of an ASEAN Free Trade Association (AFTA).

Although Asia-Pacific is less inclined to establish intra-regional economic links through official institutions than either Europe or the Americas are, such links are nonetheless being formed in informal ways by the private sector. One view is that South China, including Hong Kong and Taiwan, is becoming an independent ‘growth pole’ deriving its dynamism from the entrepreneurial talents of the Chinese diaspora. Another view is that Japan is establishing a yen bloc in East Asia, not through preferential trading arrangements or other explicit, direct means, but rather in the way it is alleged to do everything: through implicit, indirect means, such as Foreign Direct Investment, Overseas Development Assistance, and other financial flows to the rest of Asia.

A number of loose groupings have been proposed for the region. The Malaysian Prime Minister, Dr Mahatir, suggested an East Asian Economic Group (EAEG) in 1990 (later called the East Asian Economic Caucus). The suggested boundaries of membership were drawn to include Japan, but exclude Caucasian countries. Australia had earlier proposed the Asian Pacific Economic Cooperation forum (APEC), which includes Australia, New Zealand, Canada and the United States. APEC gained steam, in part as an alternative to the EAEG. Some wish to draw the boundaries even wider, to include all countries on the Pacific Rim (most of whom, including Mexico and Chile, are represented in the membership of PECC - the Pacific Economic Cooperation Council).

1.2 Trade Links, Interest Rate Links and Currency Links

The array of acronyms is impressive. What effect have these formal and informal regional arrangements had on actual patterns of trade and finance? Empirical research on this question is relatively rudimentary. Many studies of regional trading arrangements simply report statistics on shares of intra-regional trade. It is pointed out, for example, that the fraction of East Asian countries' trade that is conducted with other East Asian countries rose from 23 per cent in 1980 to 29 per cent in 1990.[1] Yet, as we will see, these statistics can be misleading. One wants to hold constant the natural economic determinants of bilateral trade, such as proximity and gross national product (GNP), before attributing any level or increase in intra-regional trade to deliberate policy measures such as Preferential Trading Arrangements, or even to the less deliberate influences of linguistic or cultural links.

Empirical research on intra-regional financial and monetary links is even less well-developed than on trade. Most studies of financial and monetary integration examine the extent to which a particular country has become integrated with 'the world', for example, the extent to which unrestricted arbitrage equates its interest rate to 'the world' interest rate or the extent to which its monetary authorities have stabilised 'the' exchange rate. Less attention is paid to the question of whether the financial and monetary links are stronger with some parts of the world than others.

The remainder of this paper tries to address these issues, in relation to East Asia and the Pacific. It is divided into three parts. Section 2 examines whether a trade bloc is forming in the region and, if so, what are its geographical boundaries (ASEAN, EAEG, the Western Pacific, APEC or the entire Pacific Rim?). It extends earlier research using the gravity model by including a variable that reflects when two trading partners share a common language, such as Chinese.

Section 3 looks for evidence of a financial bloc. Specifically, it tests whether interest rates in various Pacific countries appear to be influenced more strongly by Japanese interest rates or American interest rates.

Exchange rate arrangements, considered in Section 4 of the paper, can have an important effect on the trade and financial links that are considered in Sections 2 and 3 respectively. If a country chooses to stabilise its exchange rate *vis-à-vis* one major trading partner instead of another, this can be expected to help promote trade with the first rather than the second, assuming that exchange rate uncertainty has a negative effect on trade. Promoting intra-EC trade, for example, is one major motivation underlying the EMS and EMU. Therefore, bilateral exchange rate variability is one more factor that we would like to control for in our econometric model of bilateral trade. Similarly, if a country chooses to stabilise its exchange rate *vis-à-vis* one major monetary power instead of another, this can be expected to promote financial links with the first rather than the second and to be reflected in the interest rate correlations.

1. Somewhat smaller increases took place in the intra-regional trade shares of the Americas and Europe, respectively. The greatest increase, from 42 per cent to 53 per cent, took place among the APEC countries.

2. Is There a Trade Bloc in the Pacific?

Frankel (1993) applied to the trading bloc question the natural framework for studying bilateral trade, the gravity model. The gravity model is so called because it says that trade between two countries is proportional to the product of their sizes and inversely related to the distance between them. It has a fairly long history, but there are few recent applications to a large cross-section of countries throughout the world.[2] Frankel (1993) and Frankel and Wei (1992) found that there are indeed intra-regional trade biases in the EC and the Western Hemisphere, and perhaps in East Asia. However, they also found that the greatest intra-regional bias was in none of these three, but in the APEC grouping, which includes the United States and Canada with the Pacific countries and that the bias in the East Asia and Pacific groupings *did not increase* in the 1980s.

This paper extends those results in a number of directions. Among various extensions of the original gravity model estimation, it tests the effect of two trading partners sharing common linguistic or historical links, with particular focus on the effect when both countries are Chinese-speaking.

2.1 The Gravity Model of Bilateral Trade

One cannot meaningfully investigate the extent to which regional policy initiatives are influencing trade patterns without holding constant natural economic determinants such as size.[3] The gravity model offers a systematic framework for measuring what patterns of bilateral trade are normal around the world. Again, the goal, is to see how much of the high level of trade within each region can be explained by simple economic factors common to bilateral trade throughout the world and how much can be attributed to a special regional effect. A dummy variable is added to the gravity equation to represent when both countries in a given pair belong to the same regional grouping. One can check how the level and time trend in, for example, ASEAN compares with that in other groupings.

The dependent variable is trade (exports plus imports), in log form, between pairs of countries in a given year. We have 63 countries in our data set, so that there

2. Two others are Wang and Winters (1991) and Hamilton and Winters (1992). The focus of these papers is on potential Eastern European trade patterns; but they report statistically significant within-region biases to the following groupings: EC, Latin America, ASEAN, former British colonies, Generalised System of Preferences (GSP), and EC preferences under the Lomé convention. The most classic reference is Linnemann (1966).

3. An easy way to hold size constant is to scale bilateral trade by GNPs or total trade. Such calculations are sometimes called 'trade intensities'. See Anderson and Norheim (1992) and Drysdale and Garnaut (1992). Our main conclusions are for the most part consistent with theirs.

are 1953 data points (=63 x 62/2) for a given year.[4] Some observations are missing because the trade flow is too small to be recorded.

One would expect the two most important factors in explaining bilateral trade flows to be the geographical distance between the two countries and their economic size.

A large part of the apparent bias toward intra-regional trade is certainly due to simple geographical proximity. Indeed Krugman (1991) suggests that *most* of it may be due to proximity, so that the three trading blocs are welfare-improving 'natural' groupings (as distinct from 'unnatural' trading arrangements between distant trading partners such as the United Kingdom and a Commonwealth member, or the United States and an East Asian dragon). Despite the obvious importance of distance and transportation costs in determining the volume of trade, surprisingly, empirical studies often neglect to measure this factor. Our measure is the log of the distance between two major cities (usually the capital) of the respective countries. We also add a dummy 'adjacent' variable to indicate when two countries share a common land border.

Entering GNPs in product form is empirically well established in bilateral trade regressions. It can be justified by the modern theory of trade under imperfect competition.[5] In addition, there is reason to believe that GNP per capita has a positive effect on trade; for a given size, as countries become more developed, they tend to specialise more and to trade more. Equivalently, size as measured by population has a negative effect on openness to trade, expressed as a share of GNP. The equation to be estimated, in its most basic form, is:

$$\begin{aligned}\log(T_{ij}) &= \alpha + \beta_1 \log(GNP_i GNP_j) + \beta_2[\log(GNP_i/pop_i) + \log(GNP_j/pop_j)] \\ &+ \beta_3 \log(DISTANCE_{ij}) + \beta_4 (ADJACENT_{ij}) \\ &+ \gamma_1(EC_{ij}) + \gamma_2(WH_{ij}) + \gamma_3(EASIA_{ij}) + u_{ij} \qquad (1)\end{aligned}$$

The last four explanatory factors are dummy variables. *EC*, *WH*, and *EASIA* are three of the dummy variables we use when testing the effects of membership in a common regional grouping, representing the European Community, Western Hemisphere, and East Asian Economic Group, respectively.

Results are reported in Table 1. These differ from the tables in Frankel (1993) and Frankel and Wei (1992) by a doubling of the span of years reported (among

4. The list of countries and regional groupings is given in the Appendix.

5. The specification implies that trade between two equal-sized countries (say, of size 0.5) will be greater than trade between a large and small country (say, of size 0.9 and 0.1). This property of models with imperfect competition is not a property of the classical Heckscher-Ohlin theory of comparative advantage; see Helpman (1987) and Helpman and Krugman (1985, Section 1.5). Rudimentary foundations for the gravity model are found in Linneman (1966) and also in other papers surveyed by Deardorff (1984, pp. 503-506) and Wang and Winters (1991).

other things). All four standard variables are highly significant statistically (greater than the 99 per cent level) in every year . The adjacency variable indicates that when two countries share a common border, they trade with each other approximately twice as much as they would otherwise [exp(0.7)=2]. The coefficient

Table 1: Linguistic Links in Total Trade
(total trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.64**	0.64**	0.72**	0.74**	0.54**	0.76**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GNP per capita	0.27**	0.37**	0.27**	0.30**	0.07**	0.10**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Distance	-0.43**	-0.52**	-0.67**	-0.54**	-0.35**	-0.54**
	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)
Adjacency	0.52**	0.58**	0.47**	0.63**	0.69**	0.74**
	(0.17)	(0.17)	(0.18)	(0.18)	(0.20)	(0.16)
WH2	-0.34*	-0.19	0.10	0.34*	0.38*	0.82**
	(0. 16)	(0.14)	(0.15)	(0.15)	(0.19)	(0.14)
EAEG2	1.59**	1.80**	0.96**	0.93**	-0.27	0.75**
	(0.29)	(0.29)	(0.31)	(0.26)	(0.28)	(0.24)
EC2	0.28#	0.12	-0.03	0.27	1.58**	0.54**
	(0.16)	(0.17)	(0.18)	(0.18)	(0.19)	(0.16)
APEC2	0.37#	0.64**	0.85**	1.29**	1.39**	1.19**
	(0.21)	(0.21)	(0.22)	(0.18)	(0.20)	(0.17)
Common language	0.50**	0.33**	0.33**	0.52**	0.53**	0.35**
	(0.09)	(0.09)	(0.09)	(0.08)	(0.10)	(0.08)
Number of observations	1194	1274	1453	1708	1343	1573
SEE	1.05	1.07	1.17	1.19	1.26	1.06
adj. R^2	0.68	0.71	0.72	0.72	0.53	0.77

Notes: (a) Standard errors are in parentheses.
(b) ** denotes significance at 1% level ($t \geqslant 2.576$);
* denotes significance at 5% level ($t \geqslant 1.96$); and
\# denotes significance at 10% level ($t \geqslant 1.645$).
(c) All variables except the dummies are in logarithms.
(d) Common language is the dummy for common linguistic or colonial links (German, Japanese, Dutch, English, Spanish, Chinese, Arabic, French and Portugese).

on the log of distance is about -0.5, holding constant for the adjacency variable. This means that when the distance between two non-adjacent countries is higher by 1 per cent, the trade between them falls by about 0.5 per cent. We have tested for possible non-linearity in the log-distance term, as it could conceivably be the cause of any apparent bias toward intra-regional trade that is left after controlling linearly for distance.[6]

The estimated coefficient on GNP per capita is about 0.3 from 1965 through 1980, indicating that richer countries do indeed trade more, though this term declines during the 1980s, reaching 0.1 in 1990.[7] The estimated coefficient for the log of the product of the two countries' GNPs is about 0.75, indicating that, though trade increases with size, it increases less than proportionately (holding GNP per capita constant). This presumably reflects the widely known pattern that small economies tend to be more open to international trade than larger, more diversified economies. At the same time, the equation explains why worldwide trade has historically increased faster than GNP.[8] If two countries are each experiencing growth in GNP per capita of 1 per cent a year, then trade between them will grow at about 2 per cent a year (1.05 + 1.05 = 2.1). As East Asian developing countries have recently been growing in the vicinity of 8 per cent a year, the equation predicts very rapid growth in trade among them (16 per cent).

We have recently added a few checks for econometric robustness regarding the sample of countries and their size. We also tried running the equation in multiplicative form, instead of log-linear form, to allow the inclusion of pairs of countries that are reported as undertaking zero trade. (Under the log-linear specification, any pair of countries that shows up with zero trade must necessarily be dropped from the sample.) We find that the inclusion or omission of such countries in the multiplicative specification makes little difference to the results.[9] A correction for heteroscedasticity based on the size of the countries also makes little difference.

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6. When distance, distance squared and the log of distance are included at the same time, only the last is significant.
7. Linnemann (1966) obtains similar estimates for this parameter (in the range 0.21 to 0.27) and for other parameters, for the year 1959.
8. See, for example, Rose (1991).
9. However, the use of the multiplicative form itself changes the results somewhat. These results are reported in an Appendix Table A2-A3 in Frankel and Wei (1993). Linnemann (1966) and Wang and Winters (1992) address the problem of trade flows so small as to be recorded as zero in another way: by trying the tests substituting fractions (like 0.5) of the minimum recordable unit for the zeros. They too found that inclusion of the missing values made little substantive difference to the results.

2.2 Estimation of Trade Bloc Effects

If there was nothing to the notion of trading blocs, then the four or five basic variables would soak up most of the explanatory power. There would be little left to attribute to a dummy variable representing whether two trading partners are both located in the same bloc. In this case, the level and trend in intra-regional trade would be due solely to the proximity of the countries, and to their rate of overall economic growth.

However, we have found that dummy variables for intra-regional trade *are* highly significant statistically. If two countries are both located in East Asia, for example, in 1980 they traded with each other by an estimated two and a half times as much as they would have otherwise [exp(0.9) = 2.5], after taking into account distance and the other gravity variables.

In earlier results, we tested for a nested sequence of possible trading blocs: ASEAN, East Asia (the membership of the EAEG), the Asian Pacific (including also Australia and New Zealand), APEC (including also the United States and Canada), and the entire Pacific Rim (including also Mexico, Colombia, Ecuador, Peru and Chile). While groupings such as ASEAN or the Asian Pacific can appear to be statistically significant if one does not test for larger groupings at the same time, there appear to be two right places to draw the boundaries: around East Asia and around APEC. The smaller and larger groupings are not statistically significant when these two are included in the equation. (For one year, 1985, the presence of the APEC term reduces or eliminates the significance of the East Asia term.)

To see if the East Asian bloc can be interpreted as Japan-centred, we included a dummy variable representing Japan's bilateral trade with other East Asian countries. It was not statistically significant (or even greater than zero). We also tried allowing for a special entrêpot effect by including a dummy variable representing all bilateral trade of either Singapore or Hong Kong. The entrêpot variable is highly significant, but does little to diminish the East Asian bloc effect.[10] When one allows for the greater average openness of East Asian countries to trade with all partners, the East Asian bloc effect does diminish somewhat, but is still statistically significant.[11]

We have also tried to capture classic Heckscher-Ohlin effects. Earlier we tried including bilateral absolute differences in GNP per capita figures. The variable did not have the positive effect that one might think if countries traded capital-intensive products for products intensive in unskilled labor. Rather, it had a

10. These results are not reported here but are described in Frankel (1992).

11. This greater openness indicates that trade diversion is not taking place in East Asia. The openness effect is also significant for the EC where it eliminates the significance of the bloc effect in some years. These results are reported in Frankel, Stein and Wei (1993).

moderately significant *negative* effect, as in the Linder hypothesis that similar countries trade more than dissimilar ones.

The gravity model was estimated including some direct measures of factor endowments: the two countries' differences in capital/labor ratios, educational attainment levels, and land/labor ratios. The data (for a subset of 656 of our 1953 pairs of countries) was generously supplied by Saxonhouse (1989). Most of the coefficients were little affected.

As another extension, we tried disaggregating total trade into three categories: manufactured products, agricultural products, and other raw materials. Perhaps surprisingly, the effect of distance is as high (or higher) for manufactures as for the other categories. But in general, the findings were little affected by the disaggregation.[12]

Although the coefficient for the East Asian grouping in Table 1 is significant, it diminishes in the 1980s, rather than increasing as is often assumed on the basis of simple statistics on intra-regional trade. The explanation for this is that rapid growth of East Asian economies is, in itself, sufficient to explain the increase in the intra-regional trade share mentioned in the introduction. The extension of the time period back to 1965 reveals that the trend in the intra-regional trade bias has been, if anything, downward rather than upward throughout this period.[13] Also, as in earlier results, the strongest grouping in the world in the 1980s was APEC. East Asia is still dependent on the North American market.

Inferences about Europe and the Western Hemisphere, like inferences about East Asia, are overturned with the use of the gravity model in place of intra-regional trade shares. It turns out that the EC was not a statistically significant trade bloc as recently as 1980, but that in the first half of the 1980s it experienced the most rapid intensification of intra-regional trade bias of any region. (The EFTA countries show no trade bloc effect at any time.)[14] The Western Hemisphere countries show the most rapid intensification of intra-regional trade bias in the *second* half of the 1980s. More detailed analysis reveals that this regionalisation took place in particular within MERCOSUR and within the Andean Pact.[15]

2.3 Extension: the Role of Common Language in Trade Groupings

Now we extend the results by adding a dummy variable to represent when a pair

12. See Frankel, Stein and Wei (1993).
13. This corresponds to findings in Petri (1993), based on somewhat simpler calculations.
14. See Frankel and Wei (1993).
15. See Frankel, Stein and Wei (1993). NAFTA had not experienced any significant bloc effect as of 1990.

of countries share a common language or had colonial links earlier in the century. We allow for English, Spanish, Chinese, Arabic, French, German, Japanese, Dutch and Portuguese. The results, reported in Table 1, show a significant coefficient that fluctuates in the range of 0.33 to 0.53. In 1990, two countries sharing such linguistic or colonial links tended to trade roughly 42 per cent more than they would otherwise [exp(0.35)=1.42]. We tested whether some of the major languages were more important than the others.[16] Chinese is the one language to qualify, though even here, the independent effect is significant only in 1970 and 1990. (We count four countries as primarily Chinese speaking: Taiwan, China, Hong Kong and Singapore.) Its independent effect is reported in Table 2. As of 1990, two Chinese-speaking countries appear to trade an estimated four and one-half times as much [exp(0.33+1.2=1.53)=4.62] as other similarly situated countries.

The presence of the language terms reduces the East Asian bloc coefficient only slightly; in most years the latter is still highly significant statistically. The apparent magnitude of the Chinese language term does raise the possibility that the influence of the Chinese diaspora is a more important contributor to the East Asian intra-regional trade than is the influence of 'Japan Inc'. However, there is an important objection that must be registered. Taiwan-China trade does not appear in the statistics, because it is officially non-existent. Such trade is in reality thought to be large and rapidly growing and heavily to take the form of trade routed indirectly through Hong Kong. If Taiwan-China trade is routed through Hong Kong (or Singapore), then it is counted twice in our data and thus may be exaggerating the estimate of the influence of the Chinese variable.

We now attempt to correct for this double-counting of Taiwan-China trade. The Governments of Taiwan and China each report estimates of their true bilateral trade. To err on the side of caution, we took the larger of the estimates and treated it as if it were all counted twice in the form of Hong Kong trade. The numbers were $0.047 billion in 1980 and $1.974 billion in 1990. (The Governments report no estimate for 1985, but we took the average of the other two years.) We re-ran the gravity estimates with trade among 'the three Chinas' adjusted in this way. The results, reported in Table 3, show that the independent Chinese language effect is no longer statistically significant. Even the East Asian bloc coefficient is reduced slightly. However, the dummy variable for linguistic links, in general, is as strong as ever. Given the small number of observations of Chinese-speaking pairs of countries (4 x 3/2 = 6), we are left without a clear verdict one way or the other on the importance of the contribution of the Chinese diaspora effect to intra-regional trade.

16. The coefficient for English is never close to statistically significant, beyond the general coefficient for common languages.

Table 2: Linguistic Links in Total Trade: Adding the Chinese Link

(total trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.64**	0.64**	0.72**	0.74**	0.54**	0.76**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GNP per capita	0.27**	0.37**	0.27**	0.30**	0.06**	0.10**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Distance	-0.44**	-0.53**	-0.67**	-0.54**	-0.35**	-0.54**
	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)
Adjacency	0.51**	0.59**	0.47**	0.62**	0.69**	0.73**
	(0.17)	(0.17)	(0.18)	(0.18)	(0.20)	(0.16)
WH2	-0.33*	-0.19	0.10	0.35*	0.39*	0.83**
	(0.16)	(0.14)	(0.15)	(0.15)	(0.19)	(0.14)
EAEG2	1.50**	1.67**	0.92**	0.85**	-0.36	0.60**
	(0.29)	(0.30)	(0.31)	(0.27)	(0.29)	(0.24)
EC2	0.28#	0.11	-0.03	0.27	1.58**	0.54**
	(0.16)	(0.17)	(0.18)	(0.18)	(0.19)	(0.16)
APEC2	0.38#	0.65**	0.85**	1.29**	1.40**	1.19**
	(0.21)	(0.21)	(0.22)	(0.18)	(0.20)	(0.17)
Common language	0.48**	0.31**	0.32**	0.50**	0.51**	0.33**
	(0.09)	(0.09)	(0.09)	(0.08)	(0.10)	(0.08)
Chinese	0.80	1.94*	0.58	0.71	0.77	1.21*
	(0.56)	(0.79)	(0.86)	(0.57)	(0.60)	(0.51)
Number of observations	1194	1274	1453	1708	1343	1573
SEE	1.05	1.07	1.17	1.19	1.26	1.06
adj. R^2	0.69	0.71	0.72	0.72	0.53	0.77

Notes: (a) Standard errors are in parentheses.

(b) ** denotes significance at 1% level ($t \geq 2.576$);
* denotes significance at 5% level ($t \geq 1.96$); and
\# denotes significance at 10% level ($t \geq 1.645$).

(c) All variables except the dummies are in logarithms.

(d) Common language is the dummy for common linguistic or colonial links (German, Japanese, Dutch, English, Spanish, Chinese, Arabic, French and Portugese).

Table 3: Adjusting for Indirect Trade Between China and Taiwan via Hong Kong
(total trade, 1980-1990)

	1980	1985	1990	1980	1985	1990
GNP	0.74**	0.54**	0.71**	0.70**	0.56**	0.71**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GNP per capita	0.30**	0.07**	0.08**	0.29**	0.07**	0.08**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Distance	-0.54**	-0.37**	-0.50**	-0.46**	-0.38**	-0.50**
	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)
Adjacency	0.65**	0.65**	0.72**	0.56**	0.64**	0.72**
	(0.18)	(0.20)	(0.18)	(0.17)	(0.20)	(0.16)
WH2	0.35*	0.39*	0.78	0.36*	0.40*	0.78**
	(0.15)	(0.19)	(0.15)	(0.16)	(0.19)	(0.15)
EAEG2	0.84**	-0.26	0.62**	0.85**	-0.38	0.55*
	(0.26)	(0.28)	(0.31)	(0.24)	(0.29)	(0.22)
EC2	0.27	1.55**	0.59**	0.29#	1.51**	0.59**
	(0.18)	(0.19)	(0.18)	(0.16)	(0.19)	(0.15)
APEC2	1.29**	1.39**	1.12**	1.04**	1.37**	1.12**
	(0.18)	(0.20)	(0.22)	(0.16)	(0.20)	(0.15)
Common language	0.50**	0.54**	0.32**	0.62**	0.56**	0.30**
	(0.08)	(0.10)	(0.09)	(0.09)	(0.10)	(0.08)
Chinese				-0.41	1.15#	0.65
				(0.55)	(0.66)	(0.51)
Number of observations	1709	1324	1259	1259	1259	1259
SEE	1.20	1.26	0.95	1.03	1.25	0.95
adj. R^2	0.72	0.53	0.77	0.72	0.54	0.77

Notes:
(a) Standard errors are in parentheses.
(b) ** denotes significance at 1% level ($t \geq 2.576$);
* denotes significance at 5% level ($t \geq 1.96$); and
# denotes significance at 10% level ($t \geq 1.645$).
(c) All variables except the dummies are in logarithms.
(d) Common language is the dummy for common linguistic or colonial links (German, Japanese, Dutch, English, Spanish, Chinese, Arabic, French and Portugese).

3. Is There a Financial Bloc in the Pacific?

Those who believe that Japan is establishing an economic bloc in Asia often describe it as a 'yen bloc', which carries a financial/monetary connotation. We turn now from trade to financial effects.

We seek to investigate the extent to which Pacific financial markets are becoming more tightly linked, by analysing interest rates in a number of countries around the Pacific. International equalisation of interest rates would be an important phenomenon for many reasons. It would imply, for example, that national monetary authorities had lost the ability to affect domestic demand through independent monetary policies and that countries would easily be able to finance investments despite savings shortfalls. Earlier studies of interest rate parity issues in the Pacific context include Glick (1987) and Glick and Hutchison (1990). A number of studies have found evidence of financial liberalisation in some Pacific countries by observing the ability of international arbitrage to link local interest rates with United States rates. Here we focus on the question: to the extent that interest rates in Pacific countries are now influenced by interest rates in world financial centres, is the power of Tokyo in the region gaining over that of New York?[17]

We tried three tests of the relative influence of Tokyo and New York financial markets, corresponding to more standard tests of simple interest rate parity, covered interest parity, and uncovered interest parity. We regressed:

(i) the local interest rate on the United States *and* Japanese interest rates (and on these interest rates interacted with a linear time trend);

(ii) the local rate on the covered counterparts of (i); and

(iii) the local rate on the uncovered counterparts of (i).

If the world's financial markets and monetary systems are perfectly integrated, then we should not expect to be able to sort out any bilateral effects, such as from Japan to smaller countries in the region. Rather, countries would simply deposit savings into, or draw funds out of, an undifferentiated pool of world capital. But few countries in the Pacific follow a perfectly pegged exchange rate, and the majority still have serious barriers to capital mobility as well.[18] Even capital mobility between the United States and Japan faces minor frictions and major

17. Another way to approach the question of whether East Asia is becoming a financial bloc would be to look at saving-investment correlations. Bayoumi and Sterne (1992) find that saving-investment correlations are lower among East Asian countries (as within other regions) than worldwide, suggesting an extra degree of intra-regional capital mobility by this test.

18. The major exception is Hong Kong, which is pegged to the $US, *and* has open financial markets.

exchange rate uncertainty. Thus, we may be able to pick up some differential effects of New York and Tokyo interest rates in the region.

3.1 The Influence of US Dollar versus Yen Interest Rates

The results of the first test are reported in Table 4.[19] The coefficients on the interaction terms can be interpreted as the increase per year (on average) of the coefficient relating the local interest rate to the corresponding US or Japanese interest rate. All the regressions exhibit a high degree of serial correlation, so the adjusted standard errors are the appropriate ones to use in conducting inference. One finding is that, in almost every case, the trend coefficients are of opposite sign, suggesting that one financial centre is gaining at the expense of another. However, since the relevant parameter estimates are not always statistically significant, one cannot make too much of this result.

Perhaps the most interesting finding is that over the 1982-92 period, New York seems to be gaining influence at the expense of Tokyo in the English-speaking countries of the Pacific Rim (Australia, Canada and New Zealand), while the reverse is occurring in a number of East Asian countries. The observed shift in influence from New York interest rates to Tokyo interest rates is highly significant in the case of Indonesia and somewhat less so in the case of Korea. It is positive but not significant for Malaysia, Singapore and Hong Kong.

3.2 The Influence of United States' versus Japanese Interest Rates, with Currency Factors Removed

It is interesting to try to distinguish whether the links to Tokyo and New York are attributable to country-specific factors on the one hand, such as information advantages that might be afforded by common cultures or tax and legal systems, or to currency factors on the other hand, such as the weights of the yen and United States dollar ($US) in a country's currency basket. To the extent that an Asian currency is linked to the yen or $US, currency factors such as expectations of depreciation or an exchange risk premium should disappear from the interest rate equation. (We will be looking at the currency links directly in terms of exchange rates in the next section of the paper.)

We tried, in two different ways ('covered' and 'uncovered'), to remove the currency factors from the interest rate regressions, to see what remains. Unfortunately, data are not available for some of the countries in Table 4, including Indonesia. We regressed the local interest rate on both the covered

19. Table 4 reports results where the foreign interest rates are the Eurodollar and Euroyen rates, taken from the London markets. Table 10a in Chinn and Frankel (1993) reports analogous regressions where the foreign interest rates are taken from the New York and Tokyo financial markets respectively. The results are similar.

United States and covered Japanese interest rates, where the cost of cover is observed in the forward exchange market, with the aim of discerning country-specific links. There is strong *a priori* reason to expect high multicollinearity, since covered interest parity holds fairly well between $US and yen interest rates.[20] Thus, it should not be very surprising that none of the interaction parameter estimates is statistically significant.[21] The two that are almost significant, Malaysia and Singapore, continue to indicate that influence is shifting from New York to Tokyo.

We also tested the effect of uncovered United States' and Japanese interest rate results, using survey data to measure expectations regarding future exchange rates. The survey data are from *Currency Forecasters' Digest*, which reports forecasts of market participants (actually the harmonic mean of the responses) on a monthly basis.[22] There is evidence of declining New York influence in Canada, and increasing influence of New York in Korea. The sign on the Tokyo term suggests that influence is shifting there for a majority of the six countries, but most are not statistically significant. Here, the destroyer of statistical significance is probably measurement error in the survey data, rather than the less serious disease of multicollinearity.

4. Currency Blocs

As already noted, the phrase 'yen bloc' connotes Japanese monetary influence in Pacific Asia. Such a trend would certainly round out the symmetry of the three blocs, as the $US is dominant in the Western Hemisphere and the deutschemark (DM) in Europe. But, as with trade, formal currency links are missing in East Asia. No currency is pegged to the yen, for example. Are informal currency links forming between Japan and other East Asian countries?

4.1 Stabilisation of Exchange Rates within the Blocs

Consider bilateral exchange rate variability, computed in Table 5. Worldwide, monthly exchange rate variability rose in the 1980s, from a standard deviation of 0.33 per cent in 1980 to 0.38 per cent in 1990. The latter figure suggests that for a typical pair of countries, approximately 95 per cent of exchange rate changes are smaller than 0.76 per cent (two standard deviations, under the simplifying assumption of a log-normal distribution).

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20. Multicollinearity does not, of course, bias the coefficient estimates or their reported standard errors. It just makes it unlikely that there will be enough information in the data to answer the question at hand.
21. The results are reported in Table 12 of Chinn and Frankel (1993).
22. The results are reported in Table 13 of Chinn and Frankel (1993).

Table 4: Trends in the Influence of US Dollar versus Yen Interest Rates on Local Interest Rates

(1982:9-92:3)

	Constant	Eurodollar	Eurodollar trend	Euroyen	Euroyen trend	R^2	DW	Q
Australia	8.473*	-1.992**	0.429**	3.470**	-0.539**	0.52	0.409	141.47**
	(1.143)	(0.277)	(0.041)	(0.411)	(0.054)			
	[3.428]	[0.479]	[0.071]	[0.712]	[0.094]			
Canada	0.535	0.487*	0.086**	0.670*	-0.057	0.79	0.477	158.12**
	(0.458)	(0.111)	(0.016)	(0.165)	(0.022)			
	[1.375]	[0.192]	[0.028]	[0.285]	[0.038]			
Hong Kong	-4.115	1.691**	-0.068	-0.353	0.104	0.71	1.047	41.35**
	(0.857)	(0.208)	(0.031)	(0.308)	(0.041)			
	[2.570]	[0.360]	[0.053]	[0.533]	[0.071]			
Indonesia	14.010**	1.852**	-0.267**	-2.337*	0.410**	0.33	0.700	na
	(1.483)	(0.356)	(0.053)	(0.529)	(0.070)			
	[4.449]	[0.616]	[0.091]	[0.916]	[0.121]			
Korea 1	9.094**	-0.037	-0.031*	-0.103	0.002	0.82	0.488	124.18**
	(0.194)	(0.039)	(0.009)	(0.065)	(0.011)			
	[0.581]	[0.067]	[0.015]	[0.113]	[0.019]			
Korea 2	16.294**	-0.754	0.097	-0.929	0.086	0.64	0.671	57.01**
	(1.087)	(0.527)	(0.077)	(0.704)	(0.091)			
	[3.262]	[0.913]	[0.133]	[1.219]	[0.158]			
Korea 3	10.079**	0.320	-0.061	-0.019	0.124*	0.69	0.204	194.35**
	(0.690)	(0.143)	(0.026)	(0.231)	(0.031)			
	[2.070]	[0.248]	[0.045]	[0.400]	[0.053]			

Malaysia	5.520	-0.057	-0.072	0.700	0.016	0.41	0.463	na
	(1.262)	(0.286)	(0.049)	(0.453)	(0.059)			
	[3.785]	[0.496]	[0.086]	[0.784]	[0.102]			
New Zealand	18.573**	-2.584**	0.379**	3.405**	-0.599**	0.37	0.327	204.22**
	(2.063)	(0.500)	(0.074)	(0.742)	(0.098)			
	[6.291]	[0.866]	[0.129]	[1.285]	[0.169]			
Singapore	-2.768*	0.960**	-0.052*	0.174	0.056	0.86	0.842	103.64**
	(0.413)	(0.093)	(0.014)	(0.142)	(0.019)			
	[1.239]	[0.161]	[0.025]	[0.246]	[0.032]			
Taiwan	-4.144	0.635	0.017	0.811	0.049	0.45	0.422	109.01**
	(1.217)	(0.292)	(0.043)	(0.437)	(0.057)			
	[3.651]	[0.505]	[0.075]	[0.757]	[0.099]			
Thailand	-3.846	0.780	-0.069	1.363*	0.097	0.78	0.461	na
	(1.114)	(0.232)	(0.039)	(0.363)	(0.049)			
	[3.341]	[0.402]	[0.068]	[0.628]	[0.085]			

Notes: (a) Figures in parentheses (.) are asymptotic standard errors; figures in brackets [.] are standard errors assuming N/3 independent observations.
(b) Q statistic indicates the Ljung-Box Q statistic.
(c) ** denotes significance at 1% level (using adjusted standard errors); * denotes significance at 5% level (using adjusted standard errors).

Table 5: Mean Volatility of Monthly Bilateral Exchange Rates
(standard deviation of the first difference of the logs)

'Entire World'	*(63 countries)*	
80	0.00333	
85	0.00390	
90	0.00375	
Western Hemisphere	*Among Members*	*With the Rest of the World*
Number of observations:	36	344
80	0.000821	0.00231
85	0.00891	0.00757
90	0.00920	0.00636
EC	*Among Members*	*With the Rest of the World*
Number of observations:	45	375
80	0.000504	0.00233
85	0.000516	0.00255
90	0.000187	0.00241
EFTA	*Among Members*	*With the Rest of the World*
Number of observations:	15	239
80	0.000398	0.00215
85	0.000198	0.00226
90	0.000210	0.00222
Europe	*Among Members*	*With the Rest of the World*
Number of observations:	105	527
80	0.000445	0.00244
85	0.000398	0.00265
90	0.000206	0.00254
EAEG	*Among Members*	*With the Rest of the World*
Number of observations:	15	237
80	0.001028	0.00234
85	0.000726	0.00221
90	0.000445	0.00235
APEC	*Among Members*	*With the Rest of the World*
Number of observations:	28	308
80	0.000834	0.00229
85	0.000608	0.00221
90	0.000394	0.00240

There is a tendency for exchange rate variability to be lower within each of the groups than across groups, supporting the idea of currency blocs. The lowest variability occurs within Europe. The 1980 statistic is a standard deviation of 0.04 per cent, and it falls by half during the course of the decade.

The members of APEC also have a relatively low level of intra-regional exchange rate variability, especially in light of the diversity of the countries involved. It too fell by half in the course of the 1980s. The level of exchange rate variability is a bit higher within East Asia considered alone. As we shall see, this reflects the fact that the international currency of Asia is not the yen, but the $US.

The Western Hemisphere considered alone shows much higher levels of exchange rate variability than any of the other groupings.

4.2 The Influence of the US Dollar, Yen, Deutschemark and Pound on the Values of Smaller Currencies in the Pacific

We now examine the influences which the four most important international currencies have on the determination of the values of currencies of smaller countries in Pacific Asia. One way that countries in a given area could achieve the lower levels of intra-regional bilateral exchange rate variability noted above is to link their currencies to the single most important currency in the region. In a simple version of the currency bloc hypothesis, one would expect that the $US has dominant influence in the Western Hemisphere, the yen in East Asia and the DM (or ECU) in Europe.

The equation to be estimated is:

$$\Delta(\textit{value of currency } i) = \alpha + \beta_1\Delta(\textit{value of \$US}) + \beta_2\Delta(\textit{value of yen}) + \beta_3\Delta(\textit{value of DM}) + \beta_4\Delta(\textit{value of £}) + \varepsilon \qquad (2)$$

where the change in the value of each currency is computed logarithmically. The goal is to see whether Pacific Asian countries try to stabilise their currencies in terms of a particular major currency. Such an equation is exceptionally well specified under a particular null hypothesis, namely that the value of the local currency is determined as a basket peg (perhaps a crawling peg, since we allow for a constant term). By ‘exceptionally well specified’, we mean that the coefficients should be highly significant and the R^2 should be close to 1.

In 1988, for example, there were 31 countries that were officially classified by the International Monetary Fund (IMF) as following a basket peg of their own design, plus another eight pegged to the SDR (Special Drawing Rights). They included Austria, Finland, Norway, Sweden, Iceland and Thailand. Others, such as Korea, claimed to define the value of their currency in terms of a basket, but in fact followed an extremely loose link. Most basket-peggers keep the weights in the basket secret, so that one can only infer the weight statistically from observed exchange rate movements. Previous tests have suggested that countries that are officially classified as basket-peggers in practice often exhibit a sufficiently wide range of variation around the basket index, or else alter the parity or weights sufficiently often, that they are difficult to distinguish from countries classified as managed floaters.[23]

In applying equation (2) to a wide variety of countries, we realise that most do not follow a basket peg. If policy makers monitor an index which is a weighted average of their trading partners, even though they allow deviations from the index depending on current macroeconomic considerations or speculative sentiments, we can meaningfully estimate the coefficients in the equation under the (restrictive) assumption that these local deviations - the error term - are uncorrelated with the values of the major currencies.

There is a methodological question of what numeraire should be used to measure the value of the currencies. Preliminary results on the determination of exchange rates tried two numeraires: the Swiss franc and purchasing power over local goods.[24] The results, for nine East Asian countries, suggested that all place very heavy weight on the $US in their implicit baskets. Only Singapore and Indonesia, and at times Malaysia and Thailand, appear to put significant weight on the yen, and the weight is usually less than 0.1, as against 0.9 to 1.0 on the $US.

Here we use the SDR as numeraire. Under the basket-peg null hypothesis, the choice of numeraire makes no difference in the estimation of the weights. But more generally, it will make a difference. We also impose the constraint that the sum of the coefficients adds to one (with the pound sterling treated as the residual in the reported results).

In Europe almost all countries give dominant weight to the major currency of the region: the DM.[25] In the Americas, most currencies tested again give dominant weight to the major regional currency, the $US (Table 6). In the results of Table 7, however, we see that this pattern is broken in East Asia. The weight on the $US is very high in Thailand, Korea and China. There is no special role for the yen. The Japanese currency is statistically significant in Singapore, and occasionally in some of the other countries. But the coefficient is low. The same is true of the DM and pound sterling (which are significant, for example, in Singapore). Each of the Asian countries is more properly classed in a dollar bloc than in a yen bloc. It is not a coincidence that many Asian/Pacific countries call their currencies ‘dollar’.

23. Why do countries keep the weights secret? It allows the governments to devalue their currencies secretly when they so desire. But secret weights undermine the governments’ ability to commit credibly to a low inflationary monetary policy (Lowell 1992).

24. See Frankel and Wei (1992) and Frankel (1993), respectively.

25. The results for the EC and EFTA countries are reported in Tables 5 and 6, respectively, of Frankel and Wei (1993).

Nor, given the economies of scale in the use of an international currency, is it surprising that the $US is the first choice of Asia when it comes to such measures as shares of official reserve holdings, invoicing of trade and denomination of international financial transactions, as it is the first choice of the rest of the world.

We also tried estimates of equation (2) that do not impose the constraint that the weights on the major currencies sum to one (and that also exclude the pound sterling).[26] The results are similar: the DM reigns supreme in Europe, the $US in the Western Hemisphere, and the $US - not the yen - is also dominant in East Asia. A t test does not reject the constraint that the sum of the three coefficients is 1 for the Western Hemisphere and Asian countries, but often does reject this constraint for the European countries, perhaps reflecting the absence of the pound sterling and French franc.

4.3 An Attempt to Estimate the Effect of Exchange Rate Variability on Trade

One rationale for a country to assign weight to a particular currency in determining its exchange rate is the reasoning that a more stable bilateral exchange rate will help promote bilateral trade with the partner in question. This is a major motivation for exchange rate stabilisation in Europe. There have been quite a few time series studies of the effect of exchange rate uncertainty on trade overall,[27] but fewer cross-section studies of bilateral trade. Three studies with a cross-sectional dimension are Abrams (1980), Brada and Mendez (1988) and De Grauwe (1988). We will re-examine the question here using our data set, which is more recent and more broad, covering 63 countries.

Volatility is defined to be the standard deviation of the first difference of the logarithmic exchange rate. We start with the volatility of nominal exchange rates and embed this term in our gravity equation (1) for 1980, 1985 and 1990. The results are reported in Table 8.[28] Most coefficients are similar to those reported in the earlier results without exchange rate variability (Tables 1 to 3), though the EC and Western Hemisphere bloc dummy variables appear with lower coefficients, suggesting that some of the bloc effect may have been attributable to exchange rate links. In 1980, the coefficient for the volatility term is indeed negative and statistically significant at the 99 per cent level. The magnitude is moderately

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26. These tables are reported in Frankel and Wei (1993).

27. For example, Hooper and Kohlhagen (1978), Kenen and Rodrik (1986), Akhtar and Hilton (1984) and Cushman (1986). The literature is surveyed in Edison and Melvin (1990).

28. These results extend those in Table 13a of Frankel and Wei (1992) by measuring volatility as the *level* of the standard deviation rather than its log, thus allowing the experiment of asking how much trade would increase if exchange rate variabilities, like those reported in Table 5, were reduced to zero. These results also add the EFTA bloc variable.

Table 6: Currencies in the Western Hemisphere

(weights assigned to foreign currencies in determining changes in value – constrained estimation)

Time Period	Constant	\$US	Yen	DM	adj.R^2/DW	Number of Obs.	SEE
Canada-Dollar							
79.1-82.12	-0.001	0.679**	0.021	0.126#	0.072/1.89	47	0.013
	(0.002)	(0.072)	(0.057)	(0.071)			
83.1-86.12	-0.002##	0.883**	0.011	-0.010	0.467/1.97	48	0.009
	(0.001)	(0.049)	(0.069)	(0.068)			
87.1-90.12	-0.003#	0.974**	-0.036	0.541	0.535/2.17	48	0.012
	(0.002)	(0.058)	(0.085)	(0.099)			
79.1-90.12	0.000	0.867**	-0.020	0.054	0.346/2.08	143	0.012
	(0.001)	(0.034)	(0.038)	(0.045)			
Mexico-Peso							
79.1-82.12	-0.031#	1.220#	-0.610	-0.429	0.004/1.65	47	0.120
	(0.018)	(0.652)	(0.510)	(0.643)			
83.1-86.12	-0.045**	1.477**	-0.039	-0.476*	0.485/1.83	48	0.027
	(0.004)	(0.153)	(0.213)	(0.210)			
87.1-90.12	-0.023**	1.333**	-0.547*	-0.127	0.309/1.22	48	0.036
	(0.005)	(0.166)	(0.246)	(0.286)			
79.1-90.12	-0.032**	1.414**	-0.467*	-0.361	0.104/1.99	143	0.017
	(0.001)	(0.025)	(0.028)	(0.033)			
Argentina-Peso							
79.1-82.12	-0.003#	0.280**	0.097#	0.489**	0.463/1.37	47	0.012
	(0.002)	(0.066)	(0.051)	(0.065)			
83.1-86.12	-0.004*	0.066	0.129	0.583**	0.485/1.83	48	0.014
	(0.002)	(0.072)	(0.100)	(0.099)			

87.1-90.12	0.001	0.281**	0.077	0.434**	0.523/1.60	48	0.008
	(0.001)	(0.039)	(0.058)	(0.067)			
79.1-90.12	-0.002*	0.198**	0.083*	0.529**	0.568/1.99	143	0.012
	(0.001)	(0.033)	(0.037)	(0.043)			
Chile-Escudo							
79.1-82.12	-0.015*	0.848**	0.060	0.054	-0.016/1.45	47	0.047
	(0.007)	(0.258)	(0.202)	(0.255)			
83.1-86.12	-0.022**	0.917**	-0.034	0.224	0.030/2.06	48	0.039
	(0.006)	(0.209)	(0.292)	(0.288)			
87.1-90.12	-0.010**	1.063**	-0.032	0.247*	0.572/1.63	48	0.013
	(0.002)	(0.063)	(0.093)	(0.108)			
79.1-90.12	-0.016**	0.929**	0.016	0.035	0.083/1.68	143	0.036
	(0.003)	(0.100)	(0.112)	(0.131)			
Colombia-Peso							
79.1-82.12	-0.011**	0.986**	-0.049**	0.024	0.913/0.71	47	0.004
	(0.001)	(0.021)	(0.017)	(0.021)			
83.1-86.12	-0.024**	1.090**	-0.010	0.017	0.821/0.79	48	0.007
	(0.001)	(0.039)	(0.055)	(0.054)			
87.1-90.12	0.020**	0.971**	0.063**	0.006	0.948/0.60	48	0.003
	(0.000)	(0.015)	(0.022)	(0.026)			
79.1-90.12	-0.018**	1.041**	-0.018	-0.950	0.787/0.28	143	0.008
	(0.001)	(0.021)	(0.023)	(0.028)			

Notes
(a) Standard errors are in parenthesis.
(b) All currencies are measured in terms of SDR ($US 0.42, DM 0.19, yen 0.15, French franc 0.12, pound sterling 0.12).
(c) **, *, # and ##, denote statistical significance at the 99%, 95%, 90%, 85% levels, respectively.

Table 7: Currencies in East Asia

(weights assigned to foreign currencies in determining changes in value - constrained estimation)

Time Period	Constant	$US	Yen	DM	adj.R^2/DW	Number of Obs.	SEE
Singapore-Dollar							
79.1-82.12	-0.003#	0.549**	0.130**	0.231**	0.354/2.19	47	0.009
	(0.001)	(0.050)	(0.039)	(0.049)			
83.1-86.12	-0.003	0.697**	0.275**	-0.035	0.324/2.10	48	0.012
	(0.002)	(0.066)	(0.092)	(0.091)			
87.1-90.12	-0.003**	0.752**	0.082	0.081	0.366/1.95	48	0.008
	(0.001)	(0.039)	(0.058)	(0.067)			
79.1-90.12	0.010	0.696**	0.132**	0.117**	0.270/2.05	143	0.011
	(0.001)	(0.030)	(0.033)	(0.039)			
Thailand-Baht							
79.1-82.12	-0.002	0.878**	0.056	0.015	0.378/2.08	47	0.011
	(0.002)	(0.072)	(0.057)	(0.071)			
83.1-86.12	-0.004	0.756**	0.082	0.124	0.028/2.10	48	0.025
	(0.004)	(0.131)	(0.183)	(0.180)			
87.1-90.12	-0.000	0.807**	0.127	0.44**	0.970/2.55	48	0.002
	(0.000)	(0.007)	(0.011)	(0.013)			
79.1-90.12	-0.002	0.806**	0.073##	0.062	0.228/2.09	143	0.016
	(0.001)	(0.045)	(0.049)	(0.058)			

S. Korea-Won							
79.1-82.12	-0.009*	1.025**	-0.039	0.181	0.214/2.18	47	0.027
	(0.004)	(0.147)	(0.115)	(0.145)			
83.1-86.12	-0.003**	0.932**	-0.010	0.114**	0.810/1.10	48	0.005
	(0.001)	(0.028)	(0.039)	(0.038)			
87.1-90.12	0.004**	0.983**	0.129*	-0.113#	0.734/0.80	48	0.003
	(0.001)	(0.040)	(0.059)	(0.068)			
79.1-90.12	-0.003#	0.945**	0.001	0.117#	0.344/1.74	143	0.017
	(0.001)	(0.048)	(0.054)	(0.063)			
China, P.R.-Yuan							
79.1-82.12	-0.001	0.331**	0.110**	0.480**	0.682/1.98	47	0.008
	(0.001)	(0.042)	(0.033)	(0.042)			
83.1-86.12	-0.011**	0.957**	-0.303##	0.101	0.673/2.01	48	0.027
	(0.004)	(0.142)	(0.199)	(0.196)			
87.1-90.12	-0.005	1.145**	0.485*	-0.685*	0.275/2.17	48	0.035
	(0.005)	(0.164)	(0.243)	(0.282)			
79.1-90.12	-0.008**	0.813**	0.052	0.013	0.056/1.95	143	0.029
	(0.002)	(0.082)	(0.091)	(0.107)			

Notes: (a) Standard errors are in parenthesis.
(b) All currencies are measured in terms of SDR ($US 0.42, DM 0.19, yen 0.15, French franc 0.12, pound sterling 0.12).
(c) **, *, #, and ##, denote statistical significance at the 99%, 95%, 90%, 85% levels, respectively.

Table 8: Exchange Rate Volatility and Bilateral Trade

(Ordinary Least Squares estimation)

Ex. Rate	Volatility	GNPs	GNP/ cap.	Dist.	Adjac.	WH	EC	EFTA	EAEG	APEC	adj. R^2	SEE
1980		0.74**	0.29**	-0.56**	0.72**	0.52**	0.23		0.88**	1.51**	0.71	1.20
		(0.02)	(0.02)	(0.04)	(0.18)	(0.15)	(0.18)		(0.27)	(0.17)		
Nominal	-56.11**	0.77**	0.24**	-0.74**	0.24	0.13	-0.14	-0.08	0.96**	1.31**	0.74	1.17
	(7.45)	(0.02)	(0.02)	(0.05)	(0.21)	(0.23)	(0.18)	(0.32)	(0.36)	(0.19)		
Real	-15.26**	0.74**	0.27**	-0.70**	0.48*	0.17	-0.09	-0.22	0.90*	1.40**	0.76	1.14
	(5.25)	(0.02)	(0.02)	(0.05)	(0.22)	(0.20)	(0.18)	(0.38)	(0.37)	(0.22)		
1985		0.76**	0.25**	-0.70**	0.75**	0.33**	0.44*		0.59*	1.28**	0.74	1.17
		(0.02)	(0.02)	(0.04)	(0.18)	(0.16)	(0.17)		(0.26)	(0.17)		
Nominal	0.23	0.77**	0.24**	-0.72**	0.61**	0.26##	0.45*	-0.02	0.79*	1.18**	0.75	1.16
	(0.49)	(0.02)	(0.02)	(0.04)	(0.19)	(0.17)	(0.18)	(0.31)	(0.36)	(0.19)		
Real	0.09	0.77**	0.25**	-0.77**	0.46*	-0.05	0.26##	-0.19	0.72*	1.13**	0.78	1.12
	(0.53)	(0.02)	(0.02)	(0.05)	(0.22)	(0.20)	(0.17)	(0.31)	(0.36)	(0.21)		
1990		0.75**	0.09**	-0.56**	0.79**	0.92**	0.47**		0.69*	1.36**	0.77	1.07
		(0.02)	(0.02)	(0.04)	(0.16)	(0.14)	(0.16)		(0.24)	(0.15)		
Nominal	5.23**	0.78**	0.09**	-0.66**	0.53**	0.67**	0.41**	-0.03	0.68*	1.35**	0.80	1.02
	(0.58)	(0.02)	(0.02)	(0.04)	(0.16)	(0.14)	(0.16)	(0.28)	(0.32)	(0.17)		
Real	-8.04#	0.79**	0.12**	-0.61**	0.35#	0.53**	0.29	-0.09	0.91**	1.12**	0.83	0.97
	(4.39)	(0.02)	(0.02)	(0.04)	(0.20)	(0.17)	(0.17)	(0.27)	(0.27)	(0.17)		

Notes: (a) The volatility variable is in levels. All the other variables except the dummies are in logarithms. All the regressions have an intercept for which the estimate is not reported here.
(b) Standard errors are in parenthesis.
(c) **, *, # and ## denote statistical significance at the 99%, 95%, 90% and 85% levels, respectively.

large.[29] In 1985, the volatility parameter is no longer significant (with the point estimate turning positive), while in 1990, the volatility coefficient is statistically greater than zero.

Theoretical models of the behaviour of the firm often produce the counterintuitive result that, because of convexity in the profit function, exports can be an *increasing* function of exchange rate variability. Only when the firm is sufficiently risk averse does the intuitive negative effect on trade emerge. Several empirical studies have taken this possibility seriously and perhaps we should also.[30] However, before we take our econometric findings at face value, we should note that a presumably more relevant measure of exchange rate uncertainty is the volatility of the *real* exchange rate, which takes into account the differential inflation rates in the two countries in addition to movements in the nominal exchange rate.

Regressions including the volatility of real exchange rates are also presented in Table 8. In 1980, the volatility parameter is still negative and statistically significant. The parameter for 1985 is still insignificant. In contrast to the regression with the volatility of nominal rates, the volatility parameter for 1990 is a statistically significant negative number [-8.04].

By way of illustration, these point estimates can be used for some sample calculations. Worldwide, the average level of exchange rate variability in 1990 was 0.376 per cent (Table 5). Our estimates suggest that if this variability was eliminated by adopting fixed exchange rates worldwide, the effect on trade would be 3.02 per cent (=8.04$\times$0.376).

These estimated effects cannot be regarded as large. Gagnon (1989) argues on theoretical grounds that the effect of real exchange rate uncertainty on trade volume should be quantitatively small. In a sample calculation, he suggests that an increase in the standard deviation of the exchange rate from 0.05 to 0.08 should reduce the volume of trade undertaken by an individual exporter by 2.5 per cent, which he considers very small.

These results, while less robust than most of the other gravity equation findings, are generally consistent with the hypothesis that real exchange rate volatility depresses bilateral trade. More specifically, they would appear to be evidence that the stabilisation of exchange rates within Europe has helped to promote intra-European trade, and to promote trade within the Pacific, even if the effects are small.

29. The estimate in Frankel and Wei (1992) suggests that, on average, a doubling of the standard deviation reduces bilateral trade by an apparent 4.6 per cent (= 0.066 ln (2)), holding constant all other variables.

30. See for example, Caballero and Corbo (1989). Empirically, however, they find a negative relationship.

One aspect of the ordinary least squares (OLS) estimates in Table 8 might lead one to think that the role played by exchange rate stabilisation is not small: the estimated trade bloc coefficients seem to fall sharply when the volatility term is included. There is very likely a problem of simultaneous causality. The apparent negative correlation between exchange rate variability and the volume of bilateral trade could easily be due as much to the government's deliberate efforts to stabilise the currency *vis-à-vis* a valued trading partner, as to the effects of stabilisation on trade. Therefore, we have also tried the method of instrumental variable estimation to tackle the possible simultaneity bias.[31]

We concentrate on the regressions involving the real exchange rates. In 1980, the volatility parameter is still negative and significant at the 95 per cent level. But the magnitude is much smaller than without using the instrument, suggesting that part of the apparent depressing effect of the volatility was indeed due to the simultaneity bias. Strong confirmation comes from an examination of the trade bloc coefficients for the EC and the Western Hemisphere: when the simultaneity is corrected, the presence of the volatility variable no longer reduces the trade bloc coefficient.

In 1990, the volatility parameter again turns into a positive number. The results suggest that if exchange rate volatility did depress bilateral trade, its negative effect appears to have diminished or disappeared over the course of the 1980s. (Tests on data going 15 years further back in history show a negative effect of exchange rate volatility (both nominal and real) on trade that is highly significant in 1965, but that declines steadily in the 1970s.) This sharp change is somewhat surprising. One possible explanation is the rapid development of exchange risk hedging instruments. Our estimates of this effect are, in any case, not sufficiently robust with respect to the functional form, year, or estimation technique to justify strong conclusions. But it seems safe to conclude that the negative effect, if it is still there at all, is very small in magnitude.

5. Conclusions

We have found some evidence of regionalisation of the world economy, into three trading blocs: Europe, the Americas and East Asia. But the patterns of trade, finance and monetary influence are somewhat different from those often supposed.

We have used the gravity model of bilateral trade to evaluate the trade bloc hypothesis, holding constant the sizes of the countries, their GNPs per capita, the distance between them, whether they share a common border and whether they share a common language. We find evidence of a trade bloc on each continent. But

31. The standard deviation of relative money supply is our instrument for the volatility of exchange rates. The results are reported in Table 10 of Frankel and Wei (1993).

the greatest rate of intensification of intra-regional bias has not occurred in East Asia. Rather, in the early 1980s it occurred in the EC, and in the late 1980s in the Western Hemisphere. The strongest apparent effect is not for these three continental groupings, but for APEC.

The lesson that the links across the Pacific are stronger than the links within East Asia is not limited to trade. We performed tests of Japanese versus United States' financial influences on interest rates in 10 Pacific countries. Yen interest rates appear to be gaining influence only in Indonesia, and perhaps Korea. Elsewhere there is no clear trend although, in the English-speaking countries, $US interest rates are the ones gaining influence.

A similar result emerges for currency influences. Although bilateral exchange rates are more stable within East Asia than worldwide, this is not a matter of simply being stable in terms of the most important currency within the region, the yen. While the determination of changes in currency values in Europe is dominated by the DM, and in the Americas is dominated by the $US, changes in currency values in East Asia, with the exception of Singapore and Indonesia, are not much influenced by the yen. Rather the $US is the dominant currency on this side of the Pacific as well as on the other side.

Finally, we found some tentative evidence for a small effect of bilateral exchange rate variability in determining bilateral trade, particularly before the proliferation of hedging instruments in the mid-1980s. But, even if this evidence is thought strong enough to merit being taken seriously, our results do not support the idea that there are strengthening links to the yen in East Asia that have helped to promote intra-regional trade. Rather, if anything, the links to the $US throughout the Pacific have helped to promote Pacific-wide trade and investment.

Appendix: List of Countries Used in the Gravity Equation

Regional Groupings and Main City

Americas *(WH, 13)*		**East Asia** *(EAEG, 10)*	
Canada	Ottawa	Japan	Tokyo
United States	Chicago	Indonesia	Jakarta
Argentina	Buenos Aires	Taiwan	Taipei
Brazil	Sao Paulo	Hong Kong	Hong Kong
Chile	Santiago	South Korea	Seoul
Colombia	Bogota	Malaysia	Kuala Lumpur
Ecuador	Quito	Philippines	Manila
Mexico	Mexico City	Singapore	Singapore
Peru	Lima	Thailand	Bangkok
Venezuela	Caracas	China	Shanghai
Bolivia	La Paz	**Other countries** *(23)*	
Paraguay	Asuncion	South Africa	Pretoria
Uruguay	Montevideo	Turkey	Ankara
European Community *(EC, 11)*		Yugoslavia	Belgrade
West Germany	Bonn	Israel	Jerusalem
France	Paris	Algeria	Algiers
Italy	Rome	Libya	Tripoli
United Kingdom	London	Nigeria	Lagos
Belgium	Brussels	Egypt	Cairo
Denmark	Copenhagen	Morocco	Casablanca
Netherlands	Amsterdam	Tunisia	Tunis
Greece	Athens	Sudan	Khartoum
Ireland	Dublin	Ghana	Accra
Portugal	Lisbon	Kenya	Nairobi
Spain	Madrid	Ethiopia	Addis Ababa
European Free Trade Area *(EFTA, 6)*		Iran	Tehran
Austria	Vienna	Kuwait	Kuwait
Finland	Helsinki	Saudi Arabia	Riyadh
Norway	Oslo	India	New Delhi
Sweden	Stockholm	Pakistan	Karachi
Switzerland	Geneva	Hungary	Budapest
Iceland	Reykjavik	Poland	Warsaw
		Australia	Sydney
		New Zealand	Wellington

Notes: (a) The distance between countries was computed as the great circle distance - between the relevant pair of cities

(b) APEC consists of East Asia, plus Australia, New Zealand, Canada and the United States.

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Discussion

1. Ross Garnaut

Frankel and Wei note the increasing attention being given to the geographic structure of bilateral trade flows in recent times, alongside the more traditional concerns in economics for the volume and value, and commodity composition of international trade for individual economies and the world as a whole. They note the increasing attention being given to *preferential* trade flows. These shifts in professional focus have followed the increase in importance of discriminatory regionalism in Western Europe and North America.

The paper by Frankel and Wei is a substantial contribution to understanding the geographic and, in particular, the regional pattern of international trade flows. Of special interest is the conclusion that the economies participating in Asia-Pacific Economic Cooperation (APEC) have the strongest regional associations among a variety of East Asian and Pacific alternatives, and that these strong associations have developed without major elements of institutionalised discrimination.

The paper analyses regional associations, or regional integration, in real trade within East Asia and the Pacific, and examines whether or not monetary and financial links also exist. The 'gravity model' is used to estimate the contribution of common membership of a regional trade group to the level of trade between two economies. Then comparisons are made of variations in interest and exchange rates in single economies, with variations in economies which are participants in or are excluded from regional groups.

The conclusions are striking, for the way in which separate analyses of real and monetary phenomena, using widely different techniques, reinforce each other. The member economies of APEC are closely associated with each other in their international economic transactions, and rather more so than the East Asian or Western Pacific economies viewed in isolation.

While striking in their clarity, these conclusions should not be surprising. APEC was launched in 1989, and its prospective membership was defined in their current terms, precisely because the 15 member economies traded with each other intensively (Drysdale 1988). The considerable literature that laid the intellectual foundations of APEC had long emphasised the importance of *market integration*, without institutionalised discrimination, in promoting high intensity of trade amongst Asia-Pacific economies (Drysdale and Garnaut 1993). It is an important theme, at least in the economic literature on Asia Pacific Economic Cooperation, that the close links between North America and Western Pacific economies make APEC's wide cooperation more promising than East Asian or Western Pacific cooperation. However, this theme is being challenged by recent support for narrowly regional and discriminatory approaches to trade policy in the United States (Garnaut 1993).

Early analysis of the basis of trade expansion amongst Asia-Pacific economies made use of both *gravity* and *intensity* approaches to real trade flows, but tended to emphasise the latter (Drysdale and Garnaut 1982). Each has strengths and weaknesses, yet each comes to similar conclusions on the issues addressed by Frankel and Wei.

In terms of the specifics of Frankel's use of the gravity model, it is important to go further with analysis of why the distance variable has such an important role. Frankel and Wei think of distance in terms of transport costs, and so think it 'perhaps surprising' that the effect of distance is at least as great for manufactured goods, where transport costs are proportionately less important, as for primary commodities. It ceases to be surprising when we examine the wider effects of distance, on ease and intensity of communications (including time zone effects); direct investment and other business ties; knowledge of trading opportunities (whether communicated through the public media, informal business ties, interpersonal links or other means); movement of people including through immigration; and cultural and institutional change and, over time, tendencies towards convergence. Empirical studies have suggested that these wider effects of distance are often more powerful than transport costs in influencing trade flows.

The discussion of the power of the GDP per capita variable is of considerable interest. Frankel and Wei conclude that 'intra-industry trade' and 'Linder' effects, which tend to promote trade more between economies with similar per capita incomes, are more powerful than 'Heckscher-Ohlin' effects. This is a reasonable conclusion. But this conclusion does not mean that Heckscher-Ohlin effects (that is, trade motivated by differences in relative factor endowments across countries) are unimportant: the whole experience of Western Pacific trade expansion and economic growth attests to the contrary. Neither does it mean that the welfare gains from trade between countries of similar per capita incomes are greater than from trade between economies with widely different relative resource endowments and per capita incomes. In a dynamic context, too, the East Asian experience underlines the importance of high and rising trade shares of output and expenditure to rapid incomes growth in poor countries, and therefore to substantial convergence over the decades of per capita incomes amongst open economies which share growth-promoting domestic economic policies.

One weakness (among many strengths) of the specification of the distance, and more generally the 'resistance', variables by Frankel and Wei, is the focus on absolute rather than relative values. This follows from the underlying assumption of the gravity model, that bilateral trade flows are independent of each other.

However, in reality, low resistances in a bilateral trading relationship, whether resulting from low transport costs, common membership of a discriminatory *bloc* or other sources, expand bilateral trade partly by replacing domestic production by lower cost production in the trading partner, and partly by diverting trade from other bilateral trading relationships. For this reason, proximity between two economies that are both isolated from the major centres of world production and trade, is likely to be more powerful in promoting trade than similar proximity between two countries that are both close to the centre of gravity of world production. Similarly, 'resistances' to trade between two economies that are both excluded from a major discriminatory *bloc* are *relatively* low, and likely to have a disproportionately powerful effect in promoting bilateral trade. These insights from use of the intensity approach to analysis of bilateral trade flows in a world consisting of many countries could be joined profitably to the insights available from Frankel and Wei's use of the gravity model (Drysdale and Garnaut 1982).

I draw several important policy implications from the paper. One is that intra-regional trade can expand strongly without any element of trade discrimination. A second is that any regional economic cooperation in the Asia-Pacific region should be mindful of the importance of trans-Pacific ties with North America, and careful to avoid disruption to those links. A third is that APEC is a natural grouping, which provides a useful focus for measures to promote regional trade expansion, so long as the means of promotion do not involve trade discrimination.

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2. Zenta Nakajima

It is difficult to be anything but wholeheartedly sympathetic towards the paper by Frankel and Wei. They have found some evidence of regionalisation of the world economy into European, American and East Asian groupings. They conclude that, in respect of trade patterns, finance and monetary influences, there has not occurred as much intensification of intra-regional bias in East Asia as is often supposed.

I would like to note that their findings accord well with my perception. As far as is known to me, no deliberate policy measures have been implemented with an eye to establishing a yen bloc. I fully agree with the paper that 'the US dollar is the dominant currency on this side of the Pacific', as well as on its home side.

What is also appealing is that the paper takes pains to take into account important, but often neglected, factors in determining international economic relationships, such as proximity, linguistic ties, etc. Their attempt at examining impacts of foreign exchange volatility on trade is also a significant contribution in the area that is very important, but often defies empirical testing.

Generally, it is not an easy task to comment on a paper with which you agree. In what follows, firstly, I comment briefly on the applicability of the gravity model to the issue of intra-regional bias in East Asia. Then, I discuss the possibility of a yen bloc from a more policy-oriented viewpoint.

2.1 Impacts of Japan's Direct Foreign Investment in Asia

In attempts to identify intra-regional bias in trade, the authors use the gravity model, thereby holding constant simple economic factors common to any bilateral trade throughout the world, such as proximity, GNP, etc. It is, itself, a legitimate procedure. Nevertheless, caution seems required.

In the late 1980s, Japan's direct investment in Asia (South-East Asia, in particular) increased tremendously. During the same period, direct investment in the United States and Europe also increased significantly. So, Japanese investment in Asia as a proportion of its total direct foreign investment remained more or less unchanged, as Frankel points out in his previous papers.

Investment activities by the Japanese private sector in Asia and the United States were both undertaken under enormous pressure from the sharply appreciating yen, but differed significantly in nature. Evidence suggests that direct investment in the United States consisted largely of purchases of properties (such as land and office buildings) by financial institutions, including banks, insurance companies, etc. In contrast, investment in Asia often represented desperate attempts by manufacturing firms to relocate overseas their domestic production lines.

Naturally, economic consequences varied substantially (for example, in terms of the multiplier effect). Japan's active investment in Asia is deemed to have become one of the major factors that launched the region's economic activity onto an expansionary path seldom experienced previously. In the process, the economic dependence of the region upon the course of events in Japan is likely to have increased significantly. The gravity model appears to treat GNP growth as if it were given exogenously. However, such growth was, in fact, closely related to an increase in intra-regional dependence. In this sense, to adjust GNP mechanically across-the-board may leave us with an underestimation of intra-regional bias. Of course, the authors' primary concern appears to be to pick up the deliberate policy-induced intensification of intra-regional bias. But then, what interest is there in exploring the existence of a currency bloc, if the intention is to exclude every single element of privately-induced intra-regional bias? I do not think that is the authors' overall intention.

Until formal econometric research is conducted, much of what I have just said remains a hypothesis. In any case, I am not ready to say that Japan is about to challenge United States' dominance in the region.

Nonetheless, it may interest you to know that the share of Japan's direct investment in Thailand rose from 29.5 per cent in 1986 to 37.2 per cent in 1989, whereas the United States' share declined from 30.8 per cent to 20.7 per cent during the same period.

2.2 The Yen as a Nominal Anchor in Asia

Assuming that US dominance in trade, finance, and monetary influence will remain unchanged in Asia in the foreseeable future, would there be a role - a leading role in some sense - for the yen to play in Asia? I would now like to turn to this issue.

The European Monetary System (EMS) is generally viewed as virtually a deutschemark (DM) bloc. It does not, however, imply that the DM is the most dominant currency in every respect among the EMS member currencies. For example, the DM comprises only 23.4 per cent of the total foreign reserves of member countries. It is well below 57.9 per cent, the portion held in US dollars. In the French foreign exchange market, 43.8 per cent of transactions are undertaken in DM, as compared with 71.9 per cent in US dollars.[1]

Nevertheless, the EMS is considered to be a DM bloc. Due to Germany's relatively good performance in maintaining price stability over the medium to long term, the other members have conducted monetary policy in such a way that their currencies might not deviate substantially from the DM. The DM plays the role of a nominal anchor.

It is this kind of role that the Japanese yen may be expected to play in the future. For that to happen, there are three prerequisites. Firstly, intra-regional interdependence in Asia will remain on an upward trend.[2] Secondly, macroeconomic

1. Note that the total currency breakdown adds up to 200 per cent.
2. I employ intra-regional interdependence in the ordinary sense of the word and not necessarily in the sense of the word as defined by the gravity model.

policy in the region will shift its focus from growth to stability. Thirdly, Japan's macroeconomy will, by and large, outperform the US economy over the longer run. If these three conditions are met, who can tell for sure that Asia will not form a yen bloc analogous to the EMS?

The Bank of Japan's policy on this issue has always been to maintain a neutral stance. We have no intention to encourage or discourage other Asian countries to peg their currencies to the yen or to the yen-dominated basket. It is strictly their choice.

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3. General Discussion

The discussion of the paper by Frankel covered a variety of issues concerning the determinants of world trade.

The question of what exactly defines a currency bloc was raised - in particular, how should a 'yen bloc' be defined? Four possible definitions were advanced:

- an area in which the yen is the predominant unit of account for private transactions;
- an area in which the Bank of Japan plays a similar role to that played by the Bundesbank in Europe;
- an area that sees its longer-term political and economic interests being aligned with that of Japan; and
- a grouping of countries drawn together in trade by economic links, and where Japan is at the centre of the group.

The first definition was thought to be largely irrelevant for trade. The second was important to the extent that common currency areas and low exchange rate volatility are conducive to trade. The third definition was the most commonly thought of definition of a 'bloc' most likely to generate strong trading links. The gravity model used by Frankel fits within the fourth definition. While it was thought important to study this model, the insights afforded by considering other definitions of a bloc should not be lost sight of when examining influences on the world trading environment.

There was considerable discussion of the role of factors in the third definition. In particular, political antipathy/sympathy between countries was seen as a key determinant of trade. The United States trades very little with Cuba, yet the two countries are very close geographically. This lack of trade reflects political tensions between the two countries. Another example discussed was the old Soviet-Eastern European group - the countries in this group traded disproportionately with one another because of their common political alliance. The collapse of Communism in Europe has brought about a fundamental re-orientation of trade between these countries. Some discussants argued that this re-orientation of trade is among the most important factors governing current developments in international trading arrangements. However, the point was also made that the causation did not necessarily run from solid political relationships to trade. In some important cases, international trade was said to help build stronger political ties.

The question of what mix of countries is best suited to the formation of a bloc was also considered. Some discussants thought that the development of a bloc would be easier if one of the countries in it was a large net saver.

The importance of Frankel's distance variable in explaining gross trade flows also received some attention. In particular, the question of why distance has not become less important through time was discussed. It was argued that the distance variable not only captures transportation costs, which have declined significantly, but that it also captures psychic costs imposed by distance. The increased focus in world trade on differentiated manufactured goods was making closeness to markets a more important variable than was the case in earlier decades. In this case, even though there have been massive improvements in communications and transport technologies, an ability to understand and quickly service markets has increased the need to be close to where the product is sold.

The trend towards increasing trade in services was also thought likely to lead to distance considerations becoming even more important in international trade in coming years. However, there has been relatively little research on trade in services (and assets) because of the lack of comprehensive data sources. It was suggested that for trade in services (especially financial services) distance in terms of time zones might be more important than distance in terms of kilometres.

A number of participants attempted to interpret the language variable in Frankel's trade equations. The importance of the language variable might reflect the fact that countries that share a common language often share common legal and banking systems. Nations that share a common system of commercial law might trade with one another more than countries with different systems.

The link between exchange rate volatility and international trade was also discussed. While the approach of using cross-section data to analyse this issue was generally supported, an important potential problem was raised. That is, if exchange rate volatility is higher in one period than in another for *all* countries, then the cross-section methodology is unlikely to pick up any effect. It is only if volatility differs across trading pairs that any effect can possibly be found. There was also some discussion of the appropriateness of the time periods chosen to observe the cross-sections of data. It was suggested that 1975 and 1980 were heavily influenced by developments in the world oil market.

Foreign direct investment also complicates the interpretation of exchange rate volatility and trade. Japan has invested heavily in Asian economies which have more stable exchange rates *vis-à-vis* the US dollar than does the yen. Japan is able to export to the United States from these countries.

A Perspective

Adrian Pagan

1. Introduction

Three distinctive themes ran through the Conference. Essentially, these were:

- What determines the exchange rate?
- What determines trade flows?
- What should policy be towards the exchange rate and what is its role in the current recessionary environment?

2. The Exchange Rate

A persistent issue surfacing throughout the Conference was whether or not economic research had supplied any useful guide to the factors determining the exchange rate. Paul Krugman was very pessimistic on this score, whereas Blundell-Wignall, Fahrer and Heath (BWFH) were optimistic. From the nature of the discussion it was clear that such a relationship is desirable, as it can serve both as an anchor for markets and a signal to central banks when an exchange rate is 'getting out of line'. This idea surfaced under many guises - Ken Clements felt that purchasing power parity (PPP) fitted the bill, while Mike Artis emphasised the fundamental equilibrium exchange rate (FEER), or the desirable equilibrium exchange rate (DEER), using these latter concepts to explain some of the adjustments occurring in the European Monetary System (EMS) in September 1992.

Table 1: Determinants of Exchange Rates

Time Period	y_t	x_t
Very long run	Nominal exchange rate	Domestic and foreign prices
Medium run	Real exchange rate	Terms of trade, capital productivity and stock/flow effects
Short run	Medium-run adjusted exchange rate	Short-run foreign and domestic interest rates
Very short run	Medium-run exchange rate adjusted for short-run interest differentials	Noise trading/ chartist fundamentalist dynamics

The discussion is summarised via the tree depicted in Table 1, which illustrates both the time periods and the variables that were examined. At each level of the tree, we conceive of a relationship of the form $y_t = x_t\beta + u_t$ where y_t is the variable being explained, x_t are the explanatory variables (with weights β) and u_t is the residual. At each level, y_t changes so that the 'new' y_t is an 'adjusted exchange rate' defined as $y_t - x_t\beta$ of the previous level. Thus, at the top, y_t is the log of the nominal exchange rate, the x_t*'s* are the logs of domestic and foreign price levels and the vector of weights β takes the value $\beta' = [1, -1]$, while the y_t at the next level down is the log of the real exchange rate.

In the table, PPP is taken to be a description of exchange rates in the very long run. During the medium term, the relation is disturbed by fluctuations in the terms of trade and the marginal productivity of capital, as well as exhibiting complex dynamic behaviour due to stock/flow effects stemming from imbalances caused by the cumulation of external debt. In the short run, say at monthly intervals, the exchange rate, adjusted for these medium-run effects, is unlikely to be constant, as economic agents react to short-run interest differentials. Finally, in very short periods, one observes the potential for great volatility in the adjusted rate, owing to the interaction of chartists and fundamentalists in the market.

All of these views and time periods were represented in discussion at the Conference, leading to many definitions of what a fundamental rate was. Krugman argued that the search for a relationship was an important one, particularly as these were used to close economic models. Clements pointed to the fact that Figures 1 and 2 of BWFH seemed to support PPP as a good assumption; in the case of the $US/$A, the real exchange rates in 1969 and 1992 were effectively the same. Artis essentially adopted the same device in highlighting the relative inflation differentials between the United Kingdom and Germany as a source of the September 1992 crisis. BWFH presented a medium-run relation of the form described in the paragraph above. Krugman also mentioned that the short-run connection distinguished in the table - effectively short-run uncovered interest parity if the medium and long-term x_t variables are taken to represent an expected exchange rate - had been rejected many times by the data. Finally, at very short time horizons, there is likely to be very complex dynamic behaviour in exchange rates from noise traders, and it may be that the residual at this level is of greater importance than the other determinants further up the tree.

The main empirical work on this topic presented at the Conference - BWFH - related to the prospects for determining a medium-term relationship. Implicit in the tree is the assumption that the law of large numbers can be applied to the residual at all levels, i.e., the noise trader effects, when averaged over, say, days and weeks, should 'disappear' in the sense that their variance becomes smaller relative to the factors causing deviations from fundamentals in the longer term. Effectively, such a postulate implies that there are neither bubbles which fail to burst in a reasonable period of time nor 'peso problems' that persist indefinitely. Successful modelling of the medium term can be interpreted as evidence of this effect. Cast in more formal econometric terms, and recognising that variables such as the exchange rate and prices can be regarded as possessing stochastic trends, the issue becomes whether such variables are cointegrated. Hence, the tests for this feature provided by BWFH can be regarded as shedding some light on the importance of speculative bubbles. Their presence or absence is a key question for policy; if the concept of a fundamental exchange rate is to be credible, deviations from it must not be too persistent.

How successful are BWFH in nailing down a representation of the real exchange rate? Krugman highlighted the fact that empirical studies of exchange rate behaviour had convinced many researchers of the lack of utility of exchange rate models. Of all the evidence, he cited the Meese and Rogoff (1983) results as particularly damaging. In that study, predictions from exchange rate models were not as good as those from a random walk. Applying a similar test to BWFH over the forecast period of 1990/91 to 1992/93 gives the result that the root-mean-squared error (RMSE) of prediction for the real TWI from a random walk is roughly the same as that from the BWFH model if the error-correction model (ECM) term is in the latter, but only around one-half of it if the ECM term is deleted. If the ECM term is included, the BWFH model actually has a much lower bias in forecasts than the random walk model, although it exhibits a slightly larger standard deviation. Hence, on this criterion, the model does quite well. Even if one adopts the non-ECM equation, it is important to ask whether or not this is the right criterion to use anyway. In this regard, it is instructive to think of Hall's (1978) argument that consumption should follow a random walk. This outcome reflects the inter-temporal optimising conditions of a consumer with a quadratic utility function, but the underlying model can also be expressed as the permanent income theory of consumption. In most instances, it is more useful to think of the latter relationship rather than the former when analysing consumption. Indeed, most stochastic general equilibrium researchers do think that way when considering the impact of, say, a supply-side shock. Moreover, even though these two models are isomorphic at an abstract level, given the difficulties of measurement of economic concepts, it may well be that an empirical model relating consumption to permanent income might be dominated by a pure time series model such as a random walk. My belief is that it is better to search for fundamentals that are not just yesterday's rate.

BWFH's paper is also useful for shedding light on the top of the tree. They mention that the real exchange rate is an integrated variable so that PPP is not a sufficient story for exchange rates. Previously, Blundell-Wignall and Gregory (1990) had made the argument that the missing variable was the terms of trade and that when this was introduced there was cointegration between the real exchange rate and the terms of trade. A quick check of the BWFH data shows that this is no longer true; hence, the addition of the cumulated current account variable. It is important to realise that the visual impression of PPP holding, which prompted Clements' remark, is not inconsistent with the real exchange rate being an integrated process, i.e., it has no long-run equilibrium level, as any integrated variable starting from a fixed point will essentially cross that point again, but infrequently. Such behaviour is in evidence in Figures 1 and 2 of BWFH.

One might query a few aspects of BWFH's work. Pitchford's paper makes the point that there are many relative prices that might be used in the definition of a real exchange rate, and that it makes a difference which one is chosen (see his Figure 5). Moreover, as an exchange rate is an endogenous variable in a complete system, whatever drives the system must have an impact upon it. Having been lectured on the importance of supply-side or total factor productivity (TFP) shocks during my six years in Rochester, I looked for something like TFP terms in the fundamentals equation. Such terms do not seem to be there: in BWFH, capital (marginal) productivity enters via real long-run interest rates, while labour productivity appears in the New Zealand equilibrium rate - see Pitchford's discussion of this. Nevertheless, on balance, the BWFH paper is a valuable contribution to exchange rate research and is likely to provide a useful framework upon which to build future Australian work on the topic.

3. Inspecting the Mechanism

Quantitative research into the determination of trade flows revived in the 1980s as data sets from floating exchange rate regimes became of reasonable length. Much of this research focused upon two related questions. Firstly, how important are exchange rate effects relative to income effects. Secondly, how large is the residual and what can it be ascribed to? In particular, do cultural, linguistic and institutional arrangements such as trading blocs cause increases in trade over and above what might be expected on purely economic grounds? Information on these questions is an important input into determining whether policies should be devoted to furthering cultural links or concentrating upon delivering more competitive products. Of course, these queries may not be separable. Indeed, one might well argue that import elasticities are changed by cultural contacts as consumers become aware of a bigger range of products than those seen on the domestic market. Such links were only tangentially addressed by the Conference, mainly arising in Bullock, Grenville and Heenan's (BGH) speculation about whether the high export-price elasticities they discovered are realistic.

BGH provided an account of price and income elasticities for imports and exports. Of greatest concern to them was the high income elasticity found for imports, a concern that induced them to seek modifications to their basic equation that might force it closer to their desired target of unity. In doing so, they reflect the 'modern' elasticity pessimism that income elasticities for imports are so high as to cut short any putative expansion. Two comments might be made on this work. One revolves around a measurement issue. From their Figure 9, it is clear that imports run up very strongly in expansions, suggestive of a strong non-linear effect; such a 'demand dissipation effect' was studied by Cameron (1966) some years ago. The log-linear relations estimated by BGH are unlikely to be able to capture such a regularity. How one should model this effect is a moot point. Pesaran suggested 'ratchet effects'. Another possibility would be to introduce a non-linear function of the lagged ECM term into the equation.[1] A second comment relates to the interpretation of such elasticities. Ignoring dynamics, the import equation has the form $\log M_t = b\log Y_t + c\log R_t$, with Y_t being an activity variable and R_t the real exchange rate. It is not clear what information an estimate of b provides. Mathematically, it reveals what happens to $\log M_t$ as $\log Y_t$ changes by one unit, *holding* R_t *constant*. However, that experiment is not feasible. Inevitably, there is another relation embedded in the remainder of the system linking Y_t to R_t in a negative way, and that serves to dampen the system-wide response of imports. The problem should be familiar from Sims' (1980) work with vector autoregressions. It is only useful to analyse the impact of shocks that are uncorrelated and that necessitates isolating that part of an income shock that is invariant to feedback from the real exchange rate.

Perhaps the most interesting work in the BGH paper pertains to exports for manufactures. Here, very high price elasticities are recorded, leading to the possibility that the measure might be influenced by an 'export culture' that was perceived as developing in the late 1980s. It is hard to disentangle these effects from competitiveness and one might even doubt if the former can exist without the latter. Nevertheless, anecdotal evidence of an export culture abounds and the most interesting issue is what its impact might be. To measure this effect one needs to extract some idea of what is 'normal'. Frankel's paper proposes that the gravity model of trade assume that mantle. This model provides the following description of bilateral trade:

$$\log(M_{ij} + X_{ij}) = b(\log Y_i + \log Y_j) + c\log D_{ij} \tag{1}$$

where M_{ij} and X_{ij} are imports and exports from country i to country j, Y_i and Y_j are the gross domestic products of the two countries and D_{ij} is the distance between the principal cities in each of the countries.

1 . Other non-linearity effects were mentioned at various times throughout the conference, generally via the belief that threshold effects were important. For example, Okabe mentioned that he thought this was very important in explaining the recent performance of Japanese exports.

Two lines of investigation now come to mind. Firstly, if the gravity model is correct, what does that mean for the specification adopted by BGH? Secondly, if the trade equations in BGH are valid, what then are the implications for research with the gravity model? Regarding the first, there is difficulty in 'reverse engineering' separate import and export equations that can be aggregated up to the gravity equation for total trade. It seems as if the only consistent representation for both imports and exports would be to have the same format:

$$\log(M_{ij} \text{ or } X_{ij}) = b'(\log Y_i + \log Y_j) + c'\log D_{ij} \qquad (2)$$

which implies that a variable capturing foreign activity should appear in Australian import demand equations. The absence of such a variable could easily account for estimated own-income elasticities that exceed unity. As the gravity model is sometimes rationalised as compatible with modern trade theory emphasising differentiated products, the introduction of such a variable into BGH's equations is an interesting possibility. Turning to exports, the central implication is that the export income elasticity, b', is the same for all countries. Such an assertion seems contrary to the stylised fact, mentioned by BGH, that the growth in exports to Asia during 1985-1991 was the same as to North America, despite the fact that the former's growth was significantly greater than the latter.

Changing the focus to what implications the BGH equation has for the gravity model, one immediately notices the lack of any real exchange rate effects in the latter. Some of these could conceivably be captured by the distance variable, but there seems to be no reason to expect a strong relationship. Moreover, if the real exchange rate differentials between countries were highly correlated with distance in some years in the sample, the fixity of D_{ij} means that this correlation cannot remain for other years if the real exchange rates are changing. Instability in the estimated c' would therefore be expected in Frankel's equations. Frankel recognises that important variables may have been omitted from the gravity equation, but this fact must call into question the robustness of his conclusions about the significance of linguistic and institutional factors, as the magnitude of the latter are simply measured by what the gravity model does not explain.

4. Policy Issues

In the 1960s and 1970s the choice between a fixed or flexible exchange rate regime would have been guaranteed to surface at a conference like this, but the topic received only a small amount of attention in this instance. John Pitchford dealt with the question of whether or not a flexible rate regime is good from the perspective of insulating an economy against foreign inflation, concluding that (empirically) it is. He also considered the responses to real shocks, such as the terms of trade and investment shocks sustained by the Australian economy in the

1980s and the real shock of German unification. Artis made the excellent point that the latter was an internal shock to Europe and that the experience of 1992 demonstrated the difficulties that a fixed exchange rate system faces when adjustments to real shocks are called for.

Of course Australia has not had a 'clean' float, raising the spectre of intervention and what it has achieved. Pitchford made some good points about this topic, but his analysis generated little discussion of what the costs and benefits of intervention are. Illustrations offered for the belief that intervention works were the exchange rate behaviour after the Plaza and Louvre agreements, and the idea that it has been important in preventing 'free fall' in the Australian dollar ($A) at various times in the past 10 years. Still, intervention in the $A market has been very active and seemingly not just aimed at pricking speculative bubbles, and that fact would suggest that its role in policy deserves more discussion than it has received. Because the logic of intervention carries with it some idea of a fundamental exchange rate, there is a sense in which a central bank that has an active interventionist stance is effectively adopting an exchange rate target and this, in turn, raises the issue of whether it is productive to keep such a target secret.

At various junctures in the Conference, authors referred to the empirical regularity with which (across many time periods and countries) nominal exchange rate changes translate into real exchange rate movements for substantial periods of time. Such a correspondence holds the promise of a 'quick fix' for a small economy with underemployed resources but a current account deficit. An expansionary monetary policy could drive down the nominal exchange rate, thereby raising the prospect of simultaneously increasing aggregate demand and stabilising the current account. As Artis reminded us, whether such a policy works depends upon the transmission mechanism. Even if it did, the question has to be whether such action changes the dynamics of the system; in the long run, the real exchange rate will revert to its fundamental level, so that any policy of this type is simply aimed at trying to force a faster convergence to equilibrium than the normal adjustment processes would allow. One expects and needs to hear more detail and justification about any such proposal.

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Discussion

The discussion following Pagan's summary of the Conference began by revisiting, with a wider perspective, a number of important issues discussed in the preceding papers. It then turned to a discussion of current Australian monetary policy and its links with the exchange rate and the macroeconomy.

1. Exchange Rate Issues

It was observed that very few countries were prepared to engage in benign neglect of their exchange rate; most countries want to have some form of exchange rate policy. It was suggested that this desire for an exchange rate policy reflects two considerations. The first is a concern about misalignment of the exchange rate. The experience of the US dollar in the mid-1980s and perhaps the Australian dollar in 1986 suggests that exchange rates can sometimes move too far, given movements in the fundamentals. The resulting misalignments have adverse effects on resource allocation. Secondly, for some countries, exchange rate policy provides an element of discipline for monetary policy (e.g. within the ERM).

On the other hand, the point was made that having too strong an exchange rate policy has its own dangers. It is not possible to know exactly what the equilibrium exchange rate is. It was argued that it was often the case that central banks get caught defending inappropriate exchange rates and incur huge losses for the taxpayer. Having too strong an exchange rate policy may also force more of the adjustment of real exchange rates through the domestic price level, and thus output, rather than through the nominal exchange rate.

In this respect it was noted that the United States was able to succeed as a large monetary union because it has a high level of labour market flexibility. Labour mobility is high and wages are relatively flexible. Ironically, these conditions are not a characteristic of European countries attempting to move towards monetary union.

While these costs and benefits of an exchange rate policy were widely acknowledged, there was no universal agreement as to the extent to which the authorities should explicitly consider the exchange rate in the formulation of macroeconomic policy. Using a variant of Dornbusch's terminology, Frankel put forward the notion that exchange rate dynamics could be characterised as 'overshooting the overshooting equilibrium'. That is, in response to some shock, exchange rates do not move instantly, but take time to adjust. When they do start adjusting, they eventually move too far (even after accounting for sticky goods prices) and, later, some of the movement must be reversed. This phenomenon may reflect the behaviour of noise traders or other market inefficiencies, and give good reason for the authorities to be concerned with the behaviour of the exchange rate.

One participant expressed caution at interpreting the empirical tests as definitely rejecting the efficient markets model. He argued that the tests were of very low power and that more work needed to be done in this area. He also saw it as important to conduct microeconomic studies of the impact of exchange rate changes on the individual decisions of households and firms.

There was some discussion of the relationship between the current account and savings-investment imbalances. It was generally accepted that changes in the real exchange rate do, in fact, change the trade balance (with an uncertain lag). But most participants saw the causation as running from a change in the savings-investment imbalance to the current account which, in turn, required a change in the real exchange rate. The current account, the real exchange rate and the savings-investment imbalance are determined simultaneously, as the outcome of a variety of forces acting on the macroeconomy. The point was made that Australia has run current account deficits for decades, not because the exchange rate is overvalued, but because there has been an imbalance between savings and investment. This made it difficult to make normative judgements about whether or not current account deficits are 'bad' because foreign debt rises or 'good' because the world views Australia as a reasonable place in which to invest.

2. Current Policy Issues in Australia

When discussing current policy issues, participants generally agreed that the most pressing problem facing Australia is the current high level of unemployment. It was argued that high unemployment not only causes social distress, but it also has hysteretic effects; once people are unemployed for a long period of time, the likelihood that they will ever find employment again falls significantly. This increases the unemployment rate that is consistent with a constant level of inflation.

A number of speakers argued that the high level of unemployment in Australia implies that there is still room for a considerable cut in interest rates. Proponents of this view argued that this would stimulate economic activity by reducing the cost of intermediated funds and causing a depreciation of the currency. In the current environment, further nominal depreciation would be associated with sustained real depreciation, and would give a substantial stimulus to the traded goods sector.

This notion was, however, questioned by several others. They doubted whether a large fall in the exchange rate would lead to a sustained real depreciation. Given the already large depreciation of the $A over the past year, further substantial depreciation could have severe inflationary consequences. In this respect it was noted that the very large depreciation in 1985/86 threw Australia 'off-track' in its adjustment to low inflation. Any significant increase in inflation could lead to a deterioration in the central bank's hard-won credibility, and thus increase inflationary expectations. This, in turn, could set off undesirable wage-price dynamics. It was also argued by some that the current high level of unemployment partly has its roots in technological change, internationalisation of the economy and structural rigidities in the labour market. The speakers in support of this view argued that policies other than monetary policies should be directed towards the unemployment problem. A counterargument was put that high unemployment had less to do with the internationalisation of the economy than with straightforward demand deflation.

One speaker pointed out that it was not possible for all countries to adopt 'beggar-thy-neighbour' nominal depreciations to improve employment in the current environment. But others argued that a major characteristic of current weak activity in the world economy was the lack of demand. If all countries simultaneously eased monetary policy, there would be a substantial stimulus to world economic activity without depreciations of exchange rates in individual countries. This view was based on the notion that confidence is a major obstacle to business investment, consumption and economic growth at present. The stimulus would come from the general easing of monetary policy and its effects on confidence rather than through a depreciation of the exchange rate. A number of speakers argued that if other countries reduced their interest rates, there would be more room for Australia to reduce its interest rates.

There was relatively little discussion of the role of fiscal policy solutions to unemployment. The discussion that did take place centred on the dangers of winding back Australia's fiscal deficit too slowly. If this occurred, the economy would be left with a considerable increase in the ratio of debt to GDP, reducing the flexibility of fiscal policy in the next business cycle. The implications of the fiscal deficit for the balance of payments were also mentioned as an area of concern. A number of speakers felt that cumulating current account deficits were a concern over the medium term, and this had implications for fiscal policy and other measures to influence national saving.

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