Macroeconomic Policies and Growth*

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> 'Is there some action a government of Australia could take that would lead the Australian economy to grow like Korea's or Taiwan's? If so, what, exactly? If not, what is it about the 'nature of Australia' that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else' (With apologies to Lucas (1988)).

1. Introduction

Conferences on macroeconomics and macroeconomic developments usually conclude with a paper on the implications for macro-policies. However, for a conference on growth, this poses a bit of a dilemma. On the one hand, according to the natural-rate hypothesis which is accepted by many analysts, macroeconomic policies are neutral with respect to long-run real output and employment. Moreover, in the neoclassical theory of growth, technological progress falls like manna from heaven and the level of investment – the only variable susceptible to policy changes – affects the steady-state level of output, but not its rate of change. Endogenous growth theory recognises that technological change can be endogenous and that changes in the stock of capital – human as well as non-human – may generate positive externalities and are not necessarily subject to diminishing returns. However, most policy implications are microeconomic in nature and the theory does not assign any specific role to macroeconomic policies.

On the other hand, when looking at the growth performance of different countries over various periods and the policies they pursued, it is difficult to believe that macro-policies did not play a role. The impressive economic achievements of most industrial countries during the 1950-73 period owed much to reconstruction and technological catch-ups, but these catch-ups did not take place automatically. They were facilitated by policies promoting economic integration and investment in human and non-human capital. Growth was also helped by low inflation, the absence of fiscal imbalances and stable factor-income shares. While macro-policies aimed at full employment may well have had a positive effect, they may also have sowed the seeds for the slowdown during the 1970s and 1980s. The astonishing growth performance of the four NIEs (the four Asian 'tigers') and later the South-East Asian economies also seems to be associated with policies favouring low inflation and sound fiscal policies. At the same time, the 'lost decade' of the 1980s in Latin America and depressing developments in most of Africa can be traced, not only to political instability, but also to inward-looking policies that stimulated domestic demand growth while paying little attention to the costs in terms of inflation and external imbalances.

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If we accept the view that actual developments should receive a larger weight than pure theory, one important question remains: how should 'macroeconomic policies' be defined and measured and through which channels do 'good' or 'bad' policies affect growth? In this paper, we associate macroeconomic policies with monetary, fiscal and exchange rate policies as reflected in, or measured by, the rate of inflation, the budget balance, the real rate of interest, the real exchange rate and the current account of the balance of payments. This is not a very precise definition and it has the added problem that these measures of macroeconomic policies are to some extent endogenous to actual economic developments. As regards transmission channels, we are persuaded by Fischer's (1993) hypothesis that policies which lead to high inflation or large internal or external imbalances generate uncertainty which adversely affects growth. We also discuss additional channels which may exist if potential output depends on past developments in actual output because of path dependence.

The rest of the paper is divided into four sections. Section 2 provides a broad review of macroeconomic developments in the post-war period in an attempt to detect some preliminary evidence of the role of policies. Section 3 looks at the policy related variables in the generally-accepted theories of growth and the empirical evidence from cross-country regressions, reviewing major results as well as problems of measurement and interpretation. Section 4 deals with the relationship between inflation and growth while Section 5 summarises and derives tentative policy implications.

2. An Overview of Long-Run Growth Trends

To gain a preliminary impression of the potential role of macroeconomic policies, Table 1 presents long-run trends in per capita income growth over the period 1870-1989. Four features are worth noting:

- growth does not evolve along a smooth constant trend – there is clear evidence of 'epochs' of growth, raising important questions as to the causes of trend breaks;
- the period 1951-73 clearly stands out as a period of exceptionally strong growth and, seen in a longer perspective, post-1973 developments are relatively favourable;
- the growth performance of Australia is rather poor compared with that of other industrial countries, especially during 1951-73 when the growth differential exceeded one percentage point; and
- among the developing countries, the extraordinary growth performance of the Asian countries is of relatively recent origin as, prior to 1950, growth in Asia was well below that of other regions. By contrast, Latin America grew relatively fast before 1950, while growth was rather slow during 1950-73 and almost came to a complete halt in the post-1973 period. The same pattern is even more evident in Africa, following a somewhat better growth performance during the pre-war period.

The 1951-73 era is clearly the most interesting one, especially given the macro-policy activism during the period. To what extent did 'good' policies contribute to the high growth? It is generally recognised that once-off factors such as post-war reconstruction and catch-ups with the technological leader (the United States) had a large part in explaining the favourable growth performance. Thus excluding the United States,

Table 1: Long-Run Growth Trends
(Per capita GDP based on PPP weights, per cent per annum)

	1870-1913	1914-1950	1951-1973	1974-89
Industrial countries	1.3	1.2	3.5	2.1
Australia	0.9	0.7	2.4	1.7
Asia	0.3	-0.2	3.5	5.2
Latin America	1.3	1.3	2.3	0.6
Africa	n.a.	1.6	2.0	0.0

Source: Maddison (1993).

average per capita growth in the industrial countries exceeded 4 per cent (compared with less than 1 per cent over 1914-50) while the United States grew by only 2.2 per cent (1.6 per cent). These unique factors also implied that high growth was unlikely to continue; once the catch-ups had been completed, growth would return to a slower pace.

The catch-ups did not, however, occur automatically. They were no doubt facilitated by the move towards free trade and currency convertibility and within each country they were helped by higher investment in both education and physical capital. Indeed, by 1973 the investment/GDP ratio for the industrial countries had increased to over 25 per cent, compared with 22 per cent in 1960 and for the 1960-73 period on average (Table 2). In some countries with restrictions on capital movements, the rise in investment may have been helped by low-interest-rate policies. A favourable social environment, resulting in stable factor-income shares, probably also stimulated investment. In a few countries, 'social contracts' were instrumental in generating stable factor shares (see Crafts and Toniolo (1995)) but more generally, the stability was probably the result of the high rate of productivity growth. With most prices set as a mark-up on unit labour costs, high labour-productivity growth meant that moderately rising nominal wages translated into growing real wages and low price inflation. Distributional pressures and disputes could thus be resolved in a relatively non-inflationary way and without large short-term changes in factor income shares.

The role of demand-management policies is more difficult to evaluate (and will be discussed further in Section 3). Attempts to 'fine tune' the economy may have been instrumental in generating relatively stable growth rates during 1950-73, with a variability about one-third lower than in the inter-war period (Romer 1988) and also substantially lower than in the post-1973 period (see Table 3). This is likely to have reduced uncertainty and spurred investment.[1] On the other hand, it also appears that either policy makers went too far in 'smoothing the cycle', stimulating output to a level that, in retrospect, was too high relative to potential output, or they did not take sufficient account of shocks and other external changes that reduced potential output. Thus, while inflation was low on average, it accelerated significantly during the period (Table 2). Moreover, the labour share of income rose in the late 1960s and into the 1970s, pointing to strains

1. Kormendi and Meguire (1985), however, find a *positive* coefficient for the variability of income growth in a cross-country regression of per capita income growth.

Table 2: Performance or 'Policy' Indicators

	1960-73	1974-82	1983-94	1960-73	1974-82	1983-94
Industrial countries				*Australia*		
Inflation, average rate, %	3.7	8.7	4.6	4.6	11.6	5.6
Change in inflation[a]	3.7	-3.3	-2.6	6.2	-4.7	-8.4
Budget balance/GDP, %[b]	-0.2	-2.6	-3.1	1.4	-1.7	-2.3
Investment/GDP, %	21.7	22.0	20.9	25.5	24.2	24.6
Exports, % change[c]	8.0	4.2	5.7	7.5	3.4	7.0
Current external Account/GDP, %	0.3	-0.2	-0.5	-1.7	-2.8	-4.5
External debt/GDP, %[e]	n.a.	-9.2	-13.2	n.a.	15.9	41.5
Real long-term interest rate	3.0	0.5	4.8	1.1	-2.3	6.7
Sub-Saharan Africa				*Asia*		
Inflation, average rate, %	4.7	16.4	24.0	4.2	7.9	8.0
Change in inflation[a]	5.2	3.0	15.0	5.0	-4.5	3.5
Budget balance/GDP, %[b]	n.a.	n.a.	-7.0	n.a.	-4.0	-3.3
Investment/GDP, %	17.5	23.0	16.5	19.5	25.0	27.0
Exports, % change[d]	12.0	10.0	4.5	13.5	18.5	12.5
Current external account/GDP, %[f]	-3.1	0.6	-3.0	-1.3	-2.3	-1.4
External debt, GDP, %[g]	30.7	75.2	82.8	19.6	32.0	37.1
Latin America						
Inflation, average rate, %	23.8	49.5	137.5			
Change in inflation[a]	-5.0	37.0	112.5			
Budget balance/GDP, %[b]	-2.5	-2.0	-4.0			
Investment/GDP, %	20.5	24.0	19.5			
Exports, % change[d]	9.2	17.0	2.7			
Current external account/GDP, %[f]	-2.0	-4.3	-2.0			
External debt/GDP, %[g]	36.1	66.1	36.0			

Notes: (a) From first to last year of period.
(b) General government for industrialised countries; central government for developing countries.
(c) Goods and services in volumes.
(d) Merchandise exports in US$.
(e) 1984 and 1993, respectively.
(f) First two columns refer to 1970 and 1980 respectively.
(g) 1980, 1987 and 1994, respectively.

Sources: OECD, *National Accounts*; IMF, *International Financial Statistics* and *World Economic Outlook*; Fischer (1991); and authors' estimates.

Table 3: Output Growth: Trends and Variations
(Per cent per annum)

	1960-73		1974-82		1983-94	
	μ	σ	μ	σ	μ	σ
Industrial countries	4.8	0.95	2.1	1.85	2.9	1.15
Australia	*5.1*	*2.10*	*2.4*	*1.55*	*3.3*	*2.30*
Latin America	6.0	2.50	4.1	3.00	2.1	1.70
Asia	4.7	3.90	5.9	2.30	7.4	1.10
Sub-Saharan Africa	4.2	2.00	3.3	2.80	1.8	1.70

Note: μ denotes average growth of GDP and σ standard deviations of growth rates for the periods concerned. Comparisons with the figures in Table 1 should be made cautiously. The number of countries in each group is much larger than in Table 1, and the data refer to changes in aggregate real GDP in national currencies, rather than per capita GDP converted at PPP.

Sources: IMF, *International Financial Statistics*; OECD, *National Accounts*; and national data.

in the social fabric. One tentative conclusion emerging from this episode is, therefore, that macro-policies aimed at smoothing the cycle may increase the level as well as the average rate of output growth. However, such changes are only *sustainable* if the target level of output does not lead to rising inflation.

Because the productivity slowdown in the early 1970s[2] coincided with the breakdown of the Bretton Woods system and the rise in oil prices, it is tempting to associate floating exchange rates and higher oil prices with lower output and productivity growth. With the perspective of two decades, however, there is little evidence to support these hypotheses. The share of oil and other energy products in overall output costs is only around 5 per cent and while some early studies identified higher energy prices as the principal reason for the growth slowdown, most recent analyses do not find changes in relative oil and energy prices to be significant. The terms-of-trade losses suffered by many industrial countries combined with real wage rigidities have also figured prominently in explanations of the slower growth after 1973, especially for European countries. If, however, 'real wage gaps' were a major cause, the terms-of-trade gain following the decline in oil prices in the mid 1980s should have boosted growth and reduced unemployment, which it failed to do. The evidence is also weak regarding the growth effects of the rise in the variability of exchange rates: some have found that high variability has an adverse effect on trade but most have found no significant effects.[3] It seems more likely that these two events were themselves the results of the previous developments and policies and that the slowdown would have occurred in their absence, though it might have been less abrupt.

2. A slowdown in trend growth occurred in most industrial countries around 1973, while in many developing countries, the break seems to have coincided with the second oil price rise and the debt crisis (see Crafts and Mills (1995) and Ben-David and Pappell (1995)).

3. On the other hand, maintaining exchange rates at levels that are not consistent with 'fundamentals' can have adverse output effects (see Section 3). Such policies are more likely under fixed than under flexible exchange rate regimes.

Some have also associated the productivity slowdown with the change in the consensus view of economic policies from a Keynesian paradigm based on fine-tuning economies at close to full employment to a neoclassical paradigm stressing market forces and giving high priority to low inflation. However, the change in policy regimes did not take place overnight (though by the early 1980s most industrial countries had accepted this new view) and was thus less sharp than the 1973 trend-shift would suggest. A more plausible interpretation would seem to be that part of the high growth rate generated during the Keynesian regime was unsustainable and part of the slowdown during the neoclassical regime reflects the 'costs of repairing the damage' caused by the earlier policies.

This combination of over-expansionary policies followed by a period of re-establishing macroeconomic balance is even more striking for Latin America (Adams and Davis 1994). Although there was some slowdown between 1960-73 and 1974-82, growth in the latter period was still relatively high but, as it turned out, mainly based on fiscal and monetary policies aimed at expanding domestic demand. These policies *did* succeed in raising output growth, but they also resulted in widening fiscal imbalances, accelerating inflation and, above all, in steeply rising external deficits and levels of foreign debt. The unsustainability of the situation became evident in 1982, when world real interest rates rose and the measures required to correct the past mistakes resulted in the 'lost decade' of the 1980s. In Sub-Saharan Africa, too, short-term policies – to a large extent in the form of expanding the public sector – helped to maintain relatively high growth in the 1970s. However, since the earlier 1980s, aggregate growth has averaged less than 2 per cent, partly because of a 30 per cent fall in the terms of trade and other external shocks, but also as a result of correcting unsustainable fiscal imbalances and over-expansionary policies, reinforced by a large burden of foreign debt and limited access to international capital markets.

3. Growth Theories and Empirical Evidence

3.1 Growth Theories

For three decades, growth theory was dominated by the neoclassical Solow-Swan model in which output growth is determined by technical progress and growth in capital and labour inputs.[4] This model provides few channels for macro-policy influences. Thus, technical progress is assumed to be exogenous and most empirical studies do not suggest macro-policies have much influence on labour force growth. Capital growth, however, could be influenced by policies and, as further discussed below, the neoclassical model is often used to analyse the growth effect of policy-induced changes in capital stock growth or changes in the investment/GDP ratio. Moreover, when the Solow-Swan model is extended to include human as well as physical capital, it is possible to explain per capita

4. More formally, the Solow-Swan model assumes that output, *Y*, is determined by an aggregate production function, $Y = F(L, K, E)$ where *L* is labour, *K* is the gross capital stock and *E* is technical progress. The production function is often assumed to be Cobb-Douglas with constant returns to scale, which implies that $\Delta \ln Y = (1-b)\Delta \ln L + b\Delta \ln K + \varepsilon$ or $\Delta q = b\Delta k + \varepsilon$ where $q = \ln(Y/L)$, $k = \ln(K/L)$, *1-b* and *b* are the output elasticities of labour and capital, respectively, and ε is the rate of technical progress.

income growth in a broad range of countries and show that, after controlling for the determinants of steady-state income levels, poor countries grow faster than rich ones: i.e. that there is 'conditional' convergence in per capita income levels (Mankiw, Romer and Weil 1992).

It is also possible to disaggregate changes in capital into various types of investment, including public investment in infrastructure. Of course, as long as the framework of the neoclassical model is maintained, policy-induced changes in the growth of capital or the investment/GDP ratio do not change steady-state output growth but only the steady-state output level. In practice, however, this may be of limited importance because the transition period between steady states is very long, so that growth over extended periods (as opposed to steady-state growth) is affected.[5]

Romer (1986) initiated an explosion of research on how to explain or 'endogenise' technical progress in theories of long-run growth (Dowrick 1995). For the purpose of this paper, the most important features are the emphasis on capital or a specific type of capital as the principal determinant of growth and the possibility of externalities or imperfect competition implying that markets may not generate a Pareto optimum in general. Or, to put the second point differently, if firms and other economic agents cannot internalise all the benefits of their investments, the growth of capital will be below the socially optimal rate.

3.2 What Do We Learn From Cross-Country or Panel Studies of Long-Run Growth?

Most of the specific policy measures suggested by endogenous growth theories are microeconomic in nature and macroeconomic policies as defined in this paper rarely appear. Nonetheless, based on the experience of the 1970s and 1980s, many economists came to believe that sound macroeconomic policies were conducive to long-run sustainable growth. Fischer (1993) lists five conditions which together imply that a macroeconomic framework is conducive to growth: a low and predictable inflation rate; an appropriate real interest rate; a stable and sustainable fiscal policy; a competitive and predictable real exchange rate; and a balance of payments that is regarded as viable.

Fischer stresses uncertainty, arguing that a government that allows a high budget deficit or a high rate of inflation has lost control and generates uncertainty. Uncertainty and its effects on volatility are also the transmission channels stressed by Pindyck and Solimano (1993) who attempt to identify the principal determinants of variations in investment/GDP ratios over time and between countries. In all their regressions, they find inflation to be the main source of volatility in the marginal return to investment and of variations in the investment/GDP ratio.[6]

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5. For example, assuming the parameter estimates in Mankiw *et al.* (1992), a 20 per cent rise in the savings ratio raises the steady-state level of labour productivity by 10 per cent. However, only half the adjustment is completed in 35 years and during the transition phase, labour productivity growth is approximately 0.15 percentage points (5/35) higher than prior to the change in saving.

6. This result also implies that attempts to capture the adverse effects of inflation in growth equations that control for the investment/GDP ratio will fail if inflation only affects growth via changes in investment; a point we return to in Section 4.

Indeed, with capital accumulation the principal determinant of long-run growth in both the neoclassical model and most versions of endogenous growth models, the determination of capital expenditure is likely to be an important transmission channel for macroeconomic policies and it might even be argued that macroeconomic policies should be designed with a view to stimulating capital expenditure. Moreover, if capital flows are less than perfectly mobile internationally or, for other reasons, balance-of-payments considerations act as a constraint on growth, the level of national saving and ways to raise it through policies – notably fiscal policy – become relevant as well. We address these issues in Section 3.3, following a brief discussion of measurement issues and problems of interpretation.[7]

Returning to Fischer's five conditions, note that they are not independent of each other, and there are plenty of individual country cases showing that satisfying one or two of these conditions is not enough. The most striking recent example is Mexico which in the 1990s, but before the December 1994 crisis, achieved a low inflation rate and consolidated its fiscal situation. However, growth remained low, because the real exchange rate was not competitive, leading to a nonviable balance of payments, combined with volatile but mostly quite high real interest rates. The members of the African franc zone provide another example. Because of the currency link with the French franc until early 1994 inflation was low, but over time the real exchange rate became increasingly uncompetitive and growth was well below even the modest rates of other African countries. Turning to the developed countries, several members of the European Community achieved low inflation, competitive exchange rates and viable balances of payments in the eighties and early nineties, but growth remained low because real interest rates were generally high and in several countries the fiscal situation was regarded as unsustainable. At the other end of the spectrum, many of the fast-growing Asian countries are often seen as being helped by their stable macroeconomic policies (Hughes 1995) including low inflation, sound fiscal policies, competitive exchange rates and balance of payments deficits that are generally regarded as viable because they reflect high imports of capital goods. Chile, which has achieved very high growth rates since the mid 1980s should also be mentioned as one country where macro-policies appear to have been instrumental in generating a transition from stabilisation to high and sustainable growth.[8]

The above list is by no means exhaustive. Nonetheless, finding clear evidence of policy influences from empirical studies has proven difficult. There seem to be four reasons for this. First, because all five conditions need to be satisfied, analyses including

7. Investment and saving are, however, not the only channels by which policies can affect growth over long periods. As suggested by Boltho and Holtham (1992), one empirical fact that a theory of growth needs to explain is why some countries grow at very high rates over long periods without encountering signs of decreasing returns to capital and/or labour. As discussed by Dowrick (this Volume), one reason for this is that these countries are on a transition path, catching up with the technological leader. Second, long-run growth could contain important elements of hysteresis, due to the existence of non-linearities and asymmetries, which again would make the growth path sensitive to macroeconomic policies. These issues will be further discussed in Section 3.3.

8. On a different tack, Sachs and Warner (1995) stress policies that protect property rights and promote openness, arguing that reversible policy mistakes in these two areas rather than initial conditions are the principal reasons for the absence of convergence in growth rates across countries.

only a subset are unlikely to produce conclusive evidence. On the other hand, because the five conditions are not independent of each other, multicollinearity problems often mar studies that include indicators of all conditions. Second, several countries have managed to grow strongly even over rather long periods (most notably Latin America in the 1960s and 1970s) before the accumulation of macroeconomic imbalances caused a slowdown. These exceptions from the general rule have lasted long enough to have exerted a distorting influence on analyses based on cross country comparisons. Third, none of the conditions can be directly related to policy instruments or 'executable' policies, but need to be proxied by other measures that are not necessarily exogenous with respect to general economic developments. In other words, analyses of policy effects will suffer from simultaneity or dual causality problems. Finally, even if these problems could be overcome, the coefficients estimated from cross-country regressions measure the strength of partial correlations and care must be exercised when interpreting them as behavioural relations and in deriving policy implications.

We conclude with a final point concerning the relative persistence of growth and macro-policy indicators. For most countries, levels of output and country characteristics, including many policy-related variables, are highly persistent through time, while growth rates are not (Easterly *et al.* 1993). In the Appendix, we verify this pattern of persistence for the OECD countries and discuss its relevance. As Easterly *et al*. argue, it suggests that while the differential shocks that hit countries play a big role in determining the cross-country variation in growth rates, macro-policies and other country characteristics are also important in explaining growth, in particular when countries are far from their steady-state incomes but also through the reaction of policies to shocks.

3.3 Specific Effects on Growth

Despite the problems raised above, we now turn to empirical estimates of specific policies, starting with fiscal policy and issues relating to investment and continuing with a discussion of possible balance-of-payments constraints on growth and the role of national saving. We then turn to the relationship between exchange rate policies and growth, the role of financial markets and the implications of path dependence for macroeconomic policy.[9]

3.3.1 Fiscal policy and public investment

A large number of cross-country analyses of growth have included measures of fiscal policy, focusing on three issues in particular: the relationship between the *size* of the public sector and growth; the likely adverse impact of fiscal imbalances and public debt; and whether certain types of public expenditure are associated with special positive or negative growth effects. Easterly and Rebelo (1994) is one of the most recent and most comprehensive studies dealing with the fiscal policy issues. It uses a new database for

9. We don't address the relationship between incomes policies and growth. For differing views on the implications of the Australian Prices and Incomes Accord for growth, see Blandy (1990), Chapman (1990), Fane (1990), and Gruen and Grattan (1993).

the public sector and analyses various indicators of fiscal policy and their effect on long-run per capita growth, including the budget balance, average tax rates, government consumption expenditure and public investment. The indicators are imbedded in a Barro (1991)-type equation estimated across 50-75 countries. Among the many results reported the following are worth noting:

- like most other analysts, Easterly and Rebelo find that the coefficients obtained for measures of the size of the public sector are fragile;
- the budget balance has a significant and positive coefficient, meaning that countries running large fiscal deficits tend to have lower growth (implying, of course, a failure of Ricardian debt neutrality); and
- public consumption seems to have a negative effect on growth, whereas public investment has a positive effect, with the strongest effects found for central and general government investment and for investment in education and transport facilities.

These results on public investment are consistent with a number of other recent studies which have looked at investment in infrastructure. While there has been a secular decline in the ratio of public investment to GDP in virtually all industrial countries, the implications of this decline were largely ignored until Aschauer (1989a, 1989b) found that a 1 per cent increase in the stock of public capital in the United States raised private sector capital productivity by 0.4 per cent, implying very high returns on public sector investment.[10] Equally high estimates have been obtained for Australia (Otto and Voss 1994a, 1994b) and for other countries as well.

Following Aschauer's startling results numerous other studies appeared, many of which cast doubt on his estimates (Gramlich 1994). While it would go too far to review this debate, there appear to be two principal implications for macroeconomic policies. First, reducing public investment merely as a means of cutting the government borrowing requirement is not an optimal long-run policy. Second, while federal grants encouraging infrastructure investment projects (which are mostly undertaken by State and local governments) with particularly high returns might be an area of policy relevance, the current consensus is for increased reliance on user fees or privatisation of infrastructure capital.

3.3.2 Aggregate investment

The above conclusion still leaves open the question whether, given the role of capital growth in both the neoclassical and endogenous growth models, fiscal policy should provide special incentives for investment in general. As a starting point, consider the neoclassical model assuming a Cobb-Douglas production function with constant returns to scale as given in footnote 4 above. For most countries with capital stock data, estimates yield values for b of about 0.3, implying that increasing the rate of growth of the capital stock per worker by 1 percentage point raises annual output growth per worker by 0.3 points. When capital stock figures are not available or subject to large measurement

10. In this context, note that the ratio of public investment to total government expenditure has averaged 17 per cent in South-East Asia but only 8 per cent in Latin America; see Adams and Davis (1994).

errors, Δk may be approximated by the investment/GDP ratio and the growth equation estimated as:

$$\Delta q = (r + \delta).(I / Y) + \varepsilon \qquad (1)$$

where δ denotes the rate of depreciation and r the required net rate of return.

When equation (1) is estimated across both developed and developing countries, Fischer (1993) and Dowrick (1994) find $(r + \delta)$ in the range 0.15-0.20 while Englander and Gurney estimate $(r + \delta)$ at 0.09 and at only 0.06 when the sample is confined to the OECD countries. For δ of approximately 0.05 (based on data for all OECD countries and assuming an average capital/output ratio of 2.5) the net return will be in the range 0.05-0.15 for the whole sample, but only around 0.01 for OECD countries. Moreover, when estimating the determinants of total-factor productivity growth, Englander and Gurney find that growth in the capital/labour ratio has no significant influence.[11]

On balance, the empirical evidence on aggregate investment does not point to very large positive externalities, nor does it provide strong support for special incentives.[12] Since in most countries there are numerous examples of distortions in relative prices due to the existing tax and subsidy structure, the current consensus appears to be that policies to encourage investment should mainly consist of reducing or eliminating existing distortions rather than attempting to 'pick winners' (see also Auerbach (1992)). In particular, tax systems in several countries, including Australia, distort relative prices in favour of residential investment, encouraging a type of capital expenditure and a composition of total investment which does not encourage long-run growth.

3.3.3 Growth and the balance of payments

A country's balance of payments position may influence its level or rate of growth of output in several plausible ways. In our discussion, we examine a range of possible influences, and focus particularly on the Australian experience.

If international capital flows are highly mobile, saving acts as a constraint on investment and growth for the world as a whole, but not for any individual country, as capital flows from countries with excess saving to those where profitable investment exceeds domestic saving. Access to foreign savings enables individual countries to fund higher domestic investment than would otherwise be possible.

The extent of international capital mobility, however, remains an unresolved issue. On the one hand, tests based on comparisons of interest rates such as onshore-offshore differentials suggest a high degree of capital mobility between countries. On the other

11. Gordon (1995), who analyses the adjustments of unemployment and the capital stock to various supply shocks to the labour market, reports results that are even more 'damaging'. Looking at the slowdown in labour-productivity growth between 1960-73 and 1979-92 in six of the G7 countries, he finds that it is mostly due to slower growth of total-factor productivity, whereas there is no systematic relation between changes in the contribution of capital per working hour and labour productivity.

12. Furthermore, while higher investment boosts economic growth, higher output growth also encourages investment. As a consequence, the estimated coefficient in equation (1) is likely to overstate the extent to which higher investment *causes* higher output growth. There have also been a number of recent studies dealing with the growth effects of special types of investment, especially expenditure on machinery and equipment (see Dowrick in this Volume).

hand, research examining the behaviour of real variables, like saving and investment correlations, consumption behaviour across countries, and the implications of the intertemporal approach to the balance of payments, suggest that even without institutional or legal barriers inhibiting the flow of capital internationally, the owners and managers of each nation's savings act to keep almost all of it at home (Feldstein and Horioka 1980; Tesar and Werner 1992; Lewis 1993; Obstfeld 1994; Feldstein 1995a, 1995b; Bayoumi and Klein 1995). This evidence therefore suggests that the balance of payments does act as a constraint, in the sense that countries with current account deficits invest less, and grow more slowly, than they would if domestic savings were higher. (A similar constraint would apply if domestic policy was aimed at maintaining external balance.)

One version of the idea that the balance of payments imposes a constraint on growth is presented by McCombie and Thirlwall (1994), hereafter MT. MT develop a demand-side model in which the growth rate 'consistent with balance-of-payments equilibrium' is determined by the rate of growth in total revenues available for expanding imports, allowing for the effect of terms-of-trade changes, changes in export volumes and net capital flows, and by the income elasticity of imports. Applying the MT approach to Australia suggests a growth rate consistent with balance-of-payments equilibrium of between 2 and 3 per cent per annum, well below the trend rate of growth of the Australian economy (see the Appendix for details).

The MT analysis uses an elasticities approach to the balance of payments, and as such, ignores the response of domestic savers and investors to the aggregate wealth implications of rising external indebtedness. It also excludes any real exchange rate change as part of the adjustment process. In reality, however, a depreciating real exchange rate is part of the economy's response to higher external indebtedness (Blundell-Wignall, Fahrer and Heath 1993). We therefore turn to the potential implications of this depreciation for real output.

A current account deficit of 4.5 per cent of GDP (the Australian average over the past decade) means that the ratio of net external liabilities to GDP currently rises at about 1.7 percentage points per annum (again, see the Appendix for technical details). As a consequence, the Australian dollar depreciates in real terms, at an estimated average rate of about 0.9 per cent per annum. This slow real depreciation is needed to generate a surplus on the trade and services account in the longer-run – which is required to fund the income payments on foreign liabilities. As the external liabilities ratio rises, the extent of required real depreciation also rises.

A depreciating real exchange rate, however, exerts upward pressure on the domestic price of imports, and creates domestic inflationary pressure. To keep inflation from rising then requires real unit labour costs to fall at an estimated average rate of about 0.4 per cent per annum (or, equivalently, real wages to rise at an average of 0.4 per cent per annum slower than labour productivity growth).[13]

13. See the Appendix for this estimate. An alternative way to view the issue may also be helpful. With traded goods prices determined in world markets, traded goods inflation is higher than domestic inflation when the real exchange rate is depreciating. For domestic inflation to remain steady, therefore, requires non-traded prices to rise more slowly than domestic inflation which, in turn, requires domestic nominal unit labour costs to rise more slowly than inflation. This generates widening profit margins in the traded goods sector (since economy-wide real unit labour costs are falling while the real depreciation is delivering higher output prices for traded goods) and thereby attracts resources into this sector, as required.

In principle, if real exchange rate depreciation proceeds smoothly and gradually, the labour market can deliver the required gradual fall in real unit labour costs without adverse consequences on the level of output in the economy. In practice, the gradual real depreciation is superimposed on large, medium-term, movements of the exchange rate (predominantly caused by fluctuations in the terms of trade). Hence, at times it may not be possible for the labour market to adjust sufficiently quickly, and price inflation will rise. According to estimates presented in the Appendix, in such situations, the level of output must be kept an average of 0.9 per cent lower than if there was no real depreciation to be absorbed. This estimate of the average output cost associated with keeping inflation steady may, however, be overstated as it assumes the labour market generates no reduction in real unit labour costs without a fall in output.

Turning to other possible influences, a high and rising level of foreign liabilities may well generate uncertainty because economic agents are unsure how the situation will be resolved. As previously discussed, more uncertainty may adversely affect investment (Pindyck and Solimano 1993) and therefore growth (Fischer 1993). There is also empirical evidence that, in general, real interest rates are higher in countries with large current account deficits (Orr, Edey and Kennedy 1995) and, in particular, in Australia (Gruen and Smith 1994) which also has an adverse effect on investment and growth.

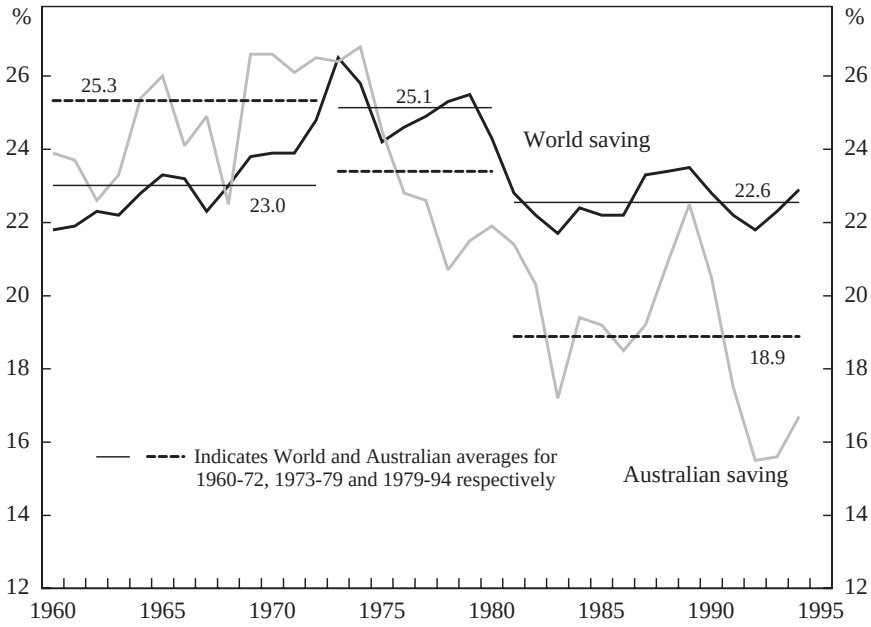
To conclude our discussion, we should point out that we have not directly addressed the question of whether the rising external liabilities are optimal or not (Pitchford 1990). Even with limited access to foreign savings, domestic investment will be higher than would otherwise be possible. Ultimately, the extent to which a country can rely on foreign savings to fund domestic investment and growth, depends on the rate of capital inflow the market accepts as sustainable. While it is impossible to be definitive, the sustainable rate of capital inflow may well be higher for Australia, with abundant natural resources and a stable political environment, than for many other capital importing countries.

3.3.4 National saving

As foreshadowed in the previous section, if savings do not move completely freely between countries, the level of national saving becomes an important determinant of the level of domestic investment, and hence of domestic growth. As can be seen from Figure 1, national saving relative to GDP in the world as a whole has fallen since the 1960s. The decline was slightly more pronounced for Australia, though Australia is not the only country with a steep decline in national saving. In six other OECD countries, the savings rate has fallen by 4½ percentage points or more and, in Figure 2 and Table 4, the experience of these countries with respect to developments in total saving and its components is compared with that of three other OECD countries where the national savings rates have been relatively stable or increased slightly.[14]

14. Apart from Turkey, for which a sectoral breakdown of saving is unavailable, Belgium, Japan and Switzerland are the only OECD countries with relatively stable national savings rates. On the other hand, while Denmark, Iceland, Sweden and Spain have also seen national savings rates falling by 5-8 per cent of GDP, again their national accounts data do not allow a sectoral breakdown of saving.

Figure 1: National Savings, World and Australia
(Percentage of GDP)



Sources: IMF(1995) and ABS Cat. No. 5206.0.

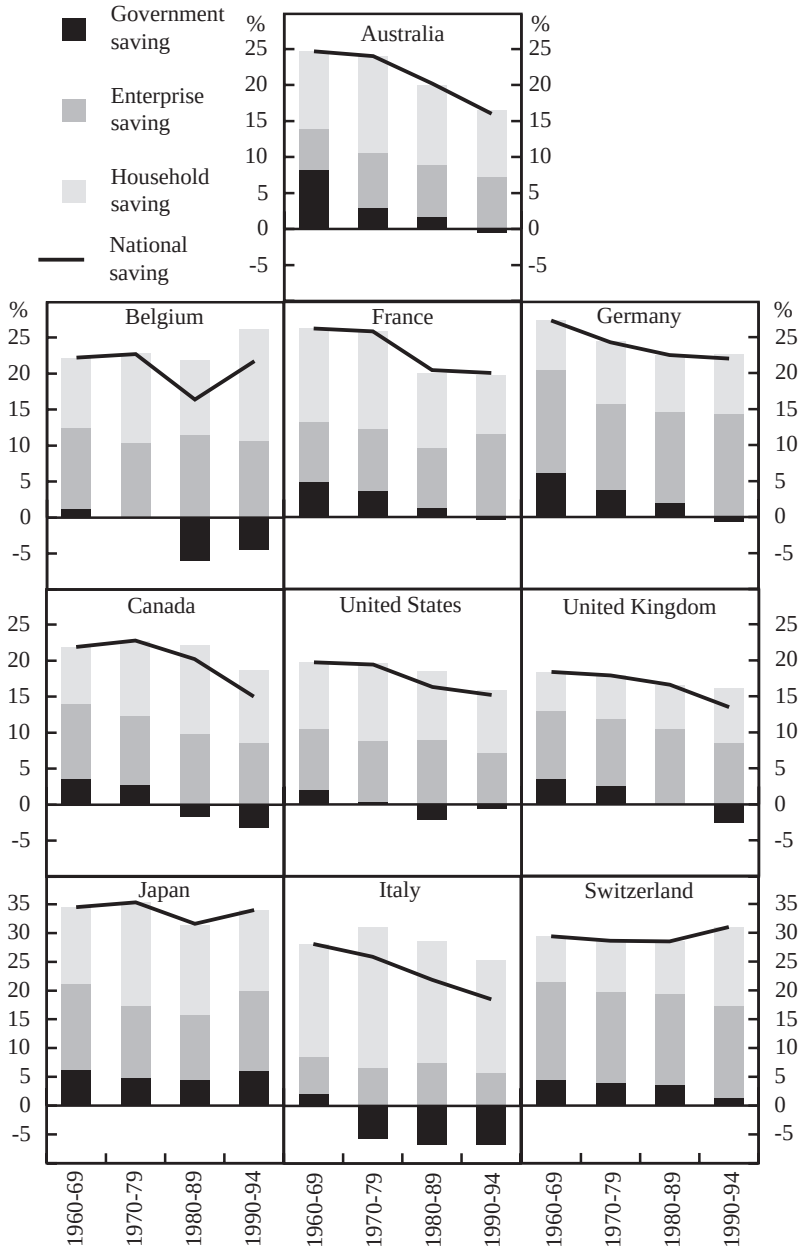
Table 4: Changes in Saving, Growth and the Current External Account
(1960s-1990s, percentage points)

Countries	NSAV	GSAV	PSAV	ESAV	HSAV	g	BoP
Italy	-9.6	-8.9	-0.8	-0.8	0.0	-4.6	-1.9
Australia	-8.7	-8.7	0.0	1.6	-1.6	-3.2	-1.9
Canada	-6.9	-7.3	0.4	-1.9	2.3	-4.2	-2.3
France	-6.2	-5.3	-0.9	3.4	-4.3	-4.5	-0.1
Germany	-5.3	-6.8	1.5	0.1	1.4	-1.5	-0.9
United Kingdom	-4.9	-6.2	1.3	-0.8	2.1	-2.0	-1.5
United States	-4.5	-2.6	-1.9	-1.4	-0.5	-1.8	-2.0
Belgium	-0.5	-5.7	5.2	-0.6	5.8	-3.3	3.5
Japan	-0.5	-0.2	-0.3	-1.0	0.7	-8.2	2.4
Switzerland	1.6	-3.1	4.7	-1.0	5.7	-4.1	6.8

Note: NSAV = national saving, GSAV = government saving, PSAV = ESAV + HSAV = private saving, ESAV = enterprise saving, HSAV = household saving and BoP = current external account, all measured as percentages of GDP, and g = rate of growth of GDP, annual rate. 1960s and 1990s refer to 1960-69 and 1990-94 respectively.

Sources: Elmeskov, Shafer and Tease (1991); OECD, *National Accounts*; OECD, *Economic Outlook*; IMF, *International Financial Statistics*; and authors' estimates.

Figure 2: Composition of National Saving
(Percentage of GDP)



Sources: Elmeskov *et al.* (1991); OECD, *National Accounts*; OECD, *Economic Outlook*; IMF, *International Financial Statistics*; and authors' estimates.

From the figure and the table the following points are worth noting:

- In all but one of the countries where the national savings rate has fallen by $4^1/_2$ percentage points or more, the main factor has been the decline in government saving.[15] In fact, in three of the countries, government saving has fallen by more than national saving. The one exception to this pattern is the United States, where the decline in national saving is almost equally split between government and private saving, with lower enterprise saving accounting for most of the latter.
- The experiences of the three countries with only minor changes in national saving, Belgium, Japan and Switzerland, show that maintaining a high national savings rate is not sufficient for generating or maintaining high growth. In all three countries, average growth fell sharply and this, combined with the weakening of enterprise saving, obviously had a much stronger adverse impact on investment than the improvement in household saving. In fact, there is growing evidence (see Carroll and Weil (1994) for industrial countries and World Bank (1993) for eight Asian countries) that the direction of causality goes, at least to some extent, from growth to saving. In other words, countries that grow faster tend to generate more saving.[16]
- While private saving has generally been stable (main exceptions are Belgium and Switzerland), in underlying terms they may have fallen, once a partial Ricardian equivalence effect is taken into account.[17] There have also been significant changes in the composition of private saving. In 7 of the 10 countries shown in the table, enterprise saving has tended to decline, while household saving has strengthened, in some cases quite significantly. Of the three remaining countries, only Australia and France show declines in the rate of household saving, possibly suggesting that in these two countries household saving is particularly sensitive to the different cyclical conditions of the 1960s and the 1990s or disincentives to household saving have become stronger.

The fall in government saving being the dominant influence in virtually all countries points to fiscal consolidation as the crucial policy measure to raise national saving, rather than, for example, special incentives to boost private saving.[18] Note, however, that the recent weakening of national saving appears to be a reversion towards longer-term

15. This differs markedly from patterns of change in the developing world (IMF 1995; Edwards 1995). In Asia, national saving rates have been rising, almost entirely because of private saving. In Latin America, by contrast, lower private saving caused a sharp fall in national saving in the 1980s. IMF (1995) finds that most of the rise in world real interest rates between 1960-72 and 1981-93 can be ascribed to lower government net saving and higher public debt in the industrial countries and estimates that the resulting fall in capital formation has led to a permanent loss equivalent to 2 per cent of world consumption.

16. See also Masson, Bayoumi and Samiei (1995) who agree that there is a positive correlation between savings and growth across a broad range of countries, but argue that the causality is unclear. There is also cross-country evidence of a non-linear relationship between national savings rates and per capita income *levels*, with savings rates very low in countries with per capita income near the subsistence level, sharply higher for middle-income developing countries and then about the same or lower for high-income industrial countries.

17. Recent estimates of Ricardian equivalence find that about one-half of a fall on government saving is offset by higher private saving (IMF 1995; Edwards 1995; Masson *et al.* 1995).

18. Australia is an exception to this general rule, with the figures in Table 4 understating the deterioration in household saving. From its peak in the early 1970s, household saving relative to GDP has fallen by almost 7 percentage points.

'norms' after an unusual postwar boom in saving. As can be seen from Table 5, the 1950-73 period was not only an unusual period with respect to growth but also with respect to gross national saving. In fact, the only country with a relatively smooth pattern of saving is the United States which, as noted earlier, also had a relatively smooth pattern of growth.

Table 5: Saving and Growth Over Longer Periods in Selected Countries

Countries	1870-1913		1913-1950		1950-1973		1973-1989	
	S/Y	*g*	*S/Y*	*g*	*S/Y*	*g*	*S/Y*	*g*
Australia	12.1	0.9	12.8	0.7	24.4	2.4	22.0	1.7
Canada	10.7	2.3	16.2	1.5	22.5	2.9	21.5	2.5
United Kingdom	13.7	1.0	6.3	0.8	17.9	2.5	19.2	1.8
United States	18.7	2.0	16.5	1.6	19.7	2.2	18.0	1.6
Japan	12.3	1.4	18.7	0.9	32.8	8.0	32.9	3.1

Note: *S/Y* = Ratio of gross national saving to GDP, in percentages and *g* = per capita GDP growth, in per cent per annum.

Source: Maddison (1992).

3.2.5 Exchange rate policies

One of Fischer's conditions for growth-conducive macroeconomic policies is that the exchange rate must be competitive and predictable. Very little empirical work has been done, however, on the relationship between exchange rates and economic growth, especially for the industrial countries. It has proven very difficult to identify equilibrium values for real exchange rates, making it almost impossible to quantify the extent to which they were over or under-valued compared to equilibrium. Further, while there is some evidence that large and persistent movements in real exchange rates affect short-run growth, very few studies have looked into the medium-term implications, partly because exchange rates have started to reverse before possible effects could be detected.

For developing countries, there is more evidence of exchange rate policies influencing growth rates. One variable frequently included in cross-country growth regressions is the differential between the official and the 'black market' exchange rate and in most cases there is significant evidence that maintaining an overvalued official exchange rate tends to reduce long-run growth.

Additional support for Fischer's condition may be obtained by comparing the experience of Asian countries with those of Africa and Latin America. Though exchange rate policies in Asia range from a currency board arrangement (Hong Kong) to various versions of pegging (Thailand), managed floats (Singapore) and a flexible rate (the Philippines) a number of countries have used exchange rate policies to promote export growth. As a result, real exchange rates have mostly been stable and tended to be undervalued. By contrast, Latin American countries have frequently relied on a fixed nominal exchange rate against the US$ or a slowly crawling peg as a means of reducing inflation. However, because other policies (notably fiscal policy) were not consistent with this target and indexation created a high degree of inertia, the rate of inflation

exceeded that of the anchor country, resulting in appreciating real exchange rates and adverse effects for export growth and the development of the manufacturing sector. A similar experience, though at much lower rates of inflation and mainly affecting agriculture and resource-based industries, has already been noted for the members of the African franc zone.

While these comparisons do not yield definitive conclusions, they do suggest that countries have some medium-term influence on their exchange rates and that exchange rate policies have potential growth effects. Promotion of international competitiveness and exports of manufactured goods was part of the 'Asian growth strategy' and keeping the exchange rate slightly undervalued was an important instrument in this strategy. In Latin America and Africa, on the other hand, exchange rates have not been used to promote exports and growth but as a means to reducing inflation. Moreover, because these policies did not succeed in sufficiently reducing inflation and eventually failed in most cases, exchange rates have tended to be overvalued for long periods, with detrimental effects for exports and for aggregate growth.

3.3.6 Financial markets and financial systems

Financial market developments is another area where it has proven difficult to identify a clear relationship between policy-related variables and growth. For many years, this has been an area of intensive research efforts but also controversy. Early works (McKinnon 1973; Shaw 1973) suggested rather large potential growth impacts on the assumption that liberalising repressed systems would boost aggregate saving. This link, however, has found little empirical support, whereas alternative models focusing on the impact that financial liberalisation might have on the allocation of capital and the efficiency and cost of financial intermediation seem more consistent with the experience of liberalising countries (Lee 1991; Pagano 1993).[19] Nonetheless, many have remained sceptical, pointing to the financial crises often following liberalisation (Dornbusch and Reynoso 1989) or arguing that there is no role for finance or the cost of finance in neoclassical growth models (Lucas 1988).

More recently, new approaches based on endogenous growth models have been developed, stressing the role of financial systems in gathering information, evaluating innovative entrepreneurs and pooling financial resources to make successful innovations operational. Galetovic (1994) and King and Levine (1993) are two examples of this new approach and the latter test the empirical validity of their model on cross-country data, using four alternative indicators of financial activity and the depth of private financial markets. All four indicators are based on money and credit aggregates and appear to be robust when included in the cross-country regressions discussed in Section 4.

Nonetheless, this evidence should be considered with some caution. First, the indicators used are rather crude approximations to the services provided by modern

19. Pagano identifies three channels through which financial market liberalisation can raise growth: more efficient investment, a less costly transmission and intermediation process and higher saving. The empirical evidence clearly points to the first channel as the most important one whereas changes in the savings ratio have mostly had a negative effect and the impact of improvements in the transmission process is uncertain.

financial systems. Second, the potential role of interest rates remains a puzzle. In Galetovic's model, a principal function of financial intermediaries is to reduce the costs of credit, but in most empirical estimates nominal and real interest rates are statistically insignificant. Third, when confining the cross-country regressions to OECD countries, Englander and Gurney (1994) find no effects of financial variables on productivity growth, suggesting that the four variables proposed by King and Levine are not the appropriate indicators for industrial countries or that the impact of financial systems on growth becomes less important beyond a certain level of economic development (Berthelemy and Varoudakis 1995). Finally, while in theory financial deregulation should improve long-run efficiency, a typical feature of liberalising countries (industrial as well as developing) is that private sector saving has declined in step with the greater availability of credit. In several industrial countries, liberalisation of financial systems in the 1980s also led to asset price bubbles with severe and long-lasting repercussions for the financial system and for private sector balance sheets.

The empirical implementation of models of financial developments based on new theories of growth is still in its infancy and until indicators which better capture the underlying models have been constructed, it is difficult to draw any firm conclusions. It does appear, however, that financial markets are neither an 'engine of growth' nor are they purely passive. In the early phase of development, strong growth would be difficult to achieve unless it is supplemented by rapid development of the financial system, in particular intermediated finance, and at a later stage information gathering, pooling of financial resources and diversification of risks are important in promoting innovation and technical progress. Moreover, liberalised financial systems promote a more efficient distribution of capital and may enhance policy efficiency in general. On the other hand, moving from a regulated to a deregulated environment, when more fundamental factors such as a high investment/GDP ratio, low budget deficits and low inflation are absent, can have long-lasting and negative effects on growth.

3.3.7 Path dependence and macroeconomic policies

If, for some reason, the long-run or steady-state growth rate depends on the past history of actual growth, the scope for macroeconomic policies to influence growth widens: a policy mistake causing a recession in one year will have long-lasting and adverse effects on future growth while, conversely, policy measures that smoothly offset shocks will keep the economy on a higher growth path than it otherwise would have been. Whatever the source, the notion of path dependence creates an important link between short-term demand management policies and long-run output and is a challenge to those versions of the natural-rate hypothesis which postulate that policies have no long-run effect on output.

It is, of course, well known that productivity growth changes *within* the cycle, but there may also be effects on the medium-term evolution of productivity. Internal funds for investment are more readily available during booms than in recessions and banks are probably more willing to finance investment projects, especially those with high risks and high potential returns. At relatively low rates of unemployment, resistance to technological change may be lower than in periods when workers fear that labour productivity gains add further to the number of unemployed. On the other hand,

recessions increase the pressure to improve efficiency and may be necessary to 'clean out' inefficient firms (Schumpeter 1939). Moreover, even if faster output growth has a positive net effect on productivity, there are clearly limits to how much can be gained, as an aggressive policy of 'going for growth' inevitably pushes up inflation.

The impressive growth performance after World War II, compared to the pre-Depression era, is attributed by some to a combination of path dependence, automatic fiscal stabilisers and macro-policy activism. Pre-eminent proponents of this view, De Long and Summers (1988), show that expansionary nominal demand shocks appear to have more effect on prices and less on output than contractionary shocks, and they point to a marked rise in output persistence and a significant decline in the average output gap in the post-war period, which they interpret as a consequence of successful counter-cyclical macro-policies after World War II.

While De Long and Summers probably go too far in their positive appraisal of demand management policies (Mankiw 1988) the asymmetric response to positive and negative nominal shocks they report supports the perception of most policy-makers who, having experienced the large output costs associated with reversing inflationary forces, have become more aware of the need to avoid excess demand pressures. It has also recently been supported by an analysis of the trade-off between inflation and the output-gap for the G7 countries. Laxton, Meredith and Rose (1995) find that a positive demand shock in an initial situation of zero excess demand leads to a rise in inflation of more than $1\frac{1}{2}$ percentage points while a negative shock of the same size reduces inflation by less than a $\frac{1}{2}$ of a percentage point. As a consequence of this asymmetric response, the average *level* of trend output is raised when the *variability* of output is lowered.[20]

Some simple policy prescriptions flow from these empirical results. First, when the trade-off is asymmetric and policy makers are faced with the risk of a permanent rise in inflation, prompt policy responses reduce the output costs of keeping inflation low and thus raise the long-run output level compared with a strategy of lagged and largely *ex post* interventions. In other words, the existence of an asymmetric trade-off supports the use of a pre-emptive policy strategy.

The second prescription also arises from the relationship between output variability and the long-run output level. Because of the numerous shocks to which an economy is exposed, there is a policy trade-off between minimising fluctuations in output from its potential and inflation from its target (Taylor 1992; Debelle and Stevens 1995). A policy strategy aimed at always keeping inflation close to its target and restoring price stability quickly after a shock generates larger fluctuations in output and thus lowers the long-run output level. By contrast, provided medium-term inflation remains close to the target, policy-makers tolerating short-term deviations from this inflation target can reduce output fluctuations and thereby increase the long-run output level. Assuming that credibility is not adversely affected, some tolerance in meeting the inflation target is thus likely to have a favourable impact on long-run output, compared with a more rigorous strategy which only allows deviations in the case of major supply shocks.

20. This is a general feature of a convex aggregate supply or Phillips curve (Mankiw 1988). In the Laxton *et al.* specification, *potential* output, at which inflation is steady, exceeds *average trend* output. The difference rises with the variance of output growth, and has averaged about half a per cent for the G7 countries.

4. Inflation and Growth

> 'Economic analysis of the costs of inflation – the mirror image of the benefits of price stability – is inevitably disappointing to the many ... who know that inflation is a deep societal problem. The question is whether what the many know is merely difficult to prove, or rather is substantially exaggerated' (Fischer 1984, p. 33).

Given the crucial role of monetary policy in determining the inflation rate in the longer run, it is important when discussing macro-policies and growth, to understand the relationship between inflation and growth. This section examines this relationship.

Of the myriad ways in which inflation reduces economic efficiency (summarised, for example, by Fischer and Modigliani (1978) and Briault (1995)) there are three of particular relevance for economic growth. First, even anticipated inflation distorts the intertemporal allocation of resources as higher nominal interest rates interact with the tax system to affect saving and investment. Second, unanticipated inflation generates greater uncertainty about future inflation, discouraging long-term contracting and raising risk premia on interest rates, which in turn inhibits investment. Third, because higher inflation is associated with larger relative price variability, price signals become more difficult to interpret and the sectoral allocation of resources is adversely affected.

While theoretical calculations have been made of some of the costs of inflation, much discussion is based on simple intuition rather than explicit theoretical formulations. Despite increasingly sophisticated attempts (see, for example, Black, Macklem and Poloz (1994)) it is still very difficult to provide theoretical analysis of many of the economic consequences of inflation. Again quoting Fischer (1984, pp. 45-46), speaking with some exasperation at this lack of progress:

> 'Surely inflation is associated with ... more weighty matters than money triangles and the efficiency of the price system.'

With theory providing little guidance on how the effects of inflation should be included in models of economic growth, most empirical studies simply add average inflation, and/or its standard deviation, to otherwise standard cross-country growth regressions. In discussing the evidence that emerges from these studies, we begin with the influential contributions of Levine and Renalt (1992) and Levine and Zervos (1993), henceforth LR and LZ.

In motivating their study, LR review the huge literature using cross-country regressions to search for empirical links between long-run growth and a variety of economic policy, political and institutional factors suggested by theory. They list 40 cross-sectional studies published between 1980 and 1990, each regressing the growth rate over a given period against a variety of variables. In all, *over 50 variables* have been found to be significant explanators of growth in at least one regression. As it is hard to believe that all these variables are important for growth, LR and LZ propose a strict test of the robustness of these regressions, based on Leamer's (1983) extreme bounds analysis.

LR and LZ consider regressions of the form:

$$\Delta q = \beta_i \mathbf{I} + \beta_m M + \beta_z \mathbf{Z} + u \qquad (2)$$

where Δq is per capita GDP growth, $\mathbf{I}$ is a set of variables always included in the regression, M is the variable of interest and $\mathbf{Z}$ is a subset from a pool of variables

identified in past studies as potentially important explanators of growth. Their analysis involves first running a 'base' regression including the **I**-variables on their own. Then the variable of interest, *M*, and all possible combinations of up to three **Z**-variables are added to the regression. If the coefficient estimate β_m remains of the same sign and significant at a 0.05 level *in all these regressions*, then the variable *M* is described by LR and LZ as a 'robust' explanatory variable for economic growth. Alternatively, if the coefficient β_m changes sign or becomes insignificant in any regression, *M* is a 'fragile' explanator for economic growth. As this description makes clear, this is a very strict test of the robustness of the variable, *M*, as an explanatory variable for economic growth.

LR and LZ differ in their choice of **I**-variables for their base regressions. Both studies include initial secondary school enrolment as a proxy for initial human capital. They both also include initial real GDP per capita to allow for 'convergence': the fact highlighted by Dowrick (this Volume) that, other things equal, poor countries grow faster than rich ones. The LR base regression also includes population growth and the average investment share of GDP while the LZ base regression includes the average number of revolutions and coups over the sample period.[21]

For the purpose of examining the empirical relationship between inflation and growth, both base regressions are of interest. Inflation may plausibly affect economic growth by both altering the level of investment as well as affecting the efficiency of resource allocation. Adding inflation to the LR base regression, therefore, tests whether inflation affects economic growth after controlling for the level of investment. Alternatively, adding inflation to the LZ base regression tests whether inflation affects growth including its effect on the level of investment as one of its channels of influence.

Both LR and LZ conclude that inflation is a fragile explanatory variable for economic growth. They both find that average inflation (or its standard deviation) makes a statistically insignificant contribution to their base regressions. It should be noted, however, that these conclusions are based on regressions for about one hundred countries with average annual inflation rates over their estimation period, 1960-89, ranging from less than 3 per cent (for Ethiopia!) to 474 per cent for Bolivia.

In this paper, we are interested in the relationship between inflation and growth for countries like Australia with similar (advanced) industrial structures, and with comparable rates of inflation. We therefore apply the LR-LZ approach to examine the empirical link between inflation and growth for OECD economies with comparable inflation rates. We repeat the LR-LZ approach as closely as possible, thereby limiting the problem of data-mining: that is, of choosing among a large number of theoretically plausible specifications, the one that provides the strongest support for the story one is trying to tell.

It is often argued that fully-anticipated inflation imposes less economic costs than uncertainty about future inflation, and hence that the variability of inflation may be a better summary measure of the effects of inflation on growth than the average inflation rate. However, as Figure 3 shows for the OECD, there is a close correlation between average inflation and the variability of inflation (as measured by the standard deviation

21. Barro (1991) shows that the average number of revolutions and coups helps explain economic growth in a broad cross-section of countries.

Figure 3: Mean and Standard Deviation of Inflation Rates (1960-1993)
(22 OECD Countries)

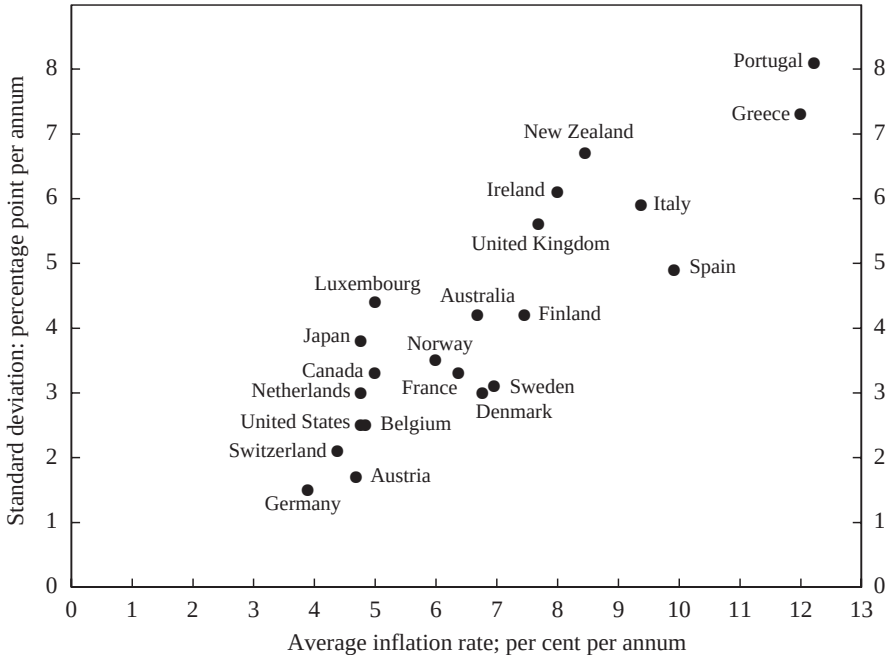
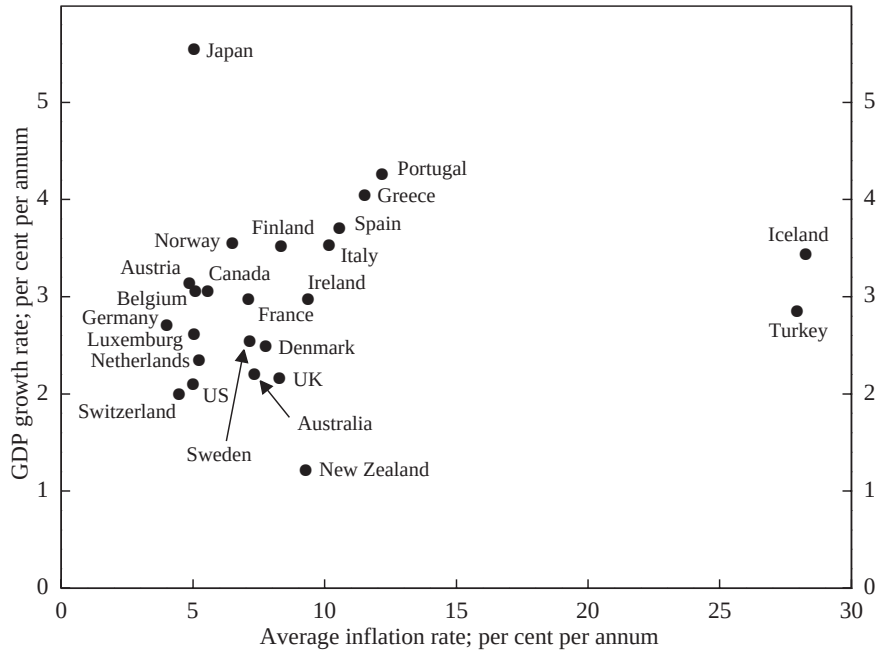


Figure 4: Per Capita GDP Growth v. Average Inflation for OECD Countries (1960-1989)



of inflation).[22] As a consequence of this correlation, it is a daunting empirical task to identify the effect on growth of the level and variability of inflation separately. In the empirical exercise to follow, we limit our analysis to examining the relationship between growth and average inflation, recognising that some of the effect on growth of higher average inflation may be a consequence of the fact that high inflation is also more variable inflation.

Figure 4 shows a scatter plot of the relationship between economic growth and average inflation for the 24 OECD countries over the period 1960-89. As previously mentioned, Iceland and Turkey are clear outliers, each with average annual inflation of 28 per cent, while the other 22 OECD countries had average annual inflation rates between 4 and 12 per cent (with Australian inflation averaging 7 per cent).

There is some evidence that the association between average inflation and growth weakens as inflation rises.[23] To minimise the influence of this effect on our regressions, we therefore exclude Iceland and Turkey from the analysis. (However, the Appendix reports regressions using the whole OECD sample.)

We now apply the LR-LZ approach to the 22 'low-inflation' OECD countries rather than the hundred countries used by them. The dependent variable is always average annual per capita GDP growth, though the explanatory variables for the LR and LZ base regressions are different, as discussed above. After estimating the base regression, we add the variable of interest, the average inflation rate (measured using the GDP deflator), and then up to three **Z**-variables to the regression. The base regressions and **Z**-variables are reported in the Appendix while Table 6 summarises the coefficient estimates on inflation for all 30 regressions.[24]

The estimated coefficient on inflation is negative for all thirty regressions (that is, higher inflation is associated with lower growth).[25] In about half the regressions, this negative estimate is statistically significant at a 5 per cent level, while in the other half, it is statistically insignificant. Using the definition introduced by LR and LZ, average inflation is, therefore, a fragile explanator of economic growth.

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22. The figure is from Edey (1994). Iceland and Turkey have much higher and more variable inflation than the rest of the OECD and are not shown. As discussed in Briault (1995), a large standard deviation does not necessarily imply more uncertainty if the process generating inflation variability is known. However, alternative measures of uncertainty, constructed from surveys or econometric models, also show a close correlation with the average rate of inflation.

23. See Fischer (1993) and Levine and Zervos (1993). Wright (1994) finds that while average inflation (*PI*) makes an insignificant negative contribution to growth in the LZ base regression, log(*PI*) makes a significant negative contribution – which also supports the point. By contrast, Barro (1995) argues that the relationship between growth and inflation is linear.

24. The data are from the database used by King and Levine (1993) and were kindly supplied to us by Steve Dowrick. We use four **Z**-variables for both LR and LZ sets of regressions. Each set therefore includes one regression adding the average inflation rate to the base regression, four regressions adding one **Z**-variable to this regression, six adding two **Z**-variables, and four adding three **Z**-variables, for a total of 15 regressions. Estimation is by OLS with heteroscedasticity-consistent standard errors. A coefficient estimate of -0.1, for example, implies that a fall in average inflation of 1 percentage point is associated with a rise in per capita GDP growth of 0.1 percentage points per annum.

25. This result seems in contrast with Figure 4 which suggests a slightly *positive* relationship between inflation and economic growth. This positive relationship occurs primarily because countries with low initial GDP tend to grow faster but also to have higher inflation. Controlling for initial GDP, the regressions suggest the relationship between inflation and growth is, in fact, negative.

Table 6: The Effect of Inflation on Growth for OECD Countries (1960-1989)

Regression type	Coefficient on inflation in growth regressions							
	Significant coefficients 5%		Significant coefficients 10%		Insignificant coefficients		Total	
	Average value	No.	Average value	No.	Average value	No.	Average value	No.
LR	-0.16	6	-0.15	5	-0.10	4	-0.14	15
LZ	-0.17	10	-0.14	3	-0.10	2	-0.15	15

A possible shortcoming of this cross-country analysis arises from the effect of supply shocks. Adverse supply shocks reduce output and raise inflation leading to a negative correlation between inflation and growth even when higher inflation has not caused lower growth. The cross-country regressions reported in Table 6 may perhaps be picking up the fact that some industrial countries suffered worse aggregate supply shocks than others, and hence had both lower output growth and higher inflation over the estimation period. Since the obvious adverse supply shocks, OPEC I and II, affected inflation and growth after 1973, we split the sample in 1973 and examine the growth experiences 1960-73 and 1974-89 separately.[26]

Table 7 summarises coefficient estimates on inflation for the two sub-samples. As the table makes clear, coefficient estimates derived for the sub-samples are less statistically significant than for the whole sample. It is also clear that the coefficient estimates on inflation are usually smaller in magnitude when estimated over 1960-73 than over 1974-89 or over the whole sample, 1960-89. This supports the earlier suggestion that some of the negative correlation between inflation and growth over the whole sample arises from the differential impact of adverse supply shocks.[27]

The overwhelming impression from the regressions reported in Tables 6 and 7 is that, after controlling for a range of other potentially relevant explanators, higher average inflation is correlated with lower average economic growth. Of the 76 regressions reported in the two tables, all but one give negative point estimates for the effect of inflation on growth. Furthermore, this conclusion should be of relevance for industrial

26. For consistency, in each sub-sample, we excluded from analysis all countries with an annual average inflation rate greater than 20 per cent. For the first sub-sample, 1960-73, all 24 OECD countries were included (Turkey and Iceland had average annual inflation rates of 11 and 16 per cent, respectively) while for the second, Iceland and Turkey were excluded.

27. Another potential shortcoming of the analysis (suggested to us by John Quiggin) arises from possible mis-allocation of nominal GDP growth into real GDP growth and inflation (measured using the GDP deflator). For given nominal GDP growth, under-estimation of real GDP growth implies over-estimation of inflation and vice versa. If the extent and direction of mis-measurement is the same in each country, the analysis is not invalidated. If mis-measurement varies between countries, however, a spurious negative correlation is generated between measured growth and inflation. We therefore repeated the analysis using consumer price inflation which reduces this measurement problem. The coefficient estimates on CPI inflation are almost all negative and similar in magnitude to those reported in Tables 6 and 7. They are, however, much less statistically significant.

Table 7: The Effect of Inflation on Growth for OECD Countries by Sub-periods (1960-1973 and 1974-1989)

Regression type	Coefficient on inflation in growth regressions: Significant coefficients (10%)		Insignificant coefficients		Total	
	Average value	No.	Average value	No.	Average value	No.
LR 60:73	-0.04	11	-0.08	4	-0.05	15
LZ 60:73	-0.06	8	—	—	-0.06	8[a]
LR 74:89	—	—	-0.09	15	-0.09	15
LZ 74:89	-0.10	7	-0.11	1	-0.10	8[a]

Note: (a) One of the conditioning variables in the LZ regressions is not available for the sub-periods (see the Appendix).

countries like Australia since it is derived for OECD countries with average inflation rates less than 20 per cent per annum.

Not surprisingly, given the importance of the issue, the literature contains a large number of empirical studies estimating the effect of inflation on growth. Table 8 summarises the recent evidence, based primarily on cross-country studies for OECD economies in the 1960s, 1970s and 1980s. The table reports only the most relevant of the many regression specifications presented in each study. While the regressions reported are not all independent of each other, there is at least some variation in sample periods and in the explanatory variables used. Given the problems of adverse supply shocks discussed above, the table also reports some results for samples which end before OPEC I.

As Table 8 makes clear, there is professional disagreement about the statistical significance of the relationship between inflation and growth. Some studies (for example Kyriakopolous (1991), LR, LZ, Clark (1993) and Englander and Gurney (1994) conclude that the relationship between inflation and growth is either statistically insignificant at conventional levels of significance or fragile. Others (such as Grimes (1991), Cozier and Selody (1992), Fischer (1993) and Motley (1993)) argue that there is indeed a significant relationship, with higher inflation correlated with lower growth.

Despite this disagreement about statistical significance, it is striking that the vast majority of growth regressions in the literature report negative coefficient estimates on inflation. This is of course true of those studies that find a significant negative relationship between inflation and growth. It is also true, however, of the vast majority of studies that conclude that the relationship is statistically insignificant (see Table 8). For example, LZ report eight different specifications for their cross-country inflation-growth regressions. While the coefficient on inflation in these regressions is sometimes statistically significant and sometimes not – indeed, that is LZ's point – *the coefficient is always negative.*

Table 8: Cross-Country Studies of the Relationship Between Inflation and Growth

(Dependent variable: real GDP growth or per capita real GDP growth in per cent per annum)

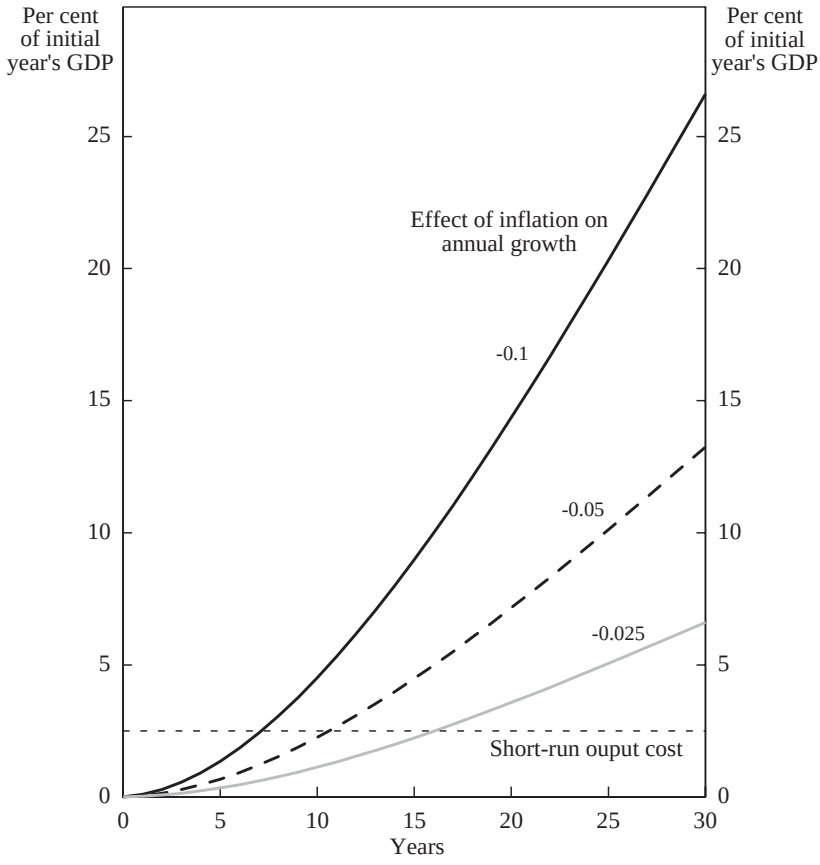
Authors	Period	Model	Sample	Coefficient on average inflation	t-statistic (abs. value)
Grier and Tullock (1989)[a]	1951-80	Panel	24 OECD countries	0.01	0.2
Grimes (1991)	1961-87	Panel	21 OECD countries	-0.11	9.2
Kyriakopoulos (1991)	1960-88	Cross country	24 OECD countries	-0.02	0.9
Cozier and Selody (1992)[b]	1960-85	Cross country	22 OECD countries	-0.13	1.8
Levine and Renelt (1992)	1960-89	Cross country	Non-oil countries	-0.004	1.7
Levine and Zervos (1993)	1960-89	Cross country	Non-oil countries	-0.002	0.6
Motley (1993)	1960-88	Cross country	22 OECD countries	-0.13	2.4
Clark (1993)	1960-85	Cross country	22 OECD countries	-0.13	2.2
	1960-88	Panel		-0.08	1.9
	1950-70	Cross country		-0.13	1.1
Fischer (1993)[c]	1961-88	Panel	Non-oil	-0.13	2.0
	1961-72	Panel	countries	-0.20	3.4
Englander and Gurney (1994)[d]	1960s-90	Panel	19 OECD countries	-0.06	1.6
Barro (1995)[e]	1960-90	Cross country	About 80 countries	-0.024	4.9
				-0.016	0.5

Notes:
(a) The reported regression also includes the standard deviation of inflation, *SDPI*, with a statistically significant negative coefficient. As *PI* and *SDPI* are highly correlated, the coefficient on *PI* is very imprecisely estimated.
(b) Average inflation, *PI*, enters this growth regression as log(*PI*). The coefficient estimate, -0.13, is the estimated effect on growth of a one percentage point rise in inflation at the sample mean inflation rate, 7.7 per cent per annum (derived from their Table 12).
(c) Results are from two of the many regressions reported (equations (36) and (48)). The former allows the effect of inflation on growth to depend on the inflation rate, and we report the coefficient for inflation less than 15 per cent per annum. The latter truncates the sample before OPEC I.
(d) The dependent variable is growth in output per employee in the business sector.
(e) Results are from two of several regressions reported. The former assumes the coefficient is independent of the inflation rate. The latter allows the effect of inflation on growth to depend on the inflation rate, and we again report the coefficient for inflation less than 15 per cent per annum.

While the results are not as robust as one would like, the most obvious interpretation of the evidence in Tables 6 to 8 is that the negative correlation between inflation and growth arises from a causal relationship. That is, other things equal, lower inflation leads to higher economic growth. (A possible alternative interpretation is that countries with low inflation also tend to have a range of growth-enhancing policies, due to a consensus about the benefits of economic growth. While the analysis attempts to control for the effect of other policies, one might argue that the measures it uses – budget surplus, ratio of trade to GDP, etc. – are too imprecise to capture the benefits of a general community commitment to growth.)

Nonetheless, accepting the interpretation that inflation has a causal impact on growth, it is worth quantifying the estimated gains from lower inflation implied by the point estimates in the tables. To do so, we assume a plausible value for per capita output growth (2 per cent per annum) and for the real interest rate used to discount future income (5 per cent per annum). Figure 5 then shows the cumulative gain in per capita output, discounted to the present, from reducing the inflation rate by one percentage point.

Figure 5: Cumulated Output Gain From Reducing Inflation By One Percentage Point



Results are presented for three alternative estimates of the effect of average inflation on annual growth (-0.025, -0.5 and -0.1), and the Figure also shows Stevens' (1992) estimate of the short-run output cost of reducing inflation by one percentage point, 2.5 per cent of one year's GDP.

As Figure 5 shows, disinflation is an investment activity: the costs are borne at the time, while the gains accrue gradually and only outweigh the costs after an extended period. If the annual growth dividend from a one percentage point fall in inflation is as small as 0.025 – an estimate smaller in magnitude than most of the estimates in Tables 6 to 8 – it takes about 16 years for the discounted cumulated gains from faster growth to exceed the short-run output costs of achieving lower inflation (see Figure 5). However, even from such a small growth dividend, the cumulated gains from faster growth eventually exceed the short-run costs by a substantial margin. Of course, if the growth dividend from lower inflation is larger, the 'break-even' point occurs earlier and the eventual gains from lower inflation dwarf the initial costs. Thus, while the estimates in Tables 6 to 8 are sometimes statistically insignificant, they are of considerable economic significance. Measured over an extended period, they imply substantial cumulated output gains from lower inflation.

To conclude, it is worth stressing that the available empirical evidence for industrial countries since World War II, is mute on the issue of whether there are gains from achieving zero or very low single-digit inflation. There are simply no data on economies operating with very low inflation for extended periods. The lowest annual inflation rate in the OECD over the 30 years, 1960-89, was achieved by Germany with a 4 per cent average. Over the shorter period, 1960-73, the lowest average annual inflation rate was in the United States, again with 4 per cent, while over the period, 1974-89, Japan had the lowest inflation with an annual average of 3 per cent. The effect on output growth of achieving average inflation below these rates is simply unknown.

5. Conclusions

The industrial world achieved an impressive improvement in long-run growth in the first generation after World War II. Since then growth has been slower, though it remains significantly above the rates recorded in the first half of this century. This slowdown renewed interest in the determinants of long-run growth and the last decade has witnessed an explosion in both theoretical and empirical studies of growth. Several analysts have also examined whether there is a role for macroeconomic policies in explaining the growth performance of the 1950-73 period, the subsequent slowdown and in improving the prospects for future growth.

This paper has reviewed this new literature, looking at both theoretical and empirical aspects that may have implications for the design of macroeconomic policies. The evidence reported is, to some extent, selective and tentative. Furthermore, since the principal determinants of growth are factor accumulation and technological progress, the impact of macro-policies is probably at the margin. Nevertheless, on balance, we conclude that macro-policies do make some difference to long-run growth. We draw the following five broad conclusions from our study.

First, although both neoclassical and endogenous growth models assign a major role to capital accumulation, policy measures to boost aggregate investment through special

incentives do not seem to be called for. There is little evidence that aggregate investment yields excess returns, suggesting that the positive externalities postulated in some versions of endogenous growth theory are very small at an economy-wide level. Consequently, the main tasks of policy makers in this area are to remove existing distortions (especially those favouring investment in property) and to abstain from reducing public investment in infrastructure merely as a means of restoring fiscal balance.

Second, in a world of liberalised capital flows, saving acts as a constraint on investment and growth for the world as a whole but less so for an individual country, as capital flows from countries with excess saving to those where profitable investment exceeds domestic saving. Yet, reliance on foreign saving is not costless as countries with growing external liabilities face higher real interest rates, a depreciating real exchange rate, and perhaps, a higher degree of economic uncertainty. Ultimately, capital inflows are limited to the rate the market accepts as sustainable, which for a country like Australia, with abundant natural resources and a stable political environment, may be higher than for many other capital importing countries.

Third, in many industrial countries, declining national saving rates are primarily a consequence of lower government saving, suggesting the need for reduced fiscal imbalances. In Australia, private savings have also fallen substantially, suggesting a role for specific incentives to boost this component of savings. There is also some evidence that the causation between higher national saving and faster growth may run both ways. While many cross-country regressions identify the saving rate as one of the principal growth determinants, several recent studies suggest that faster growth also leads, with some lag, to a higher saving rate.

Fourth, recent evidence suggests that when economies are near potential output, the short-run trade-off between inflation and the output gap is asymmetric, with short-run rises in output being more inflationary than falls in output are disinflationary. If this is the case, it opens a channel by which macro-policy can influence the level of long-run output. This has two implications. The first is that a policy strategy that acts pre-emptively to counter expected future demand pressures and quickly mitigates the effects of unexpected shocks has a positive effect on the level of output, compared with a more hesitant approach which acts only when the demand pressures have appeared. Second, provided inflation is kept close to its target in the medium-term, policy which tolerates some short-term deviations of inflation from its target can reduce fluctuations in real output and thereby generate a higher long-run output level than a policy with the sole goal of keeping inflation close to its target.

Fifth, because monetary policy determines inflation in the long run, a key role of monetary policy in influencing growth depends on the relationship between inflation and growth. Although most economists believe even moderate rates of inflation adversely affect growth, unambiguous evidence has been difficult to come by. While there is still professional disagreement on the robustness of the empirical evidence, it does appear that higher inflation, and the associated increased uncertainty about future inflation, adversely affects growth in the industrial countries. Moreover, the gains from lower inflation appear to exceed the initial costs of reducing inflation within about a decade.

Appendix A: Influences on Growth

A1. The Persistence of Growth Rates and the Determinants of Growth

As briefly discussed in the text, while levels of output have a high degree of persistence, for most countries, growth is not very persistent. The correlation between average growth rates in the 1960s and in the 1970s is as low as 0.15 for 89 non-oil countries and only slightly higher (0.3) when the same calculation is done for the 1970s and 1980s (Easterly *et al.* 1993). By contrast, country characteristics, including many policy related variables used in most cross-country regressions, are highly persistent.

We have explored this problem further for the OECD countries (excluding Iceland and Turkey) in Table A1 by regressing average growth for 5-year periods over subsequent 5-year periods. Panel (a) of the table shows that out of 21 correlation coefficients only 4 are significant, with the highest being the one for the two sub-periods of the 1960s. By contrast, as panels (b) to (d) show, inflation as well as general government deficits and investment (both as ratios to GDP) exhibit much more persistence than growth. For investment, even ratios 30 years apart yield a coefficient of almost 0.5. For inflation, the effect of the two oil shocks is clearly evident while the degree of persistence strengthens considerably for the more recent years when inflation declined. Budget deficits, on the other hand, have become less persistent in recent years, probably reflecting countries' differential success in consolidating their fiscal positions.

What is the relevance of these results for the link between policies and growth? First, country characteristics are not the only determinants of growth; as Easterly *et al*. conclude, a substantial part of the variation in growth arises from shocks, in particular terms-of-trade shocks. Second, one interpretation of the results is that country characteristics mainly serve to explain relative per capita income levels while growth rates are more dependent on shocks, and are therefore more variable. Nonetheless, policies can still have a significant influence on growth, especially when countries are far from their steady-state income levels. Third, while shocks are important in explaining growth, policy reactions to the shocks influence how growth is affected. For instance, when comparing the coefficients in Table A1 for the two oil shocks, it is noticeable that following the first oil shock (1965/70 to 1970/75) the correlation for GDP growth remained at a relatively high 0.43 while for inflation the correlation fell to 0.31. By contrast, between 1975/80 and 1980/85 the correlation for GDP growth declined to only 0.01; inflation, on the other hand, remained highly persistent because most countries tightened monetary policy to prevent the second oil shock from pushing up inflation.

Table A1: Indicators of Persistence for 22 OECD Countries

	1965/70	1970/75	1975/80	1980/85	1985/90	1990/95
(a) GDP growth						
1960/65	.74*	.30	.19	.02	.14	.26
1965/70		.43	.52*	.12	.50*	.08
1970/75			.28	.48*	.39	.28
1975/80				.01	.31	.19
1980/85					.10	.38
1985/90						.20
(b) Inflation						
1960/65	.50*	.45**	.01	.15	.31	.12
1965/70		.31	.06	.23	.31	.43
1970/75			.69*	.50*	.35	.32
1975/80				.85*	.85*	.52*
1980/85					.87*	.72*
1985/90						.82*
(c) General government deficit/GDP						
1960/65	.83*	.73*	.71*	.60*	.46	.01
1965/70		.83*	.75*	.48**	.50*	.01
1970/75			.78*	.56*	.41	.03
1975/80				.59*	.35	.00
1980/85					.56*	.18
1985/90						.38
	1960	1970	1980	1990		
(d) Investment/GDP						
1960		.78*	.57*	.48**		
1970			.73*	.66*		
1980				.64*		

Note: The numbers shown in panels (a) and (b) are correlation coefficients between average rates of respectively real GDP growth and inflation for the five-year periods in the first column and the subsequent five-year periods given in the first row. Similarly the numbers in panels (c) and (d) are correlation coefficients between respectively government deficit and investment/GDP ratios for the periods or years shown in the first column and the periods or years given in the first row. * and ** indicate respectively 99 and 95 per cent levels of significance.

A2. Growth and Balance of Payments

The McCombie and Thirlwall model

To derive their balance-of-payments consistent growth rate, McCombie and Thirlwall (1994) [MT] start from the balance-of-payments identity:

$$P_d X + F = P_f EM \tag{3}$$

where: P_d is export prices in domestic currency;

P_f is import prices in foreign currency;

X is exports of goods and services (in volumes);

M is imports of goods and services (in volumes);

E is the exchange rate (measured as domestic currency per unit of foreign currency); and

F is the capital account balance.

No distinction is made between export prices and domestic prices, which implies that the real effective exchange rate is identical to the terms of trade.

Export and import volumes depend on income and relative prices as follows:

$$\begin{aligned} M &= (P_f E / P_d)^{\psi} Y^{\pi} \\ X &= (P_d / P_f E)^{\eta} Z^{\varepsilon} \end{aligned} \tag{4}$$

where: ψ = demand elasticity of imports with respect to relative price of imports;

η = demand elasticity of exports with respect to relative price of exports;

π = elasticity of imports with respect to domestic income (Y); and

ε = elasticity of exports with respect to foreign income (Z).

Taking rates of change, denoted by small letters, (4) becomes:

$$\begin{aligned} m &= \psi(p_f + e - p_d) + \pi y \\ x &= \eta(p_d - e - p_f) + \varepsilon z \end{aligned} \tag{5}$$

Similarly, equation (3) can be rewritten in rates of change:

$$\theta(p_d + x) + (1-\theta) f = p_f + m + e \tag{6}$$

where θ denotes the proportion of import expenditure met by export earnings. Then inserting (5) into (6), the balance-of-payments constrained growth rate can be written as:

$$y^* = [(\theta\eta + \psi)(p_d - e - p_f) + (p_d - e - p_f) + \theta\varepsilon z + (1-\theta)(f - p_d)] / \pi \tag{7}$$

where the first term on the right-hand side measures the trade volume effects of relative price changes and will be positive for a real depreciation (or terms-of-trade deterioration); the second term the income effect of terms-of-trade changes; the third term the effect of export growth; and the last term the effect of capital flows (measured in constant prices) which is positive in case of inflows. The sum of the four terms determines total revenue

available for expanding imports and the corresponding growth of income is then derived by dividing by the income elasticity of imports.

To provide estimates of y^* for Australia within the MT framework, two specific problems need to be addressed. First, how should capital inflows be defined and measured? One possibility is to include only those flows (for instance, foreign direct investment, equity portfolio inflows and long-term debt inflows contracted by the private sector) that are mainly attracted by prospective returns in the Australian private economy.[28] Alternatively, one can ignore capital inflows in the calculation of y^* and leave them for an *ex post* evaluation in the event that actual output growth deviates from y^*. A second issue is the treatment of net income and transfers, which are not included in MT's measure of revenue available for imports but would significantly affect y^* if they do not remain constant. To generate our results, we include changes in capital inflows only as a memorandum item, and subtract the growth of net income payments to abroad from the growth of export earnings, with a weight corresponding to their share of total export revenue. With these assumptions, Table A2 shows our estimates, using average figures for 1959/60-1993/94 and the shorter period 1972/73-1989/90.

Table A2: Growth and the Balance of Payments: Australia

(Percentage per annum, unless otherwise indicated)

Variables	Actual or estimated values:	
	1959/60-1993/94	1972/73-1989/90
Growth in net income payments to abroad:	6.5	8.3
Change in the terms of trade:	-0.5	0.6
Growth in export volumes	6.0	4.5
Adjusted export growth [(a)]	4.50 – 5.00	3.25 – 4.00
Balance-of-payments constrained GDP growth [(b)]	2.75 – 3.05	2.00 – 2.45
Actual GDP growth	3.7	3.1
Change in capital inflows: as per cent of GDP	1.0	5.1

Notes: (a) Obtained from equation (5) by subtracting the weighted growth of net income payments (weight = the share of net income in total export revenue) and the combined effect on income and trade volumes of terms of trade changes, allowing for two extreme cases: $\theta\eta + \psi + 1 = 0$ (i.e. no adjustment to export growth) and $\theta\eta + \psi = 0$ (ie. export growth adjusted for the full terms-of-trade change).

(b) In calculating y^*, it is assumed that the proportion of import expenditure met by export earnings, θ, is 0.95 while the income elasticity of imports, π, is 1.55, from Dwyer and Kent (1993).

28. As noted in IMF (1995), countries with abundant natural resources tend to have large and sustained capital inflows. Higher labour-force growth should have a similar effect.

The implications of rising external liabilities

To derive the results in the text, we use the following empirical ingredients. First, the Blundell-Wignall *et al.* (1993) equation for the Australian real exchange rate, when re-estimated over the period 1984:1 to 1994:4, implies that a one percentage point rise in the ratio of net external liabilities to GDP is associated with a real depreciation of 0.5 per cent.

Second, the relationship between net external liabilities (*NEL*) in years t and t+1 and the current account deficit (*CAD*) in year *t* is given by $NEL_{t+1} = NEL_t + CAD_t$. Dividing throughout by *GDP* and letting lower-case letters denote ratios to *GDP* gives:

$$(1+g)\, nel_{t+1} = nel_t + cad_t \tag{8}$$

where g is nominal GDP growth per annum. Assuming g = 0.06, a current account deficit of 4.5 per cent of GDP (average for the last ten years) and a net external liabilities to GDP ratio of 45 per cent (the current value) implies that the net external liabilities to GDP ratio is rising by 1.7 percentage points per annum, leading to an average annual real exchange rate depreciation of $0.5 \times 1.7 = 0.85$ per cent.[29]

Third, to estimate the inflationary impact of this real exchange rate depreciation, we rely on the price equation in Wilkinson and Lam (1995) which explains domestic prices in the long-run by unit labour costs and import prices, with coefficients 0.7 and 0.3 respectively. In the long run, a 1 percent *nominal* depreciation therefore raises domestic prices by 0.3 per cent and hence translates into a *real* depreciation of $1 - 0.3 = 0.7$ per cent. It follows that a real depreciation of 0.85 per cent per annum generates a rise in domestic prices of $0.3 \times 0.85 / 0.7 = 0.36$ per cent per annum.

To completely offset the domestic price effect of the real depreciation, real unit labour costs must fall by $0.3 \times 0.85 / 0.7 = 0.36$ per cent per annum. With no explicit mechanism to reduce real unit labour costs, this outcome can only be achieved by reducing the level of real output. To derive the required reduction, we use the sacrifice ratio of 2.5 (Stevens 1992). To prevent the real depreciation and the rise in import prices from pushing up the domestic inflation rate, actual output must be reduced on average by about 0.9 per cent (0.36×2.5).

A3. Inflation and Growth

The LR base regression applied to the 22 low inflation OECD countries is:

$$\begin{matrix} \Delta q = 2.47 & - & 0.35\, RGDP60 & - & 0.20\, GPO & + & 0.72\, SEC & + & 8.18\, INV \\ (2.35) & & (6.13) & & (0.56) & & (0.92) & & (2.43) \end{matrix} \tag{9}$$

29. The current *nel* value of 45 per cent is calculated by cumulating current account deficits since 1970. This is the relevant measure for our purposes since we use the Blundell-Wignall *et al.* estimate of the sensitivity of the real exchange rate to changes in *nel*. Note, in passing, that the effect of a given current account deficit on the change in *nel* is inversely related to the actual size of *nel*. On the other hand, the sensitivity of the current external imbalance to changes in foreign interest rates increases in proportion to *nel*. Both relations are relevant to the notion of a balance of payments constraint, but will not be discussed further.

($\bar{R}^2 = 0.61$, estimation period 1960-89, absolute value of White robust t-statistics in parentheses), while the LZ base regression applied to the 22 low inflation OECD countries is:

$$\underset{(6.60)}{\Delta q = 6.03} \; - \; \underset{(4.28)}{1.96\, LRGDP60} + \underset{(0.71)}{0.22\, LSEC} - \underset{(1.77)}{3.32\, REVC} \qquad (10)$$

($\bar{R}^2 = 0.57$, estimation period 1960-89, absolute value of White robust t-statistics in parentheses).

The variables are average per capita real GDP growth in per cent per annum (Δq), per capita real GDP in 1960 (*RGDP60*), average annual rate of population growth (*GPO*), initial secondary school enrolment rate (*SEC*), average investment share of GDP (*INV*) and the average number of revolutions and coups per year (*REVC*). *LRGDP60* and *LSEC* are log(*RGDP60*) and log(*SEC*).

For the set of LR regressions, the **Z**-variables are: government consumption share of GDP (*GOV*), export share of GDP (*X*), the average number of revolutions and coups per year (*REVC*), and the ratio of liquid liabilities to GDP (*LLY*), while for the set of LZ regressions, the **Z**-variables are: the government fiscal surplus ratio to GDP (*SURY*), the ratio of total trade to GDP (*TRD*), *LLY* and the black-market exchange rate premium (*BMP*).[30]

Both the LR and LZ base regressions contain statistically insignificant explanatory variables when estimated for the 22 low inflation OECD countries (see above). We include these variables in the analysis reported in the text to reproduce the LR-LZ approach as closely as possible. Nevertheless, to establish that our conclusions about the correlation between inflation and growth are robust to the exclusion of these variables, we repeat the analysis for the whole estimation period 1960-89 and for the sub-period 1960-73, excluding from each base regression any variable with an absolute *t*-statistic less than 1.5. This implies that, for the LR whole estimation period regression, *GPO* and *SEC* are excluded, for the LZ whole estimation period regression, *LSEC* is excluded, for the LR 1960-73 regression, *SEC* is excluded, while for the LZ 1960-73 regression, *LSEC* is excluded.

These modified LR and LZ regressions generate the following results. The coefficient on average inflation in all 30 regressions estimated over 1960-89 is negative with point estimates ranging from -0.11 to -0.20, mostly significant at 5 per cent. For the 15 LR and 8 LZ regressions estimated over the sub-period 1960-73, the coefficient on average inflation is negative in 20 (out of 23) regressions with point estimates ranging from -0.09 to +0.01 but always insignificant at a 10 per cent level. We infer from this exercise that the conclusions drawn in the text about the inflation-growth relationship are robust to the exclusion of insignificant explanatory variables from the LR and LZ base regressions.

30. These **Z**-variables correspond closely to those used by LR and LZ. We added *LLY* (one of the LZ **Z**-variables) to the list of **Z**-variables used by LR to generate more regressions. For the LZ sub-sample regressions, we used *GOV* instead of *SURY*, but lacked data on *BMP* and so were limited to eight regressions for each sub-sample.

We also looked for any systematic non-linearity in the relationship between growth and inflation for our sample, and sub-samples, of OECD countries. To do so, we added the square of average inflation, PI^2, to each regression in our original analysis. No systematic results emerged from this exercise, with both the size and sign of the coefficients on *PI* and PI^2 often changing from one regression to the next.

For completeness, we also report results adding average inflation (*PI*) to the LR and LZ base regressions when the sample includes all 24 OECD countries. The LR regression is then:

$$\begin{array}{cccccccc} \Delta q = 2.21 & - & 0.34\ RGDP60 & - 0.23\ GPO & + 0.87\ SEC & + 9.01\ INV & - 0.004\ PI \\ (2.23) & & (4.66) & (0.78) & (1.20) & (3.06) & (0.17) \end{array} \qquad (11)$$

($\overline{R}^2 = 0.58$, estimation period 1960-89, absolute value of White robust t-statistics in parentheses), while the LZ regression is:

$$\begin{array}{cccccccc} \Delta q = 6.40 & - & 2.02\ LRGDP60 & + 0.38\ LSEC & - 4.32\ REVC & - 0.016\ PI \\ (7.48) & & (4.78) & (1.35) & (2.36) & (0.56) \end{array} \qquad (12)$$

($\overline{R}^2 = 0.50$, estimation period 1960-89, absolute value of White robust t-statistics in parentheses).

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