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The real problem with inflation targeting

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1. Introduction

A major shift in the conduct of monetary policy occurred during the 1990s with an emphasis on maintaining price stability. The Reserve Bank of Australia (RBA) in its first monetary policy statement after introducing inflation targeting in 1994 affirmed a view common among economists that espouse the idea that monetary policy should adopt the sole objective of maintaining price stability. Underpinning this view is the belief in what can be termed a 'NAIRU-view' of the world.[2] Accordingly, there is some unique real level of activity (summarised in either output or employment) that the economy gravitates to, and any episodes of price disinflation will only temporarily push the real economy below these levels.

Inflation targeting refers to a monetary policy framework where the central bank explicitly and publicly declares a target inflation (or price) quantum that it will use the monetary policy instruments to achieve and maintain. This is not the same as employing a quantitative definition of price stability (as in the case of the European Central Bank) which may require medium-term compliance but cannot be construed as something the ECM 'targets' " in the sense that the ECB will not react mechanically if the …[inflation rate] … increase goes beyond the limit of the definition" (Solans, 2000).

The RBA conducts inflation targeting by changing short-term interest rates to manipulate economic activity in order to maintain inflation within the RBA pre-announced 'target' range. This range is announced as '2 to 3 per cent, on average over the business cycle'. Inflation targeting began in Australia in 1994. The RBA's Deputy Governor in a public address coinciding with a decade of Australia inflation targeting, declared the policy shift a success (Stevens, 2003).

The move to inflation targeting on the back of an overwhelming faith in the 'NAIRU ideology' marked the final stages in the evolution of an abandonment of full employment. The modern policy framework is in contradistinction to the practice of governments in the post World War II period to 1975 which sought to maintain levels of demand using a range of fiscal and monetary measures that were sufficient to ensure that full employment was achieved. In Australia, the RBA was constituted to maintain full employment as one of its three policy goals (see Section 10 of the Reserve Bank Act 1959. Subsection 2). Unemployment rates were usually below 2 per cent throughout this period.

In this paper we consider some evidence that casts doubt on the claims that inflation targeting has been a success. Key non-inflation targeting economies, such as Japan and the US, have official interest rates of 0.001 per cent and 1.25 per cent, respectively, compared to Australia's cash rate of 5.25 per cent. Despite steady growth since 1994, Australia has not achieved sustained high rates of labour utilisation. The official unemployment rate persists at 6 per cent and recent ABS data show rising long-term unemployment and underemployment. Total labour underutilisation (around 12 per cent) represents a high level of foregone output.

A central research question is whether 'inflation targeting' has contributed to this waste and to what extent. This is reinforced by the fact that only 7 of the top 20 OECD economies studied recently by Ball and Sheridan (2003) have adopted inflation targeting – this hardly constitutes a consensus. Table 1 details the inflation targeting countries and describes their policy design.

Inflation targeting proponents claim that it has several advantages over other types of monetary policy. Economists outline the virtues of this approach in terms of higher sustainable growth rate and enhanced policy credibility (Barro, 1995; Cecchetti and Rich, 1999). Many of the gains are attributed to the fact that inflation targeting approach provides the central bank with the independence it needs to be credible, transparent and accountable. As a consequence, this independence overcomes the time inconsistency problem raised by Sargent (1983) whereby an inflation bias is generated by the pressure the elected government places (implicitly or explicitly) on non-elected officials in the central banks to achieve popular outcomes. Thus inflation targeting can lock in a low inflation environment. Svensson (1997) argues that it not only reduces inflation variability but also reduces the variance of output growth (Alesina and Summers, 1993). If certainty in monetary policy generates more stable nominal values, it is argued that lower interest rates and reduced risk premiums follows. This stimulates higher real growth rates via an enhanced investment climate. Further, inflation persistence is allegedly reduced because one time shocks to the inflation rate are quickly eliminated by the policy coherence. The reduced inflation variability allows more certainty in nominal contracting with less need for frequent wage and price adjustments. This in turn means less need for indexation and short-term contracts. However, the implications of this are a 'flatter' short-run Phillips curve. In other words, higher disinflation costs (Ball *et al.*, 1988; Jordan, 1997).[3]

While some extreme elements of the profession, who still consider rational expectations to be a reasonable assumption, will deny any real output effects, most economists acknowledge that any disinflation engendered by this approach will be accompanied by a period of reduced output and increased unemployment (and related social costs) because a period of (temporary) slack is required to break inflationary expectations (Fuhrer, 1995). The magnitude of the real losses is considered to depend on the degree of inflation persistence. The increased use of inflation targeting has been associated with persistently high (though declining) unemployment in most OECD economies. Some economists argue that inflation-first monetary policy (of which inflation targeting is an evolved form) has caused the lack of jobs, especially in European economies, over the 1990s (Modigliani, 2000).

How large are the output losses following discretionary disinflation? Can these output losses be attenuated by the design of the monetary policy? Sargent (1983) argued that the losses were minimized if the disinflation is rapid. Ball (1994) found that the losses are inversely related to the speed of disinflation. Others, such as Blinder (2000) reject the notion that a more politically independent central bank can engineer disinflations with attenuated real output losses. Blinder (2000: 1425) says "to my knowledge, there is no statistical evidence whatsoever on the other side of the debate."

Major researchers like Ball and Sheridan (2003) are now part of a 2nd wave of literature employing new techniques and new data to generate more precise estimates of the sacrifice ratio (a summary measure of the cumulative output loss over a disinflationary episode) because they recognise the theoretical, empirical and methodological issues are far from resolved. In addition, sacrifice ratios can now be computed for disinflations in the inflation targeting period which allows more reasonable comparisons with pre-inflation targeting and non-inflation targeting countries to be made. Ball and Sheridan (2003) show that targeting countries fail to achieve superior outcomes.[4]

A complete understanding of the consequences of a low inflation economy for unemployment is required before we can implicate inflation targeting in the persistence of high unemployment over the last 20 years. Some unresolved issues centre on whether the costs of maintaining a low inflation economy outweigh the benefits which, in part, necessitates more explicit estimates of the short- and long-run costs. There has been little Australian research published (see Seyfried and Bremmer, 2003; AER, 1999), which could cast light on the hypothesis that inflation targeting reduces the sacrifice ratio. There is also no consensus involving the preferred econometric (or estimation) approach.

In this paper, we examine the latest evidence on sacrifice ratio using two broad approaches: (a) the episode-specific approach; and (b) a structural price and wage system approach. We exploit the fact that the data sets post inflation targeting are now longer and more precision can be gained by way of comparing pre- and post-targeting events. In particular, in the context of the episode-specific approach we now have data covering full disinflation periods post-targeting for some countries which allow some comparative statements to be made.

Our main conclusion is that inflation targeting does not generate significant improvements in the real performance of the economy. However, we argue that the 'ideology' of inflation targeting does damage the real economy because it embraces a bias towards passive fiscal policy which in our view locks in persistently high levels of labour underutilisation. Disinflationary monetary policy and tight fiscal policy can bring inflation down and stabilise it but it does so at the expense of creating and maintaining a buffer stock of unemployment. The policy approach is seemingly incapable of achieving both price stability and full employment (Mitchell, 2001a).

The paper is constructed as follows: Section 2 rehearses the main arguments made by proponents of inflation targeting and the alleged benefits of the monetary policy framework. Section 3 considers some recent evidence of the effectiveness of inflation targeting and rejects the latest claims made by the RBA that it is a successful strategy. Section 4 develops an argument that links inflation targeting in Australia with an ideology based on the NAIRU, passive fiscal policy and persistently high rates of labour underutilisation. Section 5 develops the concept of the sacrifice ratio. Section 6 reports on our estimates of the sacrifice ratio and the implications of the results. Section 7 develops a structural model of wage adjustment, price inflation and an Okun relation and uses this approach to derive a measure of the sacrifice ratio based on nominal inertia. Section 8 provides concluding comments.

2. Alleged benefits of inflation targeting

2.1 What supporters claim are the advantages of inflation targeting

The foundation for the recent trends in monetary policy can be found in Kydland and Prescott (1977), Sargent (1983), Barro and Gordon (1983) among others. They argued (convincingly in the eyes of the majority of the profession) that unless the central bank is committed to an optimal inflation target (zero inflation), there would be an inflation bias in the economy. Given the central bank officials are appointed by politicians, it is claimed as agents of government they are under pressure to optimise the political cycle by maintaining levels of output and employment at socially popular levels. The optimal monetary policy literature burgeoned after these early publications. An emphasis developed on central bank independence to avoid the time-inconsistency problem outlined in the introduction.

Monetary theorists such as King (2003) and Bernanke and Mishkin (1997) argue that inflation targeting provides the central bank with a framework or structure in which they can access and collate a wide range of information about the economy before deciding on what the current interest rates will be. Their emphasis is on the central bank promoting understanding and dialogue with the public such that inflation expectations will be purged and lower interest rates sustained (see below). Alternatively, Svensson (1999) considers two types of monetary policy: (a) Policy based on an instrument rule such as a policy reaction function which guides monetary policy. The well-known Taylor rule (Taylor, 1994) is an example. (b) Policy based on a targeting rule. Inflation targeting is an example of this second type of monetary policy. Svensson (1997) believes inflation targeting eliminates inflationary biases in an economy because the central bank has a strong motive to maintain the policy stance. We consider the concepts of accountability and transparency below.

Saxton (1997: 1) claims that "there is a growing consensus that under current monetary arrangements … [fiat money, flexible exchange rate regime] …the single appropriate goal of monetary policy should be price stability." Price stability is deemed to be a virtuous policy goal for several reasons. Saxton (1997: 1) provides a rationale for price stability (which we paraphrase):

(a) Anchors the price system – that is, provides a nominal anchor to the value of the fiat currency.

(b) Promotes effective functioning of the price system – that is, the market allocation system is not subject to nominal price distortions and (neo-classical) efficiency is increased.

(c) Promotes stability and growth - supporters of inflation targeting claim that the policy regime allows for permanent low inflation with minimal price variability, which should lower inflation expectations and uncertainty about future inflation. King (2002) believes that as a consequence long-term interest rates should be reduced thus providing benefits to investment. The lower interest rates, in turn, promote stronger economic growth.

(d) Eliminates tax distortions – which help tax-paying investors who are caught out by the 'taxation without representation' problem in times of rapid inflation.

(e) Promotes transparency, accountability and credibility – the explicit announcement of price stability as the major focus of monetary policy makes it transparent and credible. The setting of known inflation targets places a discipline on monetary authorities to avoid non-optimal policy shifts.[5] Credibility thus suggests that the public trust the central bank to maintain its nerve and act consistently to achieve price stability. It is the result of a period of acting in a consistent fashion. Importantly, central bank credibility is considered by supporters of inflation targeting to a principle mechanism by which the economy purges inflationary expectations and risk premiums on interest rates (see Judd, 1995).

It is common to frame the goal of price stability not in terms of a price level target but rather an inflation target. We do not enter the debate here about the nuances of targeting the level or the rate of change. US Federal Reserve Chairman Greenspan (2001) defined price stability as that situation where "households and businesses need not factor expectations of changes in the average level of prices in their decisions". He argued that it was difficult to define a specific numerical estimate of this rate. "… By price stability … I do not refer to a single number as measured by a particular price index. In fact, it has become increasingly difficult to pin down the notion of what constitutes a stable general price level … For all these conceptual uncertainties and measurement problems, a specific numerical inflation target would represent an unhelpful and false precision. Rather price stability is best thought as an environment in which inflation is so low and stable over time that it does not materially enter into the decisions of households and firms."

Masson *et al* (1997) claim that the case for inflation targeting is based on four basic propositions that hold a "consensus" position among monetary economists:

> "(1) An increase in the money supply is neutral in the medium to long run; i.e., a monetary expansion has lasting effects only on the price level, not on output or unemployment.
>
> (2) Inflation is costly, either in terms of resource allocation (efficiency costs) or in terms of long-run output growth (breakdown of 'superneutrality'), or both.
>
> (3) Money is not neutral in the short run; i.e., monetary policy has important transitory effects on a number of real variables such as output and unemployment. There is, however, at best an imperfect understanding of the nature and/or size of these effects, of the horizon over which they manifest themselves and of the mechanisms through which monetary impulses are transmitted to the rest of the economy. And, a corollary of (3),
>
> (4) Monetary policy affects the rate of inflation with lags of uncertain duration and with variable strength, which undermine the central bank's ability to control inflation on a period-by-period basis."

Masson *et al* (1997: 6-7) say that "central banks … are subject to continual pressure to stimulate activity and/or pursue other objectives that may conflict with price stability. Inflation targeting in principle helps to redress this asymmetry by making inflation, not output or some other target variable, the explicit goal of monetary policy and by providing the central bank a forward-looking framework to undertake a **pre-emptive** tightening of policies before inflationary pressures become visible." (emphasis in original).

2.2 What supporters claim are the prerequisites for inflation targeting

For the argument in this paper, it is useful to reflect on what the adoption of inflation targeting means for the conduct of other arms of macroeconomic policy, particularly fiscal policy. Saxton (1997: 5) says that "most countries adopting explicit inflation targets recognize that monetary policy goals of price stability should be consistent with other macroeconomic policies of the government. A disinflation monetary policy program which is inconsistent with other macroeconomic policies may not be credible and hence may be more costly to implement than otherwise would be the case."

The propositions summarised in Section 2.1, of-course, underpin the orthodox NAIRU approach where unemployment is used as a buffer stock to control unemployment (Mitchell and Mosler, 2002). We will consider this issue in a later section. Taken together they lead Masson *et al* (1997) to outline what they see as the prerequisites for conducting a successful inflation targeting regime.

1. The central bank must be able to conduct monetary policy with a degree of 'instrument independence" which is different to 'goal independence' (Masson *et al*, 1997: 7). This is taken to mean that the central bank must "be able to gear … freely the instruments of monetary policy toward the attainment of some nominal objective". It suggests that there is no *fiscal dominance* which means "the conduct

of monetary policy will not be dictated or severely constrained by developments of a fiscal nature. In general terms, this implies that the public sector borrowing from the central bank (and the banking system) will be low or nonexistent, that the government will have a broad revenue base and therefore will not rely systematically and significantly on revenues from seignorage, that domestic financial markets will have enough depth to absorb placements of public (and private) debt instruments, and that the accumulation of public debt will not give rise to explosive … dynamics. Failure to comply with these conditions will make the country vulnerable to inflation pressures of a fiscal origin."

2. "… the absence of any firm commitment by the authorities to **target the level or path of any other nominal variables**, such as wages or, especially, the nominal exchange rate" (Masson *et al*, 1997: 8). In other words, a flexible exchange rate regime must be in place.

If these requirements are in place, then IT necessitates "four essential elements: (i) explicit *quantitative targets* for the rate of inflation some period(s) ahead; (ii) clear and unambiguous indications that the attainment of the inflation target constitutes the *overriding objective* of monetary policy in the sense that it takes precedence of all other objectives; (iii) a methodology … for producing *inflation forecasts* that uses a number of variables and indicators containing information on future inflation; (iv) a *forward-looking* operating procedure in which the setting of policy instruments depends on the assessment of inflationary pressures and where the inflation forecasts are used as the *main intermediate target*." (Masson *et al*, 1997: 10)

2.3 An alternative approach to price stability

Given the fact that despite steady growth in Australia over the inflation targeting period (since 1994), high rates of labour utilisation still escape the economy, critics of this approach focus less on the fact that the central bank may set interest rates to target inflation and more on what the inflation targeting 'ideology' means for fiscal policy activism. The persistence of high official unemployment, rising long-term unemployment and rising underemployment in Australia, such that total labour underutilisation is currently (June 2004) around 12 per cent suggest that fiscal policy is too constrained. The primary role of fiscal policy is to ensure high levels of spending are maintained to keep employment at high levels and underutilisation of labour at low levels. The emphasis of monetary policy on price stability has been at the expense of a fiscal policy emphasis on employment stability. Proponents of inflation targeting claim that in the long-run real output growth will be favourable if inflation is stabilised but fail to convincingly explain why high levels of labour underutilisation persist.

Critics of this orthodox ideology challenge its claim that price stability maintained ostensibly via the creation of a buffer stock of unemployment is preferable to a policy environment where full employment and price stability is maintained via active fiscal policy with monetary policy passively setting a rate structure consistent with robust long-term investment. Mitchell (1998), Wray (1998) and others (see Mitchell and Wray, 2004 among others) argue that full employment can be maintained by the introduction of an open-ended (infinitely elastic) public employment program that offers a job to anyone who is ready, willing and able to work and cannot find alternative employment. The jobs 'hire of the bottom' in the sense that the minimum wages paid which are not in competition with the market sector wage structure. By avoiding competing with the private market, the Job Guarantee anchors the nominal value of money and the economy avoids the inflationary tendencies of old-fashioned 'military Keynesianism', which attempts to maintain full capacity utilisation by 'hiring off the top' (making purchases at market prices and competing for resources with all other demand elements).

The major test of inflation targeting or active monetary policy (buttressed with passive fiscal policy) is whether it can achieve and maintain full utilisation of labour resources in a stable price environment. The evidence to date is that monetary policy has failed to deliver on this goal. In the next section, we turn our attention to some of the evidence that inflation targeting proponents offer to support their claim that it has been a success.

3. Some evidence on the effectiveness of inflation targeting to date

3.1 The RBA claims of success and the rebuttal

In a recent RBA bulletin, RBA Deputy Governor Stevens (2003: 26) concluded that:

> Inflation targeting has been a successful model for monetary policy in Australia. It has been associated with lower, less variable inflation, and better and less variable economic growth. While I would not claim that improved overall economic performance has been entirely due to the adoption of inflation targeting, I do claim that this approach to policy has made a significant contribution. Inflation targeting allows a considerable degree of short-term flexibility for monetary policy decisions, but also imposes the appropriate medium-term constraints. That's a very good combination. There are no alternative models at the moment for Australia's monetary policy which offer a better mix.

In commenting on the move to a single monetary policy goal of price stability in a number of countries (such as Canada, the UK, New Zealand, Sweden, Finland and Australia), Saxton (1997: 3) claims that "evidence to date indicates these experiments have been quite successful. Those countries adopting a price stability goal, for example, have significantly improved their inflation performances. Specifically they have all dramatically lowered their inflation rates since adopting targets for inflation, often to lower rates not observed for decades."

Stevens (2003: 23) bases his conclusion on the coincidence between the period after inflation targeting was introduced and the fact "that Australia's growth performance in the past decade has been exceptionally good." He produces a table which is an updated version of a table from Brooks (1998) which compares Australia with other targeting and non-targeting countries. We reproduce it as Table 2. He says by way of description of the contents in Table 2 that:

> There are now more inflation-targeting countries than when that study was conducted and, of course, there are more years of experience … The table shows mean and standard deviations for inflation and real GDP growth for two periods: from 1980 to the adoption of inflation targeting, and since the adoption of inflation targeting. The data are for Australia and two country groups: other inflation-targeting countries in the OECD, and other (non-inflation-targeting) countries in the OECD. The essential results are unchanged from those of a few years ago:
>
> - all groups observed a decline in inflation, much reduced inflation volatility, a pick-up in growth and reduced volatility of growth – it was a good period for most economies;
> - compared with non-inflation-targeting countries, inflation-targeting countries saw a bigger reduction in inflation (from a higher starting point), a proportionately larger

reduction in inflation variability, a larger pick-up in growth and a more marked reduction in volatility of growth (again, from a higher starting point); and

- Australia enjoyed a smaller absolute variability in inflation, a bigger pick-up in growth, a bigger reduction in volatility of growth and a smaller absolute volatility in growth than either of the other two groups.

… It is apparent that inflation targeting has been associated not with reduced growth, but faster growth on average and less variable growth, as well as less variable prices.

Clearly, the eyeballing of the data in Table 2 can lead one to draw these conclusions but such an analysis lacks rigour because there is no control exercised. General economic trends in the 1990s have been favourable and we will not fully comprehend the consequences of running an inflation targeting regime with passive fiscal policy until the next serious downturn in economic activity occurs. The conjecture is that the accumulation of household debt and the resulting deterioration in private sector balance sheets that has accompanied this macroeconomic policy stance will result in a very serious recession when demand finally starts to slow.

Recent work by Ball and Sheridan (2003) attempted "to measure the effects of inflation targeting on macroeconomic performance" in 20 OECD economies, of which only seven adopted inflation targeting in the 1990s. To examine whether the introduction of inflation targeting improves economic performance, Ball and Sheridan (2003) ran standard 'differences in differences' regressions - $X_{post} - X_{pre} = \alpha_0 + \alpha_1 D + \varepsilon$, where X_{post} is the value of a variable of interest (for example, inflation, trend inflation, real output), X_{pre} is the value of a variable of interest prior to targeting, and *D* is a dummy variable discriminating between targeters and non-targeters. The coefficient α_1 measures the effect of targeting on variable *X*. They ran several regressions corresponding to different start dates for the pre- and post-targeting periods and also differentiated between targeting countries that had maintained a constant target and those that had varied its target over the targeting period.

To control for the 'regression to the mean' problem (which in this case refers to the fact that "poor performers in the pre-targeting period tend to improve more than good performers simply because initial performance depends partly on transitory factors" (Ball and Sheridan, 2003: 12), the initial value of *X* was added to the differences regression. The coefficient on the targeting dummy variable then indicates "whether targeting affects a country's change in performance for a given initial performance. If α_1 is significant, then a targeter with poor initial performance improves more than a non-targeter with equally poor initial performance. This difference implies the true effect of targeting" (Ball and Sheridan, 2003: 13).

We collate the results presented by Ball and Sheridan (2003: Tables III to XI) in Table 4 below, while Table 3 shows the samples that Ball and Sheridan used. The results confirm that for mean inflation, regression to the mean is strong and the IT dummy is not statistically significant. Most of the change in mean inflation is explained by the initial inflation. Further, there is "no evidence that inflation targeting reduces inflation variability" (Ball and Sheridan, 2003: 17). From Table 4, it is clear that inflation targeting increases variability with the effect being statistically significant for (6)-(4) and marginally so for (6)-(5) and (3)-(1). For average growth and variability of real output, inflation targeting has no statistically significant impact in any sample comparison. For long-term interest rates, the results show that non-targeters enjoy lower rates but the results are not statistically significant when initial values are controlled for. Finally, seeking to shed light on whether, inflation targeting central banks adjust their short-term interest rates more than non-targeting countries, Ball and Sheridan (2003) examined the variability of short-term interest rates. The results show that interest-rate volatility is low for non-targeters but the significance of the effects is eliminated when initial values are taken into account.

Overall, the more formal analysis by Ball and Sheridan (2003) appears to be at odds with the conclusions made by Stevens (2003). We summarise the conclusions of Ball and Sheridan as:

(a) The "economic performance varies greatly across individual countries, both targeters and non-targeters. But on average, there is no evidence that inflation targeting improves performance as measured by the behaviour of inflation, output, or interest rates" (Ball and Sheridan, 2003: 2);
(b) Examining the inflation targeting countries separately they found "that their performance improved on average between the period before targeting and the targeting period … However, countries that did not adopt inflation targeting also experienced improvements around the same time as targeters" Ball and Sheridan (2003: 2);
(c) "For some performance measures, both inflation targeters and non-targeters improve over time, but the improvements are larger for targeters. For example, average inflation fell for both groups between the pre-targeting and targeting periods, but the average for targeters went from above that of non-targeters to roughly the same" Ball and Sheridan (2003: 2-3);
(d) Rejecting the idea that "inflation targeting promotes 'convergence'" Ball and Sheridan (2003: 3) find "strong evidence of generic regression to the mean … countries with high and unstable inflation tend to see these problems diminish, regardless of whether they adopt inflation targeting. Once we control for this effect, the apparent benefits of targeting disappear";
(e) They do not present a "case against inflation targeting" and "do not find that targeting does anything harmful" Ball and Sheridan (2003: 4) rather they conclude "that no major benefits have occurred so far" Ball and Sheridan (2003: 4-5).

3.2 Has inflation persistence been reduced by inflation targeting?

One of the claims made for inflation targeting is that central bank independence and the alleged credibility bonus that this brings should encourage faster adjustment of inflationary expectations to the policy announcements (Walsh, 1995). Andersen and Wascher (1999: 18) argue that this implies that "a high degree of independence shifts the output-inflation trade-off, or the Phillips curve, inwards while at the same time, flattening it."

Ball and Sheridan (2003) compute impulse response functions derived from autoregressive models of quarterly inflation for the 20 countries in their sample (see Table 3) which show the effects of inflation shocks on future inflation. They report that inflation shocks die out slowly but are less important for the targeting period. "Crucially, this pattern holds for both targeting and non-targeting countries … there is no evidence that targeting affects inflation behaviour" (Ball and Sheridan, 2003: 18).

As a test of changing behaviour we ran an AR(4) regression on the annual inflation rate and included level and slope dummy variables for the inflation targeting period in Australia. We constructed the inflation targeting dummy D_IT944 takes the value of 1 after 1994:4 and zero otherwise in line with the inflation targeting periods outlined in Table 1. A dummy variable to control for the introduction of the Goods and Services Tax was also added. The results are presented in Table 5. The results show that the annual inflation rate exhibits extreme (statistically-significant) persistence. Neither the intercept dummy nor the slope dummies for the inflation targeting period was significant suggesting that there was no structural break in the regression coinciding with the introduction of inflation targeting in Australia. We also dropped the dummy variables and tested for structural stability using Chow's breakpoint test (with the break specified at 1994:4). The results confirm that the pattern of inflation persistence has not been altered by the introduction of inflation targeting in Australia.

3. 3 Have inflationary expectations been lowered by inflation targeting?

In terms of inflation expectations, Stevens (2003: 20) claims that the inflation psychology has been expunged from the Australian economy. However, he struggles to explain why the popular inflation expectations series (from Westpac/Melbourne Institute) which records price change sentiments in percent for a year ahead are consistently above the evolution of the actual inflation rate measured as the annualised change in the quarterly Consumer Price Index (see Figure 1b). If the inflationary expectations series is a valid indicator of underlying sentiment in the economy, then consumers are persistently erring in their forecasts, that is, failing to learn. Stevens (2003: 20) claims that "One reason for this is that there continues to be a significant proportion of households who anticipate inflation of 10 per cent or more even after a decade of inflation of 21/2 per cent. Presumably our message has yet to filter through completely."

The other important point to note from Figure 1(a) is that the major mean-shift in inflation and inflationary expectations occurred during the 1991-2 recession and had nothing at all to do with the onset of inflation targeting. In fact, there were no inflationary pressures in the economy (GST period apart) after the 1991-2 recession. So it is hard to attribute the improved inflationary performance to the conduct of monetary policy at all.

3.4 Concluding remarks

There is no hard evidence available at this point in time that can support the rhetoric of the proponents of inflation targeting. Generally, the period in which it has been introduced in Australia has been characterised by a long growth cycle, increasingly tough approaches by government towards labour unions and wage determination, deregulation of many sectors of the economy, and an absence of major cost shocks. The other fact is that high levels of labour underutilisation persist. In the next section we trace the development of the RBA obsession with the NAIRU and its effective adoption of the classical dichotomy. This analysis underpins our largest objection of inflation targeting. Taken alone, inflation targeting does not appear to make much difference. But the discretionary fiscal drag which is its 'ideological partner' has been the principle reason why labour is wasted with abandon in this and other countries.

4. A potted history of the NAIRU obsession in Australia

4.1 The golden years

Mitchell (2001b) argues that the post World War II period was marked by governments maintaining levels of demand using a range of fiscal and monetary measures to ensure that full employment was achieved. In Australia, the Reserve

Bank of Australia (RBA) was constituted to maintain full employment as one of its three policy goals (see Section 10 of the Reserve Bank Act 1959. Subsection 2). Unemployment rates were usually below 2 per cent throughout this period.

The emphasis was on creating enough jobs to ensure all those who were willing to work could find opportunities to be independent of the welfare system. By the early 1950s, the attention began to shift towards a joint goal of low inflation and high employment. The concept of full employment shifted accordingly and we started to appraise macroeconomic policy on its capacity to generate a low *unemployment* rate consistent with some preconceived notion of acceptable price inflation. The Phillips curve industry in the late 1950s and through most of the 1960s was a powerful influence on economic policy making and economists believed that a trade-off between the twin evils of high unemployment and high inflation could be manipulated by fiscal and monetary policy. A delicate balance had to be continually maintained to keep the economy running at the highest pressure consistent with political and social sensibilities.

However, all was not well. Throughout the 1950s and 1960s the economics profession was dichotomised into macroeconomists who were largely considered to be Keynesian in outlook and pursued the trade-off idea, and, neo-classical microeconomists who, believing in the primacy of the private market and the costs of government intervention, considered the Phillips curve trade-off to be short-run at best, illusory at worst. The pressure within the profession to abandon Keynesian activism was intense throughout this period despite the strong growth in private investment and consistently low unemployment and inflation that it seemingly engendered.

4.2 The paradigm shift - the Natural Rate Hypothesis

By the late 1960, the notion of full employment which permitted only small amount of ‘frictional’ unemployment was abandoned with development of the expectations-augmented Phillips curve of Friedman (1968) and Phelps (1967, 1968). This model spearheaded the resurgence of pre-Keynesian macroeconomic thinking in the form of Monetarism. The embedded Natural Rate Hypothesis (NRH) outlined a natural rate of unemployment (NRU), where the inflation-unemployment trade-off was allegedly a trade-off between unemployment and unexpected inflation. As workers gained more information the trade-off vanishes. At this point there is only one unemployment rate consistent with stable inflation – the NRU. Friedman (1968: 60) stated, “There is no long-run, stable trade-off between inflation and unemployment.”

These developments represented a major theoretical break from the previous versions of the Phillips curve. The pre-Monetarist Phillips curve models were based on a disequilibrium notion of the relationship between inflation and unemployment in that they modelled the adjustment of prices and wages to some labour market imbalance between supply and demand. The causality was strictly from the labour market disequilibrium to the price adjustment function. There was no presumption that full employment is inevitable or a tendency of a capitalist monetary economy. The Friedman-Phelps story and the later developments under the rubric of rational expectations and the New Classical School are, instead, based on a market clearing relation and the causality is reversed. Unemployment is considered to be voluntary and the outcome of optimising choices by individuals between work (bad) and leisure (good). In the natural rate world of Friedman and Phelps, the central bank can promote variations in the unemployment rate by introducing unforeseen changes in inflation, a temporary capacity allowed due to expectational inertia on behalf of the workers. There is no theory in the NRH that changes in the unemployment rate cause changes in inflation. Full employment is assumed to prevail (with unemployment at the natural rate) unless there are errors in interpreting price signals. The tendency is always to restore full employment by market mechanisms. There is no discretionary role for aggregate demand management.

These arguments were simply rehashes of discredited pre-Keynesian theory but benefitted from the empirical instability in the Phillips curve in most OECD economies in the 1970s. Any Keynesian remedies proposed to reduce unemployment were met with derision from the bulk of the profession who had embraced the NRH and its policy implications. The NRH was now the characterisation of full employment and it was asserted that the economy would always tend back to a given NRU, no matter what had happened to the economy over the course of time. The path that the economy traced through time was thus irrelevant. Only microeconomic changes would cause the NRU to change. Accordingly, the policy debate became increasingly concentrated on deregulation, privatisation, and reductions in the provisions of the Welfare State (Ormerod, 1994). Unemployment continued to persist at high levels. The fact that quits were strongly pro-cyclical (contrary to the misperceptions explanation of unemployment) made the NRH untenable. However, the idea of a cyclically-invariant unemployment rate, which was consistent with inflation stability, persisted in the form of the NAIRU concept.

4.3 The NAIRU

Modigliani and Papademos (1975) first introduced the NAIRU. Their approach was in the Phillips mould in the sense that movements in the unemployment rate from some steady-state rate (defined in terms of the rate at which inflation was stable) would promote opposite movements in inflation. Modigliani and Papademos (1975: 142) said a NAIRU existed, "such that, as long as unemployment is above it, inflation can be expected to decline". Various theoretical structures support this conclusion. It can arise in a simple excess demand model where wage pressure builds as the labour market tightens and the firms pass the rising costs on in the form of higher inflation (Modigliani and Papademos, 1975). Marxist-inspired models where inflation arises due to incompatible claims on existing real income also can be used (Rowthorn, 1980). Whatever theoretical construct is used to underpin the model the conclusion is simple: there is a defined unemployment rate, which is cyclically-invariant, where price inflation is stable (see Mitchell, 1987a, 1987b for discussion of the importance of the assumption of cyclical invariance).

The notion of a constant NAIRU that conditions the potential for inflation in the economy has dominated public policy makers since the first oil shocks of the 1970s. Monetarist "fight-inflation-first" strategies exacted a harsh toll in the form of persistently high unemployment. Full employment as initially conceived was abandoned (Hughes, 1980).

The centrality of the NAIRU and the resurgence of notions of classical neutrality, at least in the long-run have underpinned the shift in monetary policy towards inflation targeting either implicitly or explicitly as in Australia, New Zealand, Canada and elsewhere (see Table 1).

4.4 The RBA and the NAIRU

The RBA has been significantly influenced by the NAIRU concept. While the RBA legal charter requires it to maintain full employment it is questionable whether it adoption of the classical dichotomy as a theoretical paradigm and inflation targeting as a policy regime keeps it within its legal obligations. The secret is of-course that they have also adopted the slippery notion that the NAIRU (whatever it is estimated to be – see Mitchell, 2001a) as its conceptualisation of full employment.

In September 1996, the Treasurer and Reserve Bank Governor issued the *Statement on the Conduct of Monetary Policy*, which set out how the RBA was approaching the attainment of its three identified policy goals. It elaborated the adoption of inflation targeting as the primary policy target. The RBA (1996: 2) said it had "adopted the objective of keeping underlying inflation between 2 and 3 percent, on average, over the cycle." In terms of the priorities, the Statement said (RBA, 1996: 2):

> These objectives allow the Reserve Bank to focus on price (currency) stability while taking account of the implications of monetary policy for activity and, therefore, employment in the short term. Price stability is a crucial precondition for sustained growth in economic activity and employment.

The rest of the text emphasised the need to target inflation and inflationary expectations and the complementary role that 'disciplined fiscal policy' had to play. There was no discussion about the links between full employment and price stability except that price stability in some way generated full employment even though the former required disciplined monetary and fiscal policy to achieve it. In a stagflation environment and price spirals reflect cost-push and distributional conflict factors, such an approach can surely never work.

How does the RBA answer this apparent contradiction? The RBA says that it only has to meet an average inflation target over a business cycle. Edey (1999), who is the Head of Economic Analysis at the RBA argues that the Bank is sensitive to the state of capacity in the economy when it pursues a change of interest rates aiming at the inflation target.

> Consider, for example, a situation in which inflation is regarded as likely to be too high. A rise in interest rates will help to reduce inflation but can also be expected to reduce growth. How far and how quickly interest rates should be raised will depend partly on how the economy is performing at the time. If the economy is operating with very little surplus capacity or is overheating, a fairly rapid rise in interest rates might be called for; if, on the other hand, there is significant surplus capacity in the economy, the appropriate increase in rates might be more gradual. Thus it makes sense for policy to take account of short-run cyclical developments in pursuing the inflation target.

But in the next paragraph, Edey (1999) says that the trade-off between inflation and unemployment is not a long-run concern because, following NAIRU logic, it simply doesn't exist.

> Ultimately the growth performance of the economy is determined by the economy's innate productive capacity, and it cannot be permanently stimulated by an expansionary monetary policy stance. Any attempt to do so simply results in rising inflation. The Bank's policy target recognises this point. It allows policy to take a role in stabilising the business cycle but, beyond the length of a cycle, the aim is to limit inflation to the target of 2-3 per cent. In

> this way, policy can provide a favourable climate for growth in productive capacity, but it does not seek to engineer growth in the longer run by artificially stimulating demand.

The RBA is silent, however, about the stock of long-term unemployed that exists beyond the cycle. The empirical evidence is clear that the economy has not provided enough jobs since the mid-1970s and the RBA and their partners in austerity, the Federal Treasury have forced the unemployed to engage in an involuntary fight against inflation.

5. Measuring the costs of disinflation – the sacrifice ratio

5.1 The concept of the sacrifice ratio

The sacrifice ratio is defined by Neely and Waller (1996: 2) as the "cumulative loss of output during a disinflation episode as a percentage of initial output divided by the cumulative reduction in the inflation rate. Thus, a sacrifice ratio of three implies that a one-point reduction in the trend inflation rate is associated with a loss equivalent to 3 per cent of initial output."

Empirical research has found that disinflations are certainly not costless (for example, Ball, 1994; Zhang, 2001; Boschen and Weise, 2001). Computed sacrifice ratios provide rough estimates of the cost of maintaining low inflation. "Ball's sacrifice ratios estimate that the cost of each percentage-point permanent reduction in US inflation is about 2 to 3 percentage points of output growth lost. This implies the price for a move from 3 percent inflation to zero inflation is around 7.5 percentage points of initial output – a heavy price in lost output and unemployment" (Neely and Waller, 1996: 9).

In Figure 2, we present a graphical depiction of the sacrifice ratio concept. The cumulative output loss as a consequence of the actual output falling below potential output is depicted by the shaded area. In this diagram, output resumes at its potential level at the exact end of the disinflation period (defined as the period between the peak inflation and the trough inflation). In the real world, there is considerable debate as to when the disinflation ceases to influence the actual output path. Persistence is built into most methods of sacrifice ratio estimation meaning that actual output is assumed to remain below potential after the disinflation period has finished. The longer this disparity exists the longer is the persistence. At a more extreme level, hysteresis theories purport permanent losses of trend output as a consequence of the disinflation.

While the concept of the sacrifice ratio is clear from Figure 2, in practice computation must employ a number of (more or less) *ad hoc* assumptions about: (a) trend inflation; (b) trend or potential output; and (c) episodes that can be deemed disinflations. There is the additional problem of netting out policy-induced episodes from those that might be provoked by external shocks (cost shocks).

The computations of the sacrifice ratio have been found to be sensitive with respect to the assumptions employed leading Neely and Waller (1996: 6) to say that "the robustness of these estimates is a serious matter: They may overestimate the true sacrifice ratio if they ignore the role of real shocks to the economy, or they may underestimate the true cost for other reasons. Using other estimates of trend output dramatically illustrates that sacrifice ratios are really back-of-the-envelope calculations and are subject to a great deal of uncertainty."

In this section we outline the different methods we use to compute the sacrifice ratios for G7 countries and Australia (a sample which mixes targeting and non-targeting countries).

5.2 Episode-specific methods of sacrifice ratio measurement

Ball (1994) introduced what has been termed an "atheoretical approach" (Filardo, 1998: 36) as a reaction against criticisms of the linear Phillips curve approach. He notes that the Phillips Curve approach constrains the output-inflation trade-off to be the same during disinflation episodes as during increases in trend inflation and fluctuations in temporary demand (Ball, 1994: 156). It also constrains the sacrifice ratio to be the same for all disinflations within the sample. Ball employs what he calls the episode specific approach which allows for comparisons of sacrifice ratios (the actual change (decline) in real output during designated disinflation episodes) across countries and time-periods to see if there is any systematic variation.

Jordan (1997) approached the problem from the other direction and estimated the output gains during an inflationary episode. The US output change was estimated to be 1 per cent per percentage point of higher inflation, which taken together with Ball's previous work (which computed a sacrifice ratio of 2.4 for the U.S) suggested that any assumption of linearity in the relationship is problematical.

Defining the disinflation episodes

Ball (1994: 4) begins by identifying the disinflation episodes which are defined as "episodes in which trend inflation falls substantially." We define the annual inflation rate as the $\dot{p}_t = \ln\left(p_t / p_{t-4}\right)$. Trend inflation in each period I_t^T is then defined as a centred, nine-quarter moving average of actual inflation:

(1) $$I_t^T = 1/9 \sum_{i=-4}^{4} \dot{p}_i$$

Ball (1994: 4) argues that this computation "captures the intuition that trend inflation is a smoothed version of actual inflation. I doubt that other reasonable definitions would produce substantially different results."

Peak inflation quarters are then derived from the trend inflation series when a quarter is the highest inflation rate compared to the previous and next four-quarters. Similarly, a trough is defined as the lowest inflation rate compared to the previous and next four-quarters. Following Ball (1994: 4) a disinflation episode "is any period that starts at an inflation peak and ends at a trough with an annual rate at least two points lower than the peak. These definitions assure than an episode is not ended by a brief increase in inflation in the midst of a longer-term increase." Thus an individual disinflation must show an inflation difference of at least 2 points between the beginning and ending points. This also ensures that the disinflation in a policy-induced rather than a contraction in demand. In some cases researchers have relaxed this requirement 'a little' to include, for example, a 1.7 percentage point drop (Boschen and Wiese, 2001). In this paper, we have strictly followed the 2 per cent rule.

Modelling trend output

To compute the sacrifice ratios, a measure of trend (potential) output is required as a comparison with the path of actual output. Ball (1994: 160) refers to this as "the most delicate issue" in the exercise. Standard approaches to computing potential output series which are common in OECD publications and elsewhere include: (a) linear trend fitted from peak-to-peak and variations (Ball, 1994); (b) linear filters computed using the Hodrick-Prescott (HP) formula (Zhang, 2001); (c) forecasts from peaks using from autoregressive models of log output (Boschen and Wiese, 2001).

Ball (1994) computes the SR for each disinflation period as the ratio of output loss over the period to change in trend inflation. Ball (1994: 5) says the "numerator is the sum of output losses – the deviation between actual output and its 'full employment' or trend level.' As in many instances where a full employment or potential or capacity aggregate is required (for example, in Okun coefficient studies) the vexed issue is the manner in which this aggregate is measured. While it is reasonably clear in concept, the various empirical applications that have been implemented all give trends that influence the computation of the sacrifice ratio.

Ball (1994: 5-6) says that these "standard approaches to measuring trend output do not yield appealing results in this application … they appear to understate or even eliminate recessions." Using NAIRU-logic (where output must be at its 'natural' level if the change in inflation is zero), Ball initially assumes that capacity output coincides with the inflation peak which begins each disinflation episode. Rather arbitrarily, Ball (1994: 6) then assumes that "output is again at its trend level four quarters after the end of an episode", which appears to be inconsistent with the previous NAIRU-logic because inflation once again stabilises at the trough. Ball (1994: 6) explains this inconsistency by noting that "the effects of disinflation are persistent: output appears to return to trend with a lag of about a year. The return to trend is indicated by above-average growth rates in the years after the trough."

Ball (1994: 6) joins the two 'peak output' points assuming that "trend output grows log-linearly between the two points when actual and trend output are equal." Ball (1994: 6) then computes the "numerator of the sacrifice ratio … [as the] … sum of deviations between this fitted line and log output."

<u>Zhang (2001) method for computing trend output</u>

Zhang (2001) follows Ball (1994) in assuming that output is at its natural level at the start of the disinflation episode. However he notes that Ball's method contains a number of restrictive assumptions, which may lead to an underestimation of true sacrifice ratios. Sacrifice ratios depend very much on the measurement of potential output; a log-linear growth rate produces a conservative estimate of trend output in the presence of persistence. Zhang (2001: 5) says that "persistence causes output to stay low. The standard method's straight forward assumption that actual output returns to its potential level four quarters after the trough results in a lower potential sacrifice ratio than it should be and a downward bias is generated. The true sacrifice ratio could be the reversal."

Assuming potential output grows log-linearly between the peak and the trough leads to conservative estimates of the sacrifice ratio because output four quarters after the trough may still be below potential, having been adversely affected by the diminished output of previous periods (see Figure 3). The counter argument is that long-lived effects of output loss in different episodes move together, so in relative terms you needn't worry about them (Ball, 1994). Zhang (2001) shows that even using a range of common methods to predict potential output (HP filter, quadratic and ARIMA models) the downward bias problem is found to exist in the standard method and that the relative impacts across episodes do differ.

Rather than having output growing log-linearly between the peak and the end of an inflation episode, Zhang projects potential output using the growth rate of the Hodrick-Prescott (HP) filter and uses the growth rate prevailing at the inflation peak, to extrapolate (forecast) potential output as a constant growth rate series.

Zhang notes that there is a potential for downward bias in the new method since the HP filter is affected by recessions. In a series with a large number of recessions, or large recessions, filtered real GDP will be lower than it would be otherwise since the HP filter aims to minimise deviations from trend. Zhang notes that this kind of potential bias can be limited by using a 'one-sided' HP filter. That is to say, for each episode, an HP filter is used up to the beginning point of the episode, not through the whole sample. Thus the HP filter will not be affected by the recession in a following period, and this is the method we have employed here. Zhang also tests the sensitivity of the HP filter to recession by using 1600 (the standard quarterly parameter) and 16000 as the smoothing parameters, the latter generating a more smoothed series and being the least affected by recession.

Zhang (2001) then computes the sacrifice ratio for Ball's disinflation period concept (inflation peak to trough plus 4 quarters) using the different method of trend output derivation and considers this to be the short-term loss. He thus considers Ball (1994) conflates the short- and long-term losses because it assumes there is no further output loss beyond the four-quarters after the inflation trough. If there are strong persistence effects then the short-term loss will be less than the overall cost. The sacrifice ratio in the face of persistence becomes specified in terms of short-term losses.

<u>Hysteresis extension</u>

Zhang (2001: 9) extends the persistence idea to the 'extreme case' of hysteresis. While the persistence of the departure of actual real output from potential output is a concern, the presence of hysteresis would mean that disinflation impacts negatively on potential output itself. Ball (1994: 7) ignores this issue by assuming "that trend output is unaffected by disinflation." Zhang (2001: 1) argues that "demand shifts may reduce output permanently. That is, contractionary monetary policy can reduce trend output as well as cause temporary deviations from the trend. It is likely that a larger recession leads to a larger permanent loss." Romer (1989) argued that contractionary monetary policy is not only associated with temporary deviations between trend and actual output but also permanently reduces the trend output path.

To see the implications of this for the different methods of computing the sacrifice ratio we use the familiar Lucas supply curve model (Zhang, 2001). The gap between potential (y_t^*) and actual output (y_t) is written as:

(2) $$\left(y_t - y_t^*\right) = \alpha \Delta \dot{p}_t + \beta \left(y_{t-1} - y_{t-1}^*\right) \qquad \alpha > 0, \quad 0 \le \beta < 1$$

where $\dot{p}$ is the rate of inflation, Δ is the difference operator, and the parameter β represents persistence (the extent to which output departs from trend after a disinflation period). We ignore any stochastic component in Equation (2) and assume all values are in logs.

The sacrifice ratio for a given disinflation (from *P* to *T*) is computed as:

(3) $$SR = 100 \sum_{t=1}^{n} \left(y_t - y_t^*\right) / \left(\dot{p}_P - \dot{p}_T\right)$$

where n is the number of periods from time t that real output is negatively affected by the disinflation (assumed in most studies to be the period that real output deviates from its potential or trend level); P is the inflation peak and T is the trough. The relationship between T and n is dependent on the assumption that is made about the behaviour of real output and trend output over the disinflation period. For example, in Ball (1994) n occurs 4 periods after T.[6]

The problem with Equation (2) is that the trend output level is assumed to be unaffected by the cyclical events that impact on actual real output. Mitchell (1993) demonstrated the difference between persistent and hysteretic time series processes. Some have considered hysteretic processes to exhibit extreme persistence. In Equation (2) the costs of disinflation are ephemeral (permanent but finite). To capture the notion that the disinflation could also impact negatively on trend output Equation (2) is supplemented with a hysteresis equation (derived from Mitchell, 1987a).

$$(4) \qquad y_t^* - y_{t-1}^* = g^* + \lambda\left(y_{t-1} - y_{t-1}^*\right) \qquad 0 \le \lambda \le 1$$

Equation (4) is consistent with Equation (4) in Zhang (2001). It says that the growth in potential (trend) output is assumed to be some constant growth rate (g^*) plus or minus the deviation of actual and potential output in the previous period. So if actual output falls below potential, the overall growth in capacity output declines. The higher is the hysteresis parameter λ, the larger is the impact of the disinflation on the trend output path. If $\lambda = 1$, the departure of actual output from potential will be fully transmitted (negatively) on the growth in capacity output. If $\lambda = 0$, then there is no endogenous (hysteresis) impact of disinflation and the sacrifice ratio is maximised according the parameters α and β. If $\lambda \neq 0$, the sacrifice ratio is reduced for a given disinflation period, other things equal.

Equation (4) can be re-written as:

$$(4a) \qquad y_t^* = g^* + \left(1-\lambda\right) y_{t-1}^* + \lambda y_{t-1}$$

which shows that potential (trend) output is a weighted average of its past value and last periods actual output plus some constant growth component (which we may assume to be zero for the purposes of the discussion).

Actual output in each period is thus:

$$(5) \qquad y_t = g^* + \left(1-\lambda-\beta\right) y_{t-1}^* + \left(\lambda+\beta\right) y_{t-1} + a\Delta\dot{p}_t$$

This is a testable hypothesis conditional on y^*. In Figure 3 the extra output losses which accumulate in the long run are shown as a decreasing cumulative function of past output losses. An obvious problem with calculating long term loss is that there is more uncertainty about potential output and in the short-run it is easier to argue that the essential reason for the recession is the monetary contraction (Zhang, 2001: 4). Another problem is whether actual output will return to the potential level. For this reason most researchers have estimated sacrifice ratios in the short-run, Ball (1994), Jordan (1997) and Boschen and Weise (2001).

6. Results of sacrifice ratio estimation

6.1 Disinflation episodes

Applying the standard method to trend inflation we ascertain disinflation episodes (peaks and troughs) for G7 countries and Australia (see Table 6 and Appendix A for data sources). As already mentioned the episode specific calculation of sacrifice ratios, while atheoretical, is heuristic in nature. Although Ball's 2 per cent rule aims to sort out minor inflation fluctuations from policy-induced disinflations, we cannot be sure that all of the 26 episodes we have identified are the result of deliberate contractionary monetary policy. For this reason Ball checks the historic record for each of his 28 disinflations identified in his quarterly dataset. He finds that in every case there is a significant tightening of monetary policy near the start of the disinflation. He notes that the motivation for tight monetary policy is either to reduce inflation or support the domestic currency and that declines in inflation from supply shocks are small and transitory and are deliberately not identified by the 2 per cent rule. (Ball, 1994:160) finds his disinflation episodes closely correspond to the lists of disinflations developed by Romer and Romer (1989) and Fernandez (1992). As Ball's episodes accord with ours we might also conclude that we are looking at periods of disinflation which are the result of contractionary monetary policy. Zhang also checks historical records for each of the disinflationary episodes, and notes that there is a significant tightening of monetary policy "near the end of the beginning of disinflation", concluding that demand contractions are essentially the only source of the two-point decline in disinflation.

Much Australian literature provides evidence that disinflation episodes resulted from deliberate policy-induced monetary contractions. Junor (1999: 41) writes that "both fiscal and monetary policy settings were tightened in the second half of the 1970s and into the 1980s…with targets being met in only one year." This coincides with the first disinflationary episode we identify for Australia (1975:1 to 1978:4). Argy (1992: 187) also notes that for a year or so after 1973 monetary policy became extremely tight and much tighter than abroad. In 1974 growth in M3 was 10.8 per cent. Looking at the Fraser government's record, monetary policy was substantially tightened in the first two years of the 1970s and then eased progressively in the three years to 1980-81 after which it was tightened again (Argy, 1992: 194), which accords with the second Australian disinflation episode we identify (1982:3 to 1984:4). For the financial year 1983-84 the announced target growth rate of M3 was in the range of 9-11 per cent (Argy, 1992: 201). During 1988, prior to the our third identified disinflationary episode (1989:2 to 1993:1), monetary policy was tightened progressively, forcing interest rates to rise in response to an increasing current account deficit (Junor, 1999: 43). There is also significant evidence that Australia's disinflationary episode 1995:3-1998:2, followed directly from high real nominal interest rates deliberately created to slow the economy, although the recessionary impact of this monetary stance in the early 1990s was exacerbated by a constrained fiscal policy (Mitchell, 1999). Junor (1999: 43) also notes "that a tightening of monetary policy" in this period "had caused a small increase in the unemployment rate."

Analysis of short-term interest rates reveal upward interest rate movements have preceded all of the disinflation episodes in the 1970s, 1980s and 1990s with the exception of the 1990:2-1994:4 disinflation episode in the US.[7] There was not a significant short-term interest rate rise prior to this disinflation episode (although Zhang has included this episode in his analysis). Interest rate changes were rapid preceding the disinflation of the 1970s, in France short-term interest rates rose to between 11 and 14 per cent. Rates rose to very high levels in Australia, Germany, Italy (close to 20 per cent), the US and Japan preceding the disinflation episodes of the early 1980s. Rate rises, while still significant, were more moderate prior to the disinflation episodes of the early 1990s, rates in most countries were around 6-8 per cent.

Ball's (1994) sample is obviously shorter than the sample we have examined here but the disinflationary episodes are reasonably similar. The dates of our trend inflation peaks and troughs are slightly later than those of Ball (who uses 1991 IMF International Financial Statistics) probably due to revisions in the data.[8] The notable difference between the timing of our episodes and Ball's are the episodes Ball records in 1960's and early 1970's for Germany, Japan, US and UK. While we record trend inflation peaks and troughs corresponding to these episodes, in the absence of a 2 per cent decline in inflation between the peak and trough we do not classify these as disinflationary episodes.[9] Another significant difference between the timing of our episodes and those of Ball is the Japanese disinflationary episode of 1980:4 to 1987:4 (although this is consistent with Zhang). Ball records two separate disinflationary episodes over this time frame one in 1980:2 to 1983:4 and one in 1984:2 to 1987:1. However Ball states that "If a trough and its peak are within 4 quarters and also the difference between the trend inflation at the trough and its next peak is less than two points, then regard it as the same episode". Zhang notes that this new rule is to ensure that the choice of an episode is not affected by the noise in the data. The change in Zhang's results made one episode out of two episodes in the UK in the 1980s (Zhang, 2001: 12). Data differences are most likely the cause of discrepancies in timing, Zhang notes the sample range of the US disinflations is different amongst authors since they use different data sets – so noise is likely to be a possible source of error for most researchers applying the episode specific methods (see also Boschen and Weise, 2001; Neely and Waller, 1996; and Zhang, 2001).

6.2 GDP movements and inflation

In calculating sacrifice ratios over the period from an inflation peak to four quarters after the trough, Ball's method assumes that disinflation impacts directly on GDP (and in a sense other factors are held constant). As mentioned, it also assumes that real GDP is at its trend value when inflation is at its peak, because trend output is the level of output when inflation is neither rising nor falling and this is when inflation is at its peak. Thus changes in GDP and inflation rates are relatively synchronised.

However the question arises as to whether the peaks and troughs in GDP coincide with peaks and troughs in inflation? Theoretically it is likely that the downturn in GDP would precede a decline in the rate of inflation depending upon how quickly the interest rate rise impacts on rates of investment, unemployment, wage demands and prices. This has implications for Zhang's method of projecting trend output, which takes the growth rate of log real GDP at the peak of the disinflation period - that is when inflation is at its peak - as the rate of growth of the projected potential output.

Table 6 below examines the timing of business cycle swings against the dates of disinflation peaks and troughs already identified. GDP peaks and troughs are determined using real GDP and applying the method explained in Mitchell (2001a) where a 'local peak' is a period in which real GDP is higher than at least the preceding or proceeding 8 quarters in total, and a 'local trough' is a period where real GDP must be lower than the preceding or proceeding 8 quarters in total. While there is a rough correspondence between disinflationary episodes and business cycle swings, the exact date of business cycle peaks/troughs and trend inflation peaks/troughs is rarely the same.

For Australia, business cycle peaks predate inflation peaks and the cycle has a longer duration than the accompanying disinflationary episode, suggesting that perhaps there is some persistence in GDP downturns.[10] For Canada and France, business cycle peaks predate peaks in inflation and the duration of cycles is shorter than the disinflationary episode. This is also the case for Germany this is also the case, although troughs in GDP are also recorded in 1977:3, 1980:4, 1993:2 and 1996:1. Italy's GDP peak predates its disinflationary episode in the 1970s. There is little correspondence between early 1980's and 1990's Italian business cycle and the late 1990s Italian GDP peak lags the inflation peak. Japan's GDP peak predates the inflation peak in the 1970s episode, and there is no noticeable business cycle swing to accompany the disinflationary episode in the 1980s. The Japanese GDP peak in the 1990s lags the peak in inflation, and business cycle swings of the late 1990s and early part of this decade have occurred without accompanying declines in inflation. For the UK, their business cycles are much shorter than the accompanying disinflation periods and GDP downturns tend to slightly predate downturns in inflation. For the US, the business cycles in the 1960s occur independently of a policy induced disinflationary episode, as they do in the UK.[11] There is reasonable correspondence between the disinflationary episodes (the timing of the 1980:3 inflation and GDP peak is exactly the same), however GDP peaks the late 1970s and late 1990s lag inflation peaks. The business cycle is much longer than the disinflationary episodes in both the early 1990s and 1970s period, while in the 1980s it is much shorter. From the early 1990s, the peak to GDP trough almost spans a decade, which is much longer than the disinflationary episode of 1990:2 to 1994:4.

6.3 Standard method - Results

Following Ball (1994) we estimate separate ratios for each episode to see whether the ratio varies systematically, within and across countries, results are presented in Table 7. For most countries we have identified three to four disinflation episodes – the highest number of episodes are in Australia and Italy. In all 26 episodes are identified. Our results show that disinflations are not costless; the average ratio for all countries is 1.37 which is very close to the Ball (1994) average of 1.4. That is on average reducing trend inflation by one percentage point results in a 1.4 per cent cumulative loss in real GDP.

The estimated GDP sacrifice ratios differ substantially between countries. Of any individual episode the highest sacrifice ratio is 4.8 in Germany in 1973:4 to 1978:2, followed by a ratio of 4.0 in the US 1990:1 to 1995:4, 3.44 in Canada in 1990:3 to 1994:1 and 3.27 in Japan for 1980:4 to 1987:3. Negative sacrifice ratios are recorded in three cases: Canada 1975:1 to 1978:2, Italy 1975:4 to 1978:3 and the UK 1975:2 to 1978:3.

Looking at the average rates for countries across episodes Germany ranks highest (2.7), followed by US (1.9), Japan (1.8), Canada (1.6), France (1.58), UK (1.0), Australia (0.9) and lastly Italy (0.5). Interestingly Ball (1994) ranks the UK as the second lowest; however his sample does not include data on the relatively large sacrifice ratio recorded in the early 1990s.

Over the 1970's, 1980's and 1990's sacrifice ratios have increased sizeably, the average ratio in the 1970s was 0.7, in the 1980s this figure was 1.6 and by the 1990s the average for the eight countries was 3.5. During the Australian disinflationary episode of 1995:3 to 1998:2, reducing the inflation rate by one per cent resulted in twice (0.54 per cent) the cumulative loss in real GDP that resulted from a one per cent drop in inflation in 1975:1-1978:4.

Table 7 also reports results for sacrifice ratios calculated using the standard method applied to industrial production data. Sacrifice ratios from industrial production data are significantly larger than those calculated using GDP, as measures of industrial production exclude the less cyclical service and government sectors. Accordingly the average industrial production sacrifice ratio is 2.46 for the eight countries across all the episodes, almost double the average for the sacrifice ratios calculated using real GDP[12]. The highest sacrifice ratio for any particular episode is 7.7 in Germany in 1973:4 to 1978:2. Averaged over all episodes Germany (5.26) ranks highest followed by Japan (4.7), US (4.1), Canada (2.7), UK (1.23), France (0.6) and Australia (0.5). Italy records a negative average sacrifice ratio for industrial production. In Italy the average is -0.7, largely due to a strongly negative ratio in 1963:4 to 1968:4.

Industrial production sacrifice ratios have also increased steadily over the decades. The average for the 1970s is 1.7; this figure is 2.2 in the 1980s and 3.3 in the 1990s.

6.4 Sacrifice Ratios with long-lived effects – results

Following Zhang (2001) we apply a HP filter to real GDP and use two smoothing parameters of 16000 and 1600. We keep Ball's assumption that potential output peaks at the beginning of the episode, when trend inflation is at its peak. We also initially employ Ball's timeframe for the disinflation episode, the sacrifice ratio is estimated from the peak to 4 quarters after the trough. In this context we will refer to this as the short run. We use a 'one-sided' HP filter, which, as mentioned, means we compute for each episode the HP filter version of log real output up to the inflation peak and then extrapolate potential output on the final growth rate.

Theoretically Zhang's method should produce larger sacrifice ratios than Ball's when estimated over Ball's disinflation timeframe. However this rests on the assumption that GDP is at its peak when inflation is at its peak. As Zhang notes if an incorrect beginning point is chosen due to noise in the data, trend output calculated by the new method will make a parallel shift up or down. In such a case trend output calculated by the standard Ball method will only make a partial shift. We know from the analysis of GDP and inflation peaks in Table 6 that inflation and GDP peaks rarely coincide and that GDP peaks often precede inflation peaks. Noise in the data might also be problematic as indicated by differences in sample ranges of the disinflation episodes between datasets.

Preliminary results suggested that this problem was relatively common in our dataset with trend GDP calculated from peak inflation often below trend output generated by the standard method.[13] For example, Figures 4 and 5 show trend output projections (HP 1600 and HP 16K) for Australian and France, estimated using the growth rate of the HP filter from the peak onwards, along with Ball's log linear projection and log real GDP. These are visibly below Ball's log linear growth for this episode, and fall quickly below actual real GDP.

Table 7 show that both of the new sacrifice ratios are, on average, significantly larger than the average of the Ball ratios - 1.56 for HP 1600 and 2.21 for HP 16000 - suggesting persistence is leading to larger output losses in disinflationary episodes.

From the country-averages, we conclude that not all of the new ratios suggest that output losses have been underestimated by the restrictive assumptions concerning trend output adopted by the standard method. Smaller ratios occur in France, Italy, Australia, Canada, UK and the US using the HP 1600 smoothing parameter. This is offset by much larger ratios in Germany and Japan. Thus Zhang's estimation method results in negative sacrifice ratios, using the HP 1600 filter in France and Italy, where the standard method produces small negative or small positive GDP. Zhang notes that this problem relates to the use of the HP 1600 series, and its being more affected by recessions. Although in our analysis, the use of the 'one-sided' HP filter was intended to overcome this problem. Sacrifice ratios calculated using the HP 16K parameter, are possibly more appropriate and only France, Australia's and Italy's new sacrifice ratios are smaller than those produced by the standard method.

To correct for the problem of trend inflation and trend real GDP not necessarily coinciding, Zhang (2001) suggests modifying the sacrifice ratio computation.[14] The modification involves testing the sensitivity of the episode span by trying different starting points (beginning from one quarter to four quarters earlier than the starting point determined by the peak) and taking the average of sacrifice ratios. We intend to explore this amended method in future research. Neely and Waller (1996: 7) also explore changing assumptions of timing, by measuring output losses 4-quarters before disinflation, and find this reduces the size of estimated sacrifice ratios using the standard method.

6.5 Long-term loss

Zhang (2001) also draws an important distinction between short-term and long term loss (see Figure 3). Short-term losses are output losses from the inflation peak to four quarters after the inflation trough, while the long-term loss includes output loss after the four quarters beyond the trough. By relaxing Ball's restrictive short-run assumption, long-run output may return to trend anytime after the trough.

The sacrifice ratio now becomes:

$$(6) \qquad SR_{LR\,Zhang} = \sum_{t=S}^{E+X} \left(y_t - y_t^* \right) \Big/ \left(\pi_t - \pi_{t-1} \right) \qquad \beta^X \approx 0$$

Where x is the time when actual output returns to trend which may be anytime after the trough, y_t^* is potential output which is now projected using HP filter and the change in trend inflation is simply the difference between peak trend inflation and the trough, as is the case in the standard method. The constraint that β^X tends to 0 reflects the assumption that actual real GDP returns to its potential level at some point.

Preliminary results are presented in Table 8 (given the downward bias in the HP 1600 series only the HP 16000 series has been reported), we have maintained an assumption that output can return to trend anytime after the trough, although not before. The average sacrifice ratio over all episodes is 3.2, although this result is influenced by an extremely large sacrifice ratio in Germany. If it is to be believed the disinflationary episode beginning 1973:4 - resulted in 64 quarters where GDP was below trend. Outside of Germany the highest long-run sacrifice ratios are found in US where GDP remained below trend for most of the 1990s following the disinflation of 90:1-93:4. Interestingly the average duration of disinflationary episodes when there is no restriction on when output returns to trend is 22.7 quarters, only slightly higher than the average duration of the standard method. Looking at the magnitude of the ratios however Ball's assumption that output returns to trend four quarters after the trough may be leading to conservative estimates of the true costs of disinflation, depending on the presence of persistence operating in the long run.

The problem, already flagged, that actual output might never return to trend occurs in a number of episodes in our data – following the disinflation episode beginning in 1980:4 in Germany actual output does not return to trend. Likewise actual output remains well below trend following the Japanese disinflation beginning 1974:2.

6.6 Boschen and Weise - results

Boschen and Weise (2001), hereafter BW, produce estimates of sacrifice ratios, using a revised measure of trend output, based on a simple forecasting method. They estimate trend output over the entire sample period for each country, using a 16 lag univariate autoregression of log output over the twelve quarters following the start of a disinflation episode.[15] The numerator of the sacrifice ratio becomes the difference between the forecasted and actual log of output over the twelve quarters. Given the average length of the disinflation episodes from peak to trough in our sample is 22 quarters, calculating output over 12 quarters may produce conservative estimates of sacrifice ratios. It is not clear why twelve quarters becomes the period for the disinflation episode, and it seems rather arbitrary, although we have followed this rule here. The denominator is simply the difference between trend inflation at the peak and trend inflation at the trough, as is the case in the standard method. This method is applied to real GDP data and industrial production data over the sample, both results are presented in Table 7 below. As found in the standard method, sacrifice ratios calculated using industrial production data are higher than those calculated using real GDP; industrial production fluctuates with the business cycle.

The correlation between real GDP sacrifice ratios using the standard method and BW's method is approximately 0.5. Using industrial production data, BW estimate sacrifice ratios for 19 countries and 62 episodes and report a very similar correlation with the standard method - 0.54 across episodes. Comparing our results for industrial production data we get a somewhat lower correlation with the standard method - 0.35. The difference in correlations between BWs estimates and ours is due to large negative industrial production sacrifice ratios recorded in France 1975:1-1977:4, Italy 1995:2-1998:3 and particularly Japan 1990:3-1995:3 (-6.94 compared to 6.76 in the standard method).

Comparing the magnitude of estimated sacrifice ratios to the standard method where trend output takes the form of log linear growth, the country averages are significantly higher than we would expect when trend output is a function of its lagged values. [16] This is particularly the case in Australia (and in Canada and US for industrial production data). Trend real GDP calculated as a function of its lagged-values is relatively high in Australia throughout 1980s and 1990s, resulting in larger sacrifice ratios than the standard method. Japan and France are also exceptions. In Japan's case, the BW country average is dramatically lower for industrial production data (-0.42 compared to 4.7), leading to lower sacrifice ratios across countries over all episodes than under the standard method. Under the new method sacrifice ratios calculated from real GDP are higher in Australia, Italy and the US, but are lower in

Germany, France and significantly lower in Japan. The overall across country and episode average for real GDP is slightly lower under the new method (1.14) than under Ball's standard method (1.37), contrary to the findings of BW (2001: 329). Comparing BW sacrifice ratios over time we find that the average for the 1970s is 0.46, the average for the 1980s is 1.94 and the average for the 1990s is 0.87.

In our data BW's method has produced some interesting results. Generally sacrifice ratios are larger, but in contrast to the standard method large negative sacrifice ratios are computed in some countries. These results might be attributable to the somewhat arbitrary 12 quarter disinflation period; in shortening the disinflation period this rule may have contributed to the lower sacrifice ratios than if the Ball time-horizon were applied.[17] Recalculating these ratios from the inflation peak to the trough plus 4 quarters, produces much larger results – the across country average is 2.13 for GDP data and 3.92 for industrial production data. The new BW estimates are larger for all countries than under the standard method, the impact of negative ratios in Japan and France is more or less eliminated when averaged over episodes. Sacrifice ratios are larger in Australia, Germany (although there is a large negative ratio in the 1990s), Japan in the 1980s and the US. In the US 1989:4-1994:3 disinflation episode, a one percent fall in inflation resulted in a 10.74 per cent cumulative decline in real GDP (the figure for industrial production data is a huge 27.5 per cent).

6.7 Has inflation targeting made a difference?

The new wave of data available for the 1990s allows us to crudely assess the proposition that inflation targeting has lowered the costs of disinflation. The summary results are presented graphically in Figure 6. Australia, Canada, and the UK, who announced policies of inflation targeting in the 1990s, do not have substantially lower sacrifice ratios compared to G7 countries who did not announce such policies. Australia does record a lower average ratio during the targeting period than in the 1980s, averaged across the three methods it is 1.2 per cent, however this figure is not lower than the average for all previous periods. Canada records a higher sacrifice ratio in the 1990s of 3.6 per cent. The ratio for the UK during inflation targeting is significantly higher at 2.5 per cent (relative to quite low sacrifice ratios in previous periods). Meanwhile Italy, Germany, Japan and the US, average 0.6, 2.3, 2.9 and 5.8, respectively. Thus inflation targeting does not appear to have produced better outcomes in terms of reducing the costs of disinflation (although obviously we have not controlled for other factors). Changes in the coefficients of factors known to impact on sacrifice ratios - speed of disinflation, wage rigidities, initial inflation - may be influential, particularly given sacrifice ratios have been increasing for all countries over the 1990s.

6.8 Conclusion

The results show that disinflation episodes are certainly not costless. A one percent reduction in the rate of inflation leads to a real output loss of between a half and two and a half per cent. Once persistence is taken into account, sacrifice ratios range between -1 and 6 per cent. That anti-inflationary policy generates sizeable losses in output and employment, raises the question of what the benefits from low and stable inflation are? Neely and Waller (1996) attempt to estimate the potential growth rate effects from low inflation and conclude that the central banks (and governments) are not irrational in pursuing monetary policy, despite the estimated sacrifice ratio effects. They calculate benefit ratios, GDP gains from periods of inflation, using Barro's

(1995) method of estimating growth effects, to address the perceived asymmetry in focusing on periods of disinflation (see also Jordon, 1997). Junor (1999: 47) notes that it is likely that the present value of “transitory” output losses, in the upper range of estimates, would exceed any permanent output gains. Moreover inflation-targeting policies adopted by the UK, Australia and Canada (among others) in the 1990s, appear to have done little to reduce the size of these ratios.

Our estimated sacrifice ratios are very similar to Ball’s and have produced similar rankings. The episode-specific approach highlights differences across countries and periods – consistently larger sacrifice ratios are found in Germany and Japan, lower in and sacrifice ratios for all countries have been increasing rapidly in recent decades.

The standard method does contain a number of restrictive assumptions, particularly that output is at trend when inflation is at its peak, that trend output for each quarter of the disinflation episode is the compound growth between these values, and lastly that actual output returns to trend four quarters after the trough. The ‘trough quarter plus four’ rule does not necessarily capture the full period in which GDP departs from trend (persistence). It is possible, also, that in some cases the method may overstate the duration of the downturn.

The application of Zhang’s method in the short-run and the long-run produces larger sacrifice ratios (although initial results suggests that this is not uniformly the case across countries) and confirms Zhang’s original finding that the standard method does not make sufficient allowance for long-lived negative effects of persistence. It also suggests that Ball’s (1994) method has a downward bias for countries with long-lived effects. Table 9 shows the differences in rankings of countries using the two methods.

It is not clear from our research as to why sacrifice ratios have been increasing in recent years. Increased nominal rigidities (as inflationary expectations are reduced) have been suggested (Boschen and Wiese, 2001). Zhang (2001: 12) notes the larger sacrifice ratios found in the US in the 1990s are most likely due to the slow down in the recovery of US economy rather than growth rates in the trend output. For most countries, Zhang’s method forecasts much lower rates of growth than in the 1990s, but actual output is so much lower, in this way larger sacrifice ratios are computed.

Results from Boschen and Weise (2001) suggest that projecting trend output using a lagged autoregressive model produces higher sacrifice ratios than the standard approach and further highlights the tendency of the standard method to produce conservative estimates of the costs of disinflationary monetary policy. However the large negative sacrifice ratios found in some countries and the large sacrifice ratios obtained in Australia, suggest that when potential output becomes a function of its lagged values (for 16 quarters), the estimated sacrifice ratios can increase substantially or decrease substantially.

7. Wage and price Phillips curve estimates of the sacrifice ratio

7.1 A structural model of wage and price adjustment

Sacrifice ratios have in the past been estimated using a Phillips curve approach (for example, Gordon and King, 1982). In this section we develop a model of wage and price adjustment which is estimated to yield sacrifice ratios for Australia that take into account real and nominal rigidities. We also test whether the period of inflation target (from 1994:4) in Australia has caused structural instability in the equations. In addition, we examine whether the rise of underemployment has altered the estimated sacrifice ratios measured in terms of unemployment.

Following Anderson and Wascher (1999), we begin with a model of price determination based on a mark-up of unit costs with inertia in adjustment and cyclical mark-up variability:

$$(7) \qquad \Delta p_t = \lambda \Delta w_t + (1-\lambda)\Delta w_{t-1} - g_t + \delta(y_t - y_t^*)$$

where Δ is the difference operator (here we express rates of change in annualised terms following Mitchell, 1987a); *p* is the log of the consumer price index; *w* is the log of the nominal wage; *g* is trend productivity growth; y_t^* is the log of potential output, and y_t is the log of actual output. Equation (7) allows for homogeneity with respect to nominal wages over a two quarter horizon thus capturing sticky prices. Annualised inflation is reduced each quarter when the output gap $\left(y_t^* - y_t\right) > 0$, other things equal, because we expect that firms are less able or willing to pass on higher labour costs when product markets become slack.

We assume that the capacity utilisation in the product market and labour utilisation is linked via an Okun relation:

$$(8) \qquad (U_t - U_t^*) = -\gamma(y_t - y_t^*)$$

where U_t^* is the current (transitory) steady-state macroequilibrium unemployment rate (in actual units) and U_t is the actual unemployment rate (Mitchell, 1987a).

We model wage adjustment according to a standard Phillips curve with target real wage aspirations, labour market utilisation rates and inertia taken into account:

$$(9) \qquad \Delta w_t = \alpha_0 + \alpha_1 \Delta p_t - \beta u_t + \alpha_2 \Delta w_{t-1}$$

We expect $\alpha_1 = (1-\alpha_2)$. Note that in Equation (8), we are using actual unemployment rates while in Equation (9) we use the unemployment rate measured in. As we will show later, this requires an adjustment when we compute the sacrifice ratios.

Combining (7), (6) and (9) and imposing the restriction $\alpha_2 = (1-\alpha_1)$ we get:

$$(10) \qquad \Delta\Delta w_t = \left[\alpha_0 - \alpha_1 g_t - \beta u_t + \left(\alpha_1 \delta / \gamma\right) U_t^* - \left(\alpha_1 \delta / \gamma\right) U_t\right] / (1-\alpha_1 \lambda)$$

which allows us to express the rate of change in wage inflation in terms of nominal and real rigidities which are influenced by technological factors, in addition to product market and labour market utilisation rates.

The sacrifice ratio is derived from the measure of degree of nominal inertia in the system. It will be based on the sum of the successive increases in unemployment following a percentage change in inflation. We compute the response of the unemployment rate to a disinflationary shock for *t*-periods as:

$$(11) \qquad \sum_t \Delta U_t = \left[(1-\alpha_1 \lambda) / \left((\beta / U_{ave}) + \left(\alpha_1 \delta / \gamma\right)\right)\right](-\Delta\Delta w)$$

Accordingly the sacrifice ratio is:

$$(12) \qquad SR = \left[(1-\alpha_1 \lambda) / \left((\beta / U_{ave}) + \left(\alpha_1 \delta / \gamma\right)\right)\right]$$

We include the U_{ave} term, which is an average unemployment rate over a designated time period (in our analysis this period is the inflation targeting period in Australia), to adjust for the fact that the sacrifice ratio is computed in terms of actual unemployment and β is a coefficient on the log of the unemployment rate in the wage equation (3).

Equation (12) indicates that the sacrifice ratio is influenced by the sensitivity of inflation to the output gap (δ), the Okun coefficient (γ), the sensitivity of wage inflation to changes in the unemployment rate (α), the extent to which current wage inflation is influenced by current inflation and inertia (α_1 and α_2) and the extent of inertia in price setting with respect to nominal wage movements (λ). The large the inertia (smaller λ) the larger is the increase in unemployment for a given nominal shock.

7.2 Estimation results

In this section, we present the results of estimation of the following system of equations, which link a wage adjustment function, a price Phillips curve, and the Okun relation. The general specification which is loosely related to the theoretical model developed in Section 7.1

The specification of the final form is as follows:

Wage adjustment: DLW = C(1) + C(2)*ur + C(3)*Dur(-1) + C(4)*DLP + C(5)*DLP(-1) + C(6)*DLW(-1)

Phillips curve: DLP = C(7) + C(8)*GDPGAP + C(10)*DLPM + C(11)*DLP(-1) + C(12)*DLW + C(13)*DLW(-1)

Okun equation: DUR = C(16) + C(17)*DYPC + C(18)*DYPC(-1)

where *DLW* is the annualised wage inflation using average weekly earnings as the wage measure; *ur* is the log of the unemployment rate, *DLP* is the annual inflation rate, *GDPGAP* is the deviation of real *GDP* from trend (computed as the Hodrick-Prescott filter) real *GDP*; *DYPC* is the quarterly percentage change in real *GDP*, Δ is the difference operator (sometimes annual sometimes quarterly as in context). The model was estimated generally and sequential testing of the dynamics performed. We estimated the system using Full Information Maximum Likelihood (FIML) which takes into account the contemporaneity of the regressors and the cross correlation among the residuals. The results are reported in Table 10.

The equations are broadly consistent with theoretical structure developed in the previous section. They confirm the presence of hysteresis in wage adjustment (Δu is marginally significant) which is (weak) evidence that the change in unemployment to influence the path of inflation. Various dummy variables were added to account for outliers or known issues - D_GST = 1 in 2000:3 to 2001:2 and zero otherwise, to account for the introduction of the Goods and Services Tax; D82_4 = 1 in 1982:4 and zero otherwise; D74_34 = 1 in both 1974:3 and 1974:4 and zero otherwise; and D_IT94 which has been previously defined (see Mitchell, 1987a).

The system was estimated over two samples: 1961:2 to 2003:4 and 1961:2 to 1994:4. Formal testing of stability showed that the inflation targeting period (post-1994:4) did not represent a regime shift in the system estimates. The usual regression diagnostics were satisfactory over the full sample regressions.

7.3 Computing the structural estimates of the sacrifice ratio

We computed the sacrifice ratios based on Equation (12) for both periods. The results are shown in Table 11. The full sample sacrifice ratio is 1.405 while the pre-inflation targeting sample is 1.397. These results are in the mid-range of values published by Anderson and Wascher (1999) for Australia using a similar approach although they estimate the wage, price equations and Okun's relation separately rather than use a system estimator.

The results show that the inflation targeting period has not been associated with any significant changes in the estimated sacrifice ratio for Australia. This confirms the results achieved using episode-specific methods in Section 6.

8. Conclusion

Empirical research in Australia and overseas does not support the claim that inflation targeting has reduced output and inflationary variability or reduced inflation persistence, despite the strong claims from the Reserve Bank touting the success of its inflationary targeting policy.

Our results support Ball and Sheridan (2003) and show that inflation targeting countries have failed to achieve superior outcomes in terms of inflation variability and output variability; moreover there is no evidence that inflation targeting has reduced persistence. There is also little evidence that inflation targeting has reduced inflationary expectations in Australia; the mean shift in expectations is more a result of the 1991-1992 recession than a result of the onset of inflationary targeting. More important than targeting has been the long-growth cycle, the dismantling of unions and the abandonment of wage determination, deregulation of the economy and major cost shifts; policies with adverse consequences for unemployment. It is clear from statements made by the RBA that a belief in the long-run trade-off between inflation and employment embodied in the NAIRU has lead it to pursue an inflation-first strategy at the expense of unemployment, even though the existence of long-term unemployment itself, beyond the cycle, cannot be explained in this context.

Disinflations are not costless irrespective of whether targeting is used or not. In Australia, the cost of the 1995:3-1998:2 disinflation resulted in a cumulative loss in GDP of between 0.52 and 4.02 per cent (depending on assumptions about potential output). Estimated sacrifice ratios remain sensitive to the choice of method and specification of model – the episode specific methods are particularly sensitive to the method of projecting of potential output and assumptions about timing. Using a range of methods we find no evidence that countries who adopted inflation targeting have reduced the costs of disinflation, relative to other countries or previous disinflationary episodes (although in Australia sacrifice ratios are slightly lower in than in the 1980s). Employing a structural model of wage price adjustment in Australia produces similar results: estimating a ratio of 1.4 per cent and finding only a marginal change (0.01 per cent) in this ratio between the inflation targeting and non-inflation targeting period.

We argue that the real costs of inflation targeting lie in the 'ideology' that accompanies it such that fiscal policy has to be passive. The failure of economies to eliminate persistently high rates of labour underutilisation despite having achieved low inflation is directly a consequence of this fiscal passivity. We thus need to move towards a new paradigm where inflation control can coincide with full employment. Elsewhere, Mitchell and others have argued that this paradigm would embrace a Job Guarantee (see Mitchell, 1998; Wray, 1998).

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Appendix A: Data sources

Output and Inflation Data

The quarterly output (real GDP) and inflation data is from the OECD Main Economic Indicators (MEI) series for the G7 countries (Canada, France, Germany, Italy, UK and the United States) and Australia. Japan and France were spliced to take into account SNA revisions. The sample periods for real GDP are as follows: Canada 1969:1-2003:3, France 1970:1 to 2003:3, Germany 1969:1 to 2003:3, Italy 1969:1-2003:3, Japan 1960:1 to 2003:3, UK 1960:1 to 2003:3 and US 1960:1 to 2003:3. Inflation rates are calculated Consumer Price Index data for the 1st quarter of 1960 to the 1st quarter of 2004. Inflation is an annualised nine-quarter moving average of changes in the CPI.

Industrial Production Data

Quarterly industrial production data is taken from the OECD Main Economic Indicators, where possible from the 1st quarter of 1960 to the 1st quarter of 2001. The sample periods for industrial production are: Canada 1961:1 – 2003:4, US 1960:1-2003:4, Australia 1974:3-2003:4, Japan 1960:1-2003:4, France 1960:1-2003:4, Germany 1960:1 to 2003;4, Italy 1960:1 to 2003:4 and UK 1960:1 to 2003:4.

Short-term Interest rates

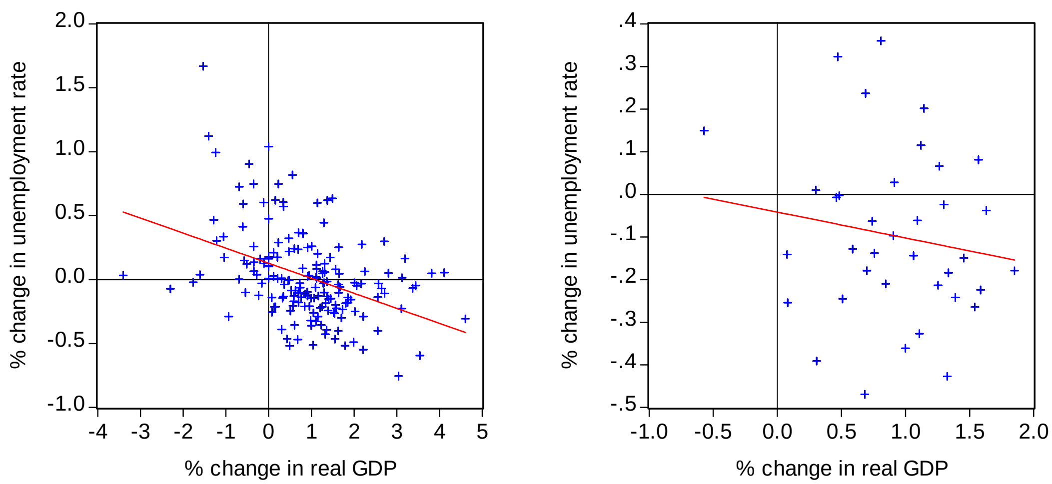
Quarterly data on short-term interest rates is also available through the OECD Main Economic Indicators (MEI) series. Where possible the data covers the sample period from the 1st quarter of 1960 to the 1st quarter of 2004, however data availability varies between countries, as does the method of calculating short-term interest rates. In the MEI series short term interest rates are measured in Canada by the 90 day deposit receipt rate and data are available for 1961:1-2003:2, In Japan ST rates are measured by the 3 month CD, available for the period 1979:3-2003:4 and Australia, 90 day bank acceptance rate, available for 1968:1-2003:4. Italian ST rates are provided by the 3 month interbank deposits rate for 1978:4-1998:4; and in Germany by the 3 month FIBOR with data are available for 1960:1-1998:4. In France, 3 month PIBOR-qrtly rate is available for 1970:1-1998:4. Finally in the US the ST rate is the CDs rate and the sample period 1964:3-2003:4; in UK it is the 3 month interbank loan, and data are available for 1978:3-2003:4.

Appendix B: Okun Estimation

Okun (1962) proposed a measure of the decrement in real GNP for every rise in unemployment above some full employment level. He suggested various methods of estimating what has become known as the 'Okun coefficient'. The most simple regresses the "quarterly changes in the unemployment rate … in percentage points…[on]…quarterly percentage changes in real GNP." For the US over the period 1947:2 to 1960:4, Okun estimated the coefficient to be -0.30 leading to the famous conclusion that "taking previous quarters as given, a one percentage point rise in the unemployment rate means 3.3 percent less GNP."

In Figure B1, we show the relationship between the quarterly percentage point change in the unemployment rate and the quarterly percentage change in real GDP for the period 1960:1 to 2004:2 and for the inflation targeting period, 1994:4 to 2004:2. The latter period (b) is characterised by strong growth and mostly downward movements in the unemployment rate. Both graphs have a simple linear regression line superimposed.

Figure B1 Okun relation, Australia, various periods.



(a) 1960:2 to 2004:2 (b) 1994:4 to 2004:2

To formalise the relationship we estimate the following version of the Okun equation:

(B1) $$\Delta u_t = \alpha + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-1} + \delta IT + \varepsilon_t$$

where Δ is the first difference operator (quarterly periodicity) expressed in percentage terms, *u* is the unemployment rate, *y* is real GDP, and IT is a dummy variable taking the value 1 from 1995:1 and zero otherwise. We also controlled for outliers in 1974:3 and 1974:4 and 1982:4 (see Mitchell, 1987a).

The results of the regression shown in Table B1. the Okun coefficient is b1 + b2 = -0.205, which means that if GDP rises by 1 percent unemployment falls by 0.205 percentage points, a small reduction and confirms the persistence in the unemployment rate. Alternatively, a one percentage point rise in the unemployment rate means 4.89 percent less GDP. The results are close to those obtained via FIML estimation as outlined in Section 7 of the main paper.

Table B1 Okun regression, 1960:3 to 2003:4, %Δ*UR* dependent variable

Variable	Coefficient	t-statistic
Constant	0.216	6.62
DYPC	-0.111	6.39
DYPC(-1)	-0.094	5.44
D_IT95	-0.117	2.35
D82_4	1.227	4.51
D74_34	0.615	3.19
R^2	0.43	

Table 1 Inflation targeting countries and targeting periods

Country	Inflation Targeting	Constant inflation target	Rationale for choice of starting dates
Australia	1994:4	1994:4	In September 1994, the Governor of the Reserve Bank of Australia announced that "underlying inflation of 2 to 3 per cent is a reasonable goal for monetary policy"
Canada	1992:1	1994:1	The first target range was announced by the Bank of Canada in February 1991 – 2 to 4 per cent over 1992 (that is, December 1991 to December 1992). In December 1993, a range of 1 to 3 per cent was established for 1994, and the range has remained constant since then.
Finland	1994:1	1994:1	In February 1993, the Bank of Finland stated its intention to "stabilise the rate of inflation permanently at the level of 2% by 1995" It appears that they were referring to year-over-year inflation measured at the start of 1995; thus the period covered by the first target begins at the start of 1994.
New Zealand	1990:3	1993:1	A target of 3-5% over 1990 was announced in April 1990. A target of 0-2% for 1993 was announced in February 1991. The target range has remained roughly unchanged since then. The date of the constant-targeting period recognises that the target range was widened from 0-2% to 0-3% in 1997. Ball and Sheridan (2003: 9) judge that "the 1997 episode was not a substantial change in policy."
Spain	1995:2	1994:1	The first target, announced in December 1994, was for year-over-year inflation of 3.5-4% "by early 1996"
Sweden	1995:1	1995:1	The Riksbank announced in January 19993 that it aimed "to limit the annual increase in the consumer price index from 1994 onwards to 2 percent." This target applied to inflation over all of 1995, not to year-over-year inflation at the start of 1995 (Svensson, 1995).
UK	1993:1	1993:1	In October 1992, the Bank of England announced a 2.5% target, beginning immediately.

Source: from Ball and Sheridan (2003).

Table 2 Inflation and growth, the RBA self-justification for its monetary policy

	Annual Inflation (a)		Real GDP growth (b)	
	Average	Std Deviation (c)	Average	Std Deviation (c)
Australia				
1980-92	7.2	2.4	2.8	2.7
1993-03	2.3	0.6	3.9	1.1
Other OECD IT countries				
1980 to adoption of targets (d)	10.2	6.1	2.3	2.6
Adoption of targets to latest	2.7	1.3	3.0	1.6
OECD non IT countries (e)				
1980–92	6.4	3.9	2.6	2.0
1993–latest	2.2	0.9	2.9	1.8

(a) Headline consumer price inflation for all countries except Australia (the Treasury underlying CPI up to June quarter 1998 and the CPI since with an adjustment for the effects of tax and health policy changes), New Zealand (the CPI excluding credit services after December quarter 1989) and the UK (the Retail Price Index, excluding mortgage interest payments). Inflation rates are calculated as the year-ended change in the quarterly index.

(b) GDP growth rates are calculated as the year-ended change in the quarterly GDP series. Where quarterly data are not available, year-average growth calculated from IMF data are used.

(c) Calculated as the average of standard deviation across countries.

(d) Dates used for adoption of targets are: Canada, 1991; Finland, 1993; Greece, 1998; Iceland, 2001; New Zealand, 1990; Norway, 2001; Spain, 1994; Sweden, 1993; the UK, 1992.

(e) Austria, Belgium, Denmark, France, Germany, Ireland, Italy, Japan, Luxembourg, Portugal and the United States. Finland and Spain are considered to have become non-inflation-targeting countries upon joining the third stage of the EMU in 1999, and Greece in 2001. The EMU is treated as a single entity after 1999.

Sources: IMF; national sources; OECD.

The Table is reproduced from Stevens (2003: 23, Table 1).

Table 3 Samples used by Ball and Sheridan (2003), Table II

	Sample					
Country	1	2	3	4	5	6
Australia	1960:1	1985:1	1994:4	1960:1	1985:1	1994:4
	1994:2	1994:2	2001:4	1994:2	1994:2	2001:4
Canada	1960:1	1985:1	1992:1	1960:1	1985:1	1994:1
	1991:4	1991:4	2001:4	1993:3	1993:3	2001:4
Finland	1960:1	1985:1	1994:1	1960:1	1985:1	1994:1
	1993:4	1993:4	1998:4	1993:4	1993:4	1998:4
New Zealand	1960:1	1985:1	1990:3	1960:1	1985:1	1993:1
	1990:1	1990:1	2001:4	1992:4	1992:4	2001:4
Spain	1960:1	1985:1	1995:2	1960:1	1985:1	1994:1
	1995:1	1995:1	1998:4	1993:3	1993:3	1998:4
Sweden	1960:1	1985:1	1995:1	1960:1	1985:1	1995:1
	1994:4	1994:4	2001:4	1994:4	1994:4	2001:4
UK	1960:1	1985:1	1993:1	1960:1	1985:1	1993:1
	1992:3	1992:3	2001:4	1992:3	1992:3	2001:4
United States, Japan, Denmark	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
	1993:2	1993:2	2001:4	1993:3	1993:3	2001:4
Austria, Belgium, France, Germany, Ireland, Italy, Netherlands, Portugal	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
	1993:2	1993:2	1998:4	1993:3	1993:3	1998:4
Norway	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
	1993:2	1993:2	2000:4	1993:3	1993:3	2000:4
Switzerland	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
	1993:2	1993:2	1999:4	1993:3	1993:3	1999:4

Source: Ball and Sheridan (2003: Table II).

Table 4 Differences in differences coefficients on inflation targeting dummy with regression to the mean controls. Dependent variable: Change in variable between samples

	Samples (see Table 3)			
	(3) - (1)	(3) - (2)	(6) - (4)	(6) - (5)
Inflation mean				
Targeting dummy	-0.38 (0.33)	-0.55 (0.35)	-0.29 (0.33)	-0.51 (0.34)
Initial Value	-0.74 (0.08)	-0.78 (0.07)	-0.77 (0.07)	-0.76 (0.07)
Inflation variability				
Targeting dummy	0.41 (0.23)	0.31 (0.27)	0.59 (0.21)	0.50 (0.26)
Initial Value	-0.84 (0.07)	-0.86 (0.10)	-0.92 (0.06)	-0.93 (0.09)
Trend inflation variability				
Targeting dummy	0.15 (0.14)	0.08 (0.16)	0.21 (0.15)	0.10 (0.19)
Initial value	-0.92 (0.05)	-0.87 (0.09)	-0.91 (0.05)	-0.89 (0.10)
Real output mean				
Targeting dummy	0.67 (0.78)	0.88 (0.81)	0.97 (0.84)	1.30 (0.88)
Initial value	-0.77 (0.48)	-0.60 (0.41)	-0.71 (0.48)	-0.52 (0.41)
Real output variability				
Targeting dummy	0.29 (0.22)	0.30 (0.28)	0.32 (0.21)	0.43 (0.26)
Initial value	-1.20 (0.13)	-0.96 (0.16)	-1.19 (0.11)	-1.06 (0.15)
Long-term interest rates mean				
Targeting dummy	0.33 (0.49)	0.20 (0.45)	0.27 (0.49)	0.12 (0.47)
Initial value	-0.60 (0.10)	-0.72 (0.06)	-0.56 (0.10)	-0.69 (0.07)
Short-term interest rates variability				
Targeting dummy	--	-0.13 (0.28)	--	-0.11 (0.28)
Initial value	--	-0.80 (0.14)	--	-0.85 (0.12)

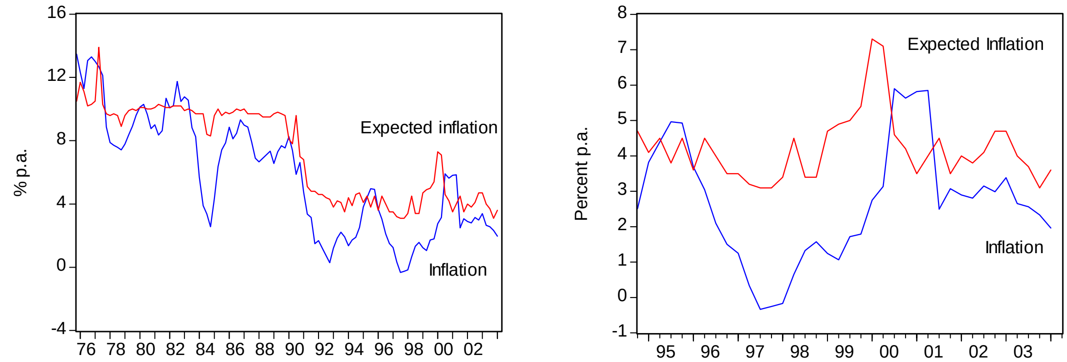
Source: Ball and Sheridan (2003), recompiled from Tables III to IX. Trend inflation is constructed as a 9-quarter moving average. Variability refers to the standard deviation of the particular variable. The samples are variable but distinguish between inflation targeting periods and non-targeting periods. Standard errors are shown in parenthesis.

Table 5 Inflation persistence in Australia, 1961:2 to 2004:1

Variable	Coefficient	t-statistic
Constant	0.37	1.16
DLP_AUS(-1)	0.76	3.34
DLP_AUS(-2)	0.18	0.61
DLP_AUS(-3)	0.37	1.23
DLP_AUS(-4)	-0.48	2.29
D_IT944	0.45	1.079
D_IT944*DLP_AUS(-1)	-0.01	0.029
D_IT944*DLP_AUS(-2)	-0.03	0.079
D_IT944*DLP_AUS(-3)	-0.48	1.299
D_IT944*DLP_AUS(-4)	0.32	1.199
D_GST	1.19	2.369
R^2	0.87	
s.e.	0.77	
Mean of DV	2.76	
Chow Breakpoint Test	F-statistic 0.722 Prob 0.61	

Notes: Dependent variable (DV) is the annual inflation rate for Consumer Price Index. The Chow Breakpoint Test was performed for 1994:4. s.e. is standard error.

Figure 1 Inflation and inflation expectations, Australia, various periods.



(a) 1975:4 to 2004:2

(b) 1994:4 to 2004:2

Source: Westpac/Melbourne Institute inflation expectations (% next year) from RBA database and AUSTATS. Rates are in annual terms.

Figure 2 The sacrifice ratio concept - output losses and disinflation

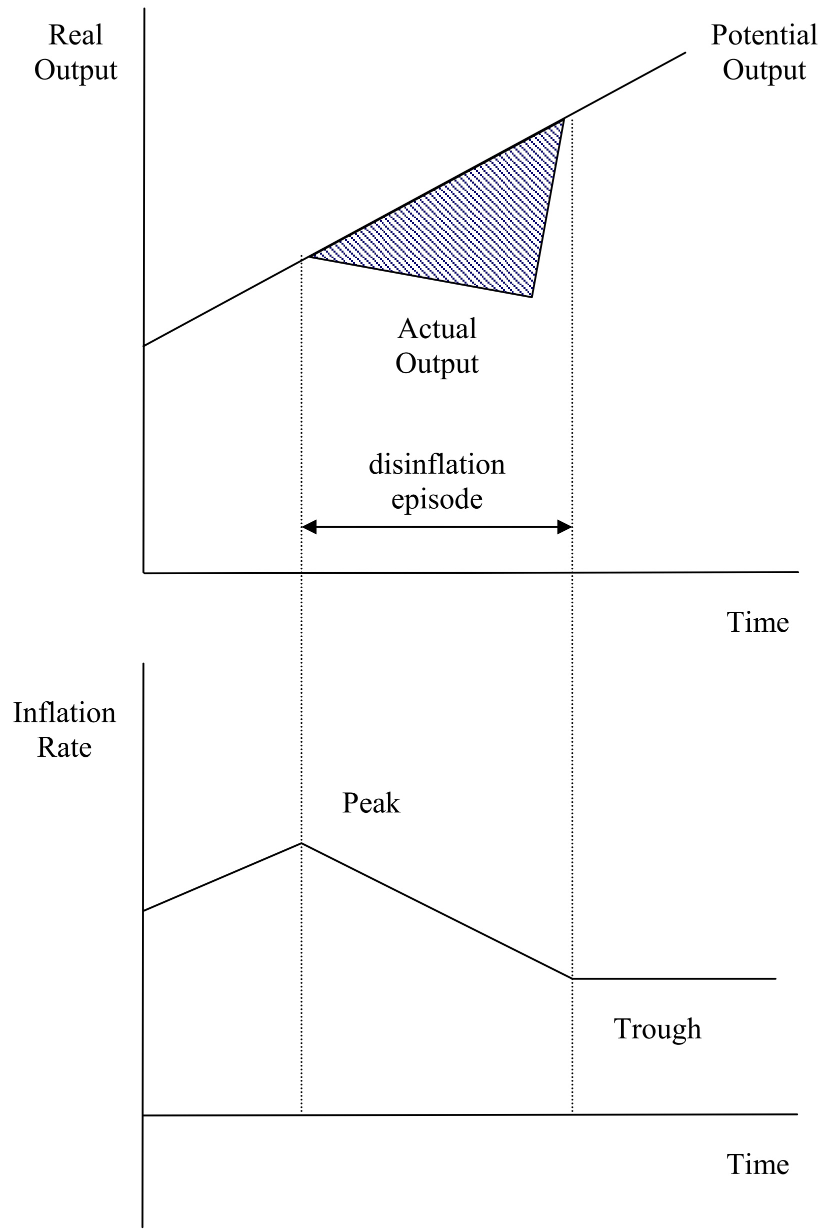


Figure 3 Persistence and hysteresis in trend output

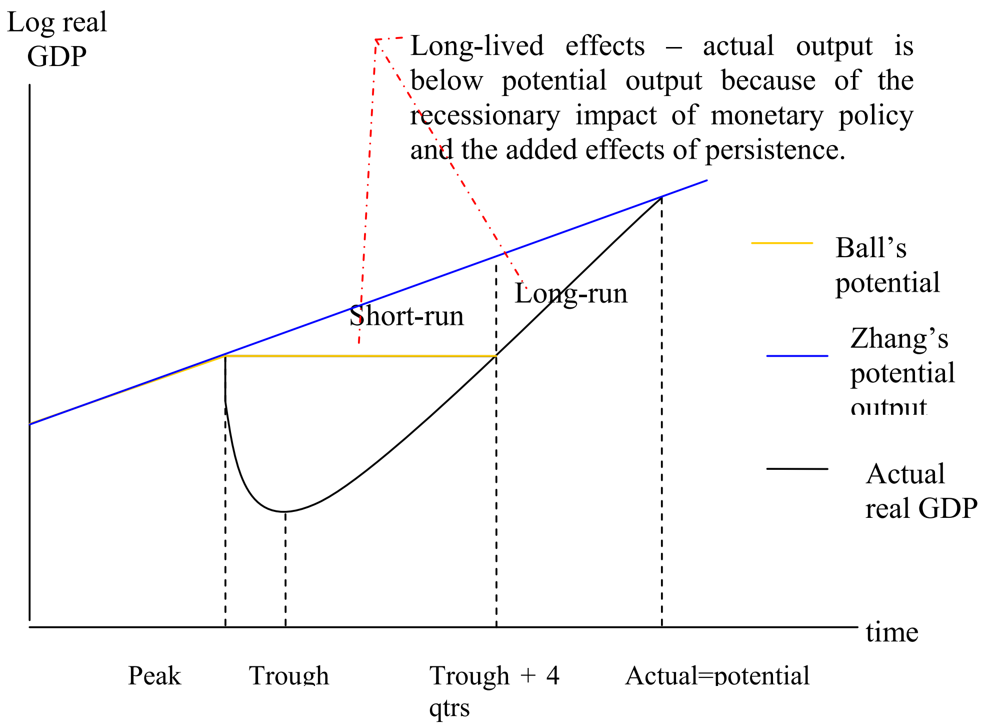


Table 6 Timing of disinflationary episodes and business cycle swings, G7 and Australia

Country	Disinflationary Episode	Business Cycle (Real GDP)
Australia		1960:3 – 1961:3
		1965:2 – 1966:1
	1975:1 - 1978:4	1974:1 – 1983:1
	1982:3 - 1984:4	1977:2 – 1983:1
	1989:2 - 1993:1	1981:3 – 1986:2
	1995:3 - 1998:2	1990:2 – 1991:2
Canada	1975:1 - 1977:2	
	1981:3 - 1985:3	1981:2 – 1982:4
	1990:3 - 1994:1	1990:1 – 1991:1
France	1975:1 - 1977:4	1974:3 – 1975:1
	1981:2 - 1987:2	1980:1 – 1980:4
		1992:3 – 1993:3
Germany	1973:4 -1978:2	1974:1 – 1975:2
	1981:1 -1987:1	1980:1 – 1982:3
	1992:3 -1996:2	1992:1 – 1993:2
Italy	1963:4 - 1968:4	1970:3- 1975:2
	1975:4 - 1978:4	1974:2- 1977:3
	1980:4 - 1987:4	1980:1- 1982:4
	1990:2 - 1995:3	1982:2 - 1990:4 [a]
		1992:1 – 1993:1
	1995:1- 1998:3	1996:1 - 2001:4[a]
Japan	1974:2 - 1978:4	1973:4 – 1974:1
	1980:4 - 1987:3	
	1990:3 - 1995:3	1993:1 – 1993:4
		1997:1 – 1998:2
		2001:1 – 2002:1
UK		1961:2 – 1961:4
		1973:2 – 1974:1
	1975:2 - 1978:3	1974:3 – 1975:3
	1980:3 - 1984:1	1979:2 – 1981:1
	1990:1 - 1993:4	1990:2 – 1991:3
United States		1960:4 – 1969:3
		1970:4 – 1973:4
	1974:4 – 1977:1	1975:1 – 1980:1
	1980:3 - 1984:1	1980:3 – 1981:3
		1982:1 – 1990:3
	1990:2 - 1994:4	1991:1 – 2000:4
		2001:3 – 2003:3

Source: OECD Main Economic Indicators (MEI), Econdata, March 2004. (a) these GDP peaks and troughs are periods where real GDP is higher (peak) or lower (trough) than the preceding or proceeding 6 quarters, in total.

Table 7 Sacrifice Ratios various methods, real GDP and Industrial Production, G7 and Australia

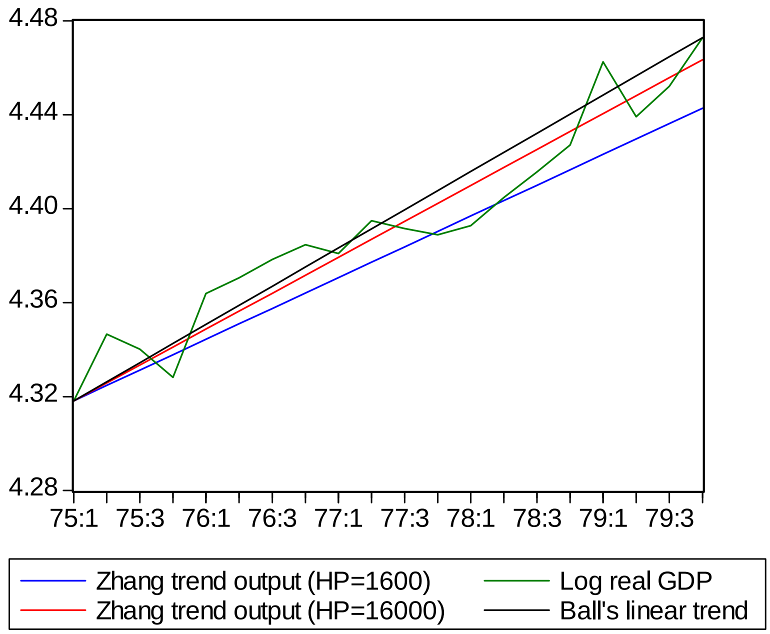
Period	Δ in ΔP	Ball GDP	Ball IP	SR Z1 HP 1600 GDP	SR Z2 HP 16k GDP	BW GDP	BW IP	BW GDP (2)	BW IP (2)	Ave SR
Australia										
75:1-78:4	5.74	0.24	0.19	-0.93	-0.12	-0.76	NA	-0.43	NA	-0.2
82:3-84:4	4.68	1.25	2.02	-0.05	0.26	4.08	3.47	4.26	3.48	1.9
89:2-93:1	5.95	1.53	1.95	2.84	3.19	2.48	-0.39	4.97	0.41	2.4
95:3-98:2	2.87	0.54	-2.09	-0.17	-1.05	4.02	-0.91	4.27	-1.18	1.2
Average	4.81	0.89	0.52	0.42	0.57	2.45	0.72	3.27	0.9	1.3
Canada										
75:1-77:2	2.58	-0.43	0.41	-0.62	-0.85	-1.47	-0.13	-1.76	-0.16	-0.9
81:3-85:3	7.12	1.75	1.44	0.81	2.05	0.93	5.53	0.75	6.94	1.6
90:3-94:1	4.13	3.44	6.12	1.46	3.76	3.54	10.67	5.6	14.92	3.6
Average	4.61	1.58	2.66	0.55	1.65	1.00	5.36	1.53	7.23	1.4
France										
75:1-77:4	2.6	0.21	-0.40	-0.89	-0.73	0.21	-1.54	-0.36	-2.17	-0.1
81:2-87:2	9.98	0.65	1.55	-0.42	0.46	0.10	1.15	0.92	3.56	0.4
Average	6.28	0.43	0.58	-0.66	-0.13	0.16	-0.19	0.28	0.69	0.2
Germany										
73:4-78:2	3.61	4.84	7.65	4.23	4.86	3.55	1.73	5.80	3.41	4.4
81:1-87:1	5.56	2.18	3.11	0.16	2.82	3.64	4.86	9.39	10.54	2.9
92:3-96:2	3.23	1.05	5.03	13.14	10.94	-4.96	5.00	-7.46	8.27	2.3
Average	4.13	2.69	5.26	5.84	6.21	0.74	3.86	2.57	7.41	3.2
Italy										
63:4-68:4	4.25	NA	-4.82			NA	2.25	NA	0.34	
75:4-78:3	3.67	-0.25	-1.81	-2.70	-1.00	0.92	0.68	0.70	0.59	-0.1
80:4-87:4	12.93	1.31	3.41	1.10	1.79	0.21	0.50	0.69	2.32	1.1
95:2-98:3	2.81	0.55	0.37	0.37	0.44	0.95	-1.55	1.25	-2.39	0.6
Average	5.91	0.54	-0.71	-0.41	0.41	0.69	0.47	0.88	0.21	0.5

Table 7 (continued)

Period	Δ in ΔP	Ball GDP	Ball IP	SR Z1 HP 1600 GDP	SR Z2 HP 16K GDP	BW GDP	BW IP	BW GDP (2)	BW IP (2)	Ave SR
Japan										
74:2-78:4	12.13	0.43	3.98	-0.04	1.31	0.39	2.09	0.97	3.59	0.7
80:4-87:3	5.77	3.27	3.37	1.43	2.07	2.54	3.59	7.24	4.76	2.6
90:3-95:3	3.01	1.70	6.76	13.14	10.94	-3.84	-6.94	-5.09	-7.86	2.9
Average	6.97	1.80	4.70	4.84	4.77	-0.30	-0.42	1.04	0.16	2.1
UK										
75:2-78:3	8.36	-0.18	-0.09	-1.12	-0.98	-0.28	1.29	-0.63	1.10	-0.5
80:3-84:1	9.79	0.89	0.80	-0.33	0.52	1.69	2.90	2.47	4.22	1.0
90:1-93:4	6.17	2.26	2.98	2.50	3.76	1.51	0.64	2.92	0.68	2.5
Average	8.10	0.99	1.23	0.35	1.10	0.97	1.61	1.58	2.00	1.0
USA										
74:4-77:1	3.37	0.42	3.36	-0.87	-0.69	1.16	4.89	1.16	4.96	0.3
80:3-84:1	7.94	1.32	1.69	-0.15	0.73	1.81	3.77	2.79	6.28	1.3
90:2-94:4	2.33	4.00	7.32	4.60	8.59	4.87	15.31	10.74	27.47	5.8
Average	4.55	1.91	4.12	1.19	2.88	2.61	7.99	4.90	12.90	2.5
Grand Average	5.68	1.37	2.46	1.56	2.21	1.14	2.45	2.13	3.92	1.6

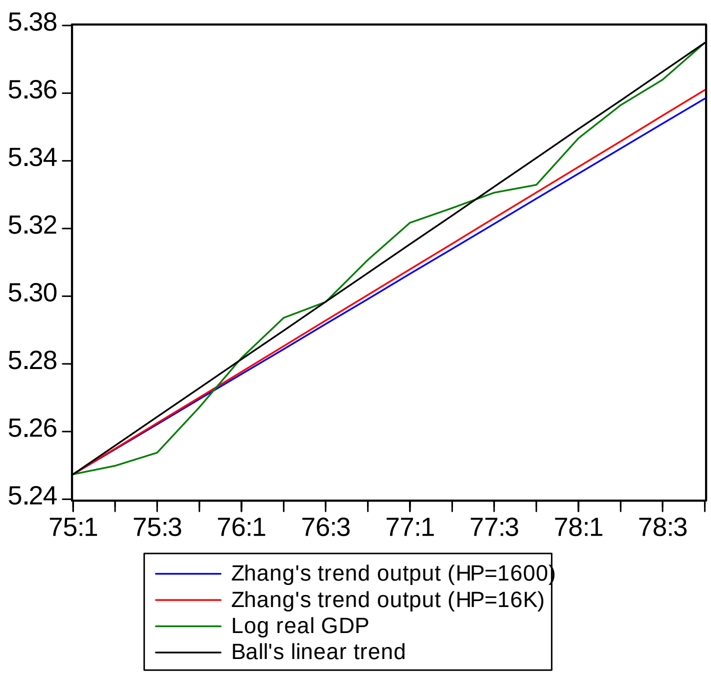
Source: OECD Main Economic Indicators (MEI), Econdata, March 2004, BW is Boschen and Wiese. Z1 and Z2 refer to Zhang's method computed for different HP windows (1600 and 16000, respectively). GDP is real Gross Domestic Product and IP is industrial production. ΔP is the inflation rate.

Figure 4 Trend output and actual log real GDP, Australia 1975:1 – 1978:4



Source: OECD Main Economic Indicators (MEI), Econdata, March 2004

Figure 5 Trend output and actual log real GDP, France 1975:1 – 1977:4



Source: OECD Main Economic Indicators (MEI), Econdata, March 2004

Table 8 Sacrifice Ratios with long-lived effects in the long-run, G7 plus Australia

Date Peak Qtr	Date End Z2	Disinflation Qtrs Z2	SR Z2 (HP=16k)
Australia			
1975Q1	1979Q1	16	-0.18
1982Q3	1984Q4	9	0.71
1989Q2	1998Q3	37	5.26
1995Q3	1998Q2	11	-0.40
Average			*1.35*
Canada			
1975Q1	1977Q2	9	-0.66
1981Q3	1985Q4	17	2.01
1990Q3	1997Q2	27	4.53
Average			*1.96*
France			
1975Q1	1977Q4	11	-0.44
1981Q2	1988Q1	27	0.46
Average			*0.01*
Germany			
1973Q4	1991Q1	69	31.21
1981Q1	1988Q3	30	2.87
Average			*17.04*
Italy			
1975Q4	1978Q3	11	-0.77
1980Q4	NA	NA	NA
1995Q2	1998Q3	13	0.31
Average			*-0.23*
Japan			
1974Q2	NA	NA	NA
1980Q4	1988Q1	29	2.10
Average			*2.10*
UK			
1975Q2	1978Q3	13	-0.61
1980Q3	1984Q1	14	0.55
1990Q1	2000Q1	40	6.11
Average			*2.02*
US			
1974Q4	1977Q1	9	-0.01
1980Q2	1984Q1	15	0.89
1990Q1	1998Q4	35	10.55
Average			*3.81*
Grand Average			*3.22*

Source: OECD Main Economic Indicators (MEI), Econdata, March 2004.

Figure 6 Summary average sacrifice ratios

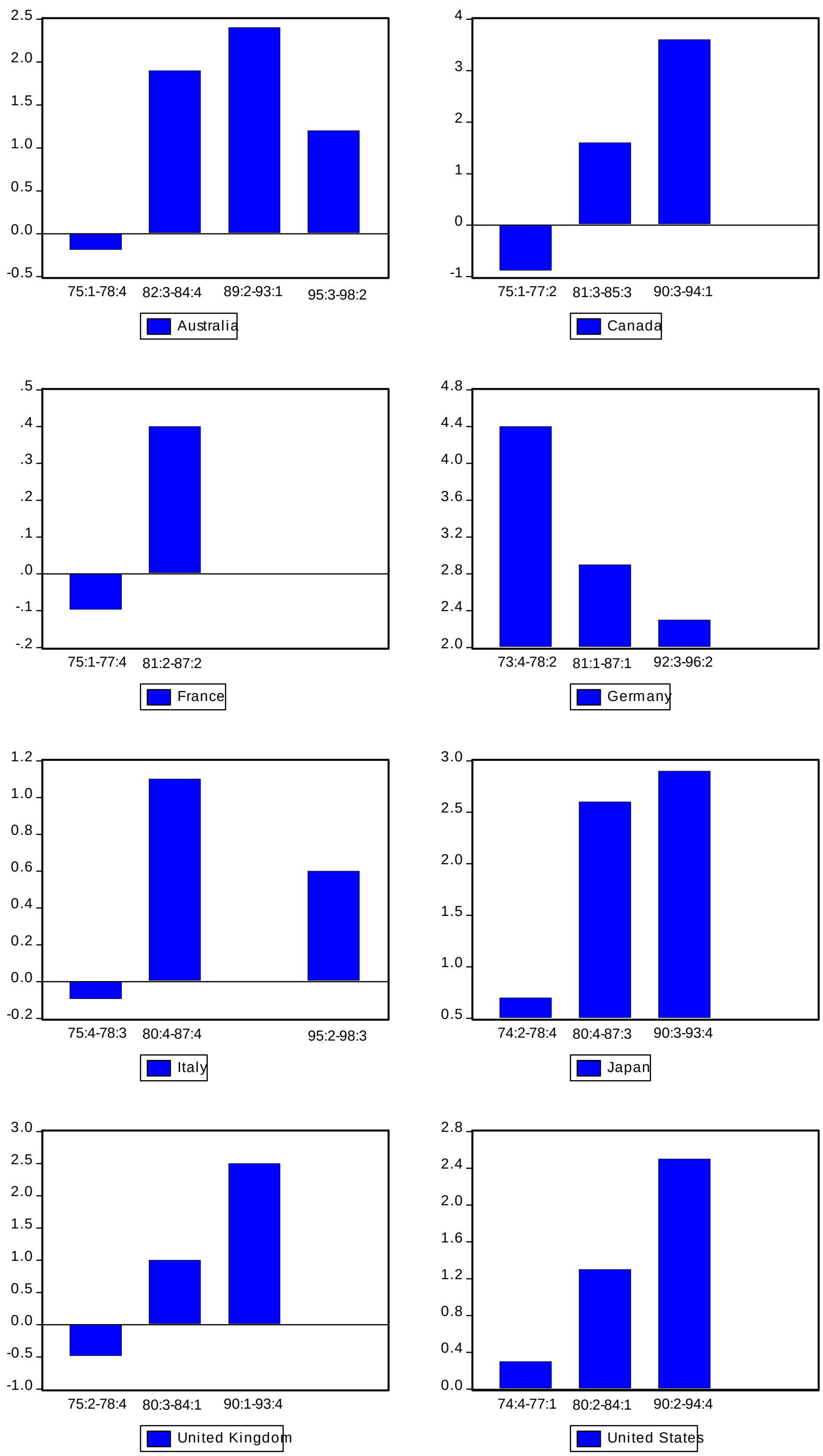


Table 9 Country Rankings and Period Averages for real GDP Sacrifice Ratios, G7 countries plus Australia

	Country Rankings			Period Average			
	Ball	BW	Zhang		Ball	BW	Zhang
1	Germany (2.69)	US (2.61)	Germany (6.21)	1970s	0.7	0.46 (a)	0.23
2	Japan (1.8)	Australia (2.45)	Japan (4.77)	1980s	1.6	1.94	1.54
3	Canada (1.58)	Canada (1.00)	US (2.88)	1990s	3.5	0.87(b)	5.34
4	US (1.37)	UK (0.97)	Canada (1.65)				
5	UK (0.99)	Germany (0.74)	UK (1.00)				
6	Australia (0.89)	Italy (0.69)	Australia (0.57)				
7	Italy (0.54)	France (0.16)	Italy (0.41)				
8	France (0.43)	Japan (-0.30)	France (-0.13)				
Average	1.37	1.14	2.21				

Note: (a) Sacrifice ratios based on 16 lag autoregresion cannot be calculated for Australia's disinflation in 1970's due to the real GDP series not extending back sufficiently. (b) This is smaller than would be expected owing to a large negative sacrifice ratio recorded in the 1990s.

Table 10 FIML estimation - wage, price and Okun's equation, various samples

	Full Sample 1961:2 to 2003:4		Pre-IT Sample 1961:2 1994:4	
Wage adjustment	Coefficient	ProbValue	Coefficient	ProbValue
Constant	1.597	0.001	1.607	0.002
LUR	-0.136	0.013	-0.135	0.045
DUR(-1)	-0.892	0.113	-0.922	0.171
DLP	0.686	0.074	0.687	0.163
DLP(-1)	-0.441	0.207	-0.441	0.325
DLW(-1)	0.689	0.000	0.690	0.000
D74_34	7.445	0.947	7.404	0.703
R-squared	0.89		0.88	
Phillips curve	Coefficient	ProbValue	Coefficient	ProbValue
Constant	0.026	0.908	0.028	0.920
GDPGAP	0.201	0.003	0.200	0.008
DLPM	0.089	0.019	0.089	0.043
DLP(-1)	0.870	0.000	0.870	0.000
DLW	0.076	0.630	0.076	0.662
DLW(-1)	0.005	0.966	0.005	0.968
D_GST	0.785	0.060		
R-squared	0.95		0.95	
Okun equation	Coefficient	ProbValue	Coefficient	ProbValue
Constant	0.218	0.000	0.218	0.000
%DY	-0.114	0.000	-0.114	0.000
%DY(-1)	-0.094	0.000	-0.095	0.000
D74_34	0.566	0.983	0.573	0.898
D_IT94	-0.115	0.103		
D82_4	1.203	0.924	1.216	0.934
R-squared	0.43		0.44	

Notes: see text for explanations of symbols.

Table 11 Structural estimates of sacrifice ratios in Australia

Sample	Sacrifice Ratio Estimate
1961:2 to 2003:4	1.405
1961:2 to 1994:4	1.397

Note: see text for explanations of formula used to compute the ratios.

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[1] The authors are Director of Centre of Full Employment and Equity and Professor of Economics at the University of Newcastle, Australia; and Research Officer, Centre of Full Employment and Equity, University of Newcastle, respectively.

[2] NAIRU is the acronym for the Non Accelerating Rate of Unemployment.

[3] The adjustment dynamics in a period of disinflation (motivated by a central bank contraction in monetary growth) are described by orthodox economists in the following way. Real output deviates below trend as demand conditions tighten and the losses begin to accumulate. Agents adjust to the slower monetary growth rate by reducing their nominal wage and price demands and eventually output returns to trend. The larger and longer is the deviation from trend by real output, the higher will be the losses (and the sacrifice ratio). In a Lucas-Barro type supply model, the sacrifice ratio would only depart from zero if the disinflation was unexpected. Real output losses would only occur if workers and firms failed to revise their nominal wage and price demands to match the reduction in nominal demand induced by the monetary slowdown. Accordingly, within this framework, as nominal wages grow in excess of the "required equilibrium rate", real wages rise above full employment marginal productivity and employment and real output reductions occur. As expectations adjust, real wages fall. In this context, the sacrifice ratio is a reflection of the inverse aggregate supply schedule, such that a flatter the aggregate supply relationship (suggesting a bias towards quantity adjustment) will generate larger sacrifice ratios than a steeper aggregate supply relationship (Andersen and Wascher, 1999).

[4] The estimation of sacrifice ratios is not new. Many different methods have been used to estimate sacrifice ratios for various countries. Some studies estimate the relationship between nominal income changes and real output variations (aggregate supply approach) (for example, Gordon, 1982); whereas others have used structural estimates of price and wage inflations (Phillips curve approach) (for example, Turner, 1995; Laxton, Meredith and Rose, 1995). Additionally, structural vector autoregression (SVAR) models of varying sizes are common (for example, Gordon and Leeper, 1994; Gali, 1992). Sacrifice ratios have also been computed using actual changes in output, inflation and unemployment during individual disinflation periods (the episode-specific approach) (for example, Ball, 1994; Svensson, 1999). Overall, the sacrifice ratio (and 'cost') estimates produced in the literature remain imprecise and appear to be significantly influenced by choice of method, specification of models, and sample periods used (Pagan and Robertson, 1998).

[5] One should reflect on the current rhetoric in Australia at present (July 2004) where the financial pundits are all saying that monetary policy is 'too expansionary' but that the RBA will not move until after the federal election some time later in the year before they correct this. The point is not that the pundits are correct but that the RBA is politically motivated.

[6] As a note, one has to be cautious in computing the real output losses to ensure they reflect the annualised loss as a percentage of annual real output flow.

[7] Due to data limitations (see section on data sources), we could not determine if short-term interest rate rises preceded the early 1970s disinflation episodes in Italy, Japan and the UK. For these periods we have relied on Ball (1994) and Zhang's (2001) verification that episodes are indeed "policy-induced" disinflationary episodes.

[8] We contacted Laurence Ball concerning his data but he was no longer able to provide his original dataset so that we could verify the reason for the slight differences in our results.

[9] In Germany 1966:1-1968:2 inflation falls by 0.70, in Japan 1965:4-1968:1 inflation falls by 1.18 points, in the US 1970:1-1972:1 inflation falls by 1.68 points and in the UK 1965:3-1967:1 inflation falls by 1.76 percentage points.

10 The decline in GDP may not be uniform in the downswing from peak to trough; it is inaccurate to conclude the effects of disinflationary policy are necessarily more persistent solely on the basis of dates of GDP peaks and troughs.

[11] Zhang (2001) and Ball (1994) do record disinflationary episodes in the early late 1960s early 1970s in the United States 1969:4 to 1971:4 and the UK 1961:2-1963:3.

12 Boschen and Weise (2001) apply Ball's method and calculate an average of 2.36 in 67 episodes across 19 countries.

13 Cursory examination reveals trend growth rates below Ball's potential and in a few cases actual output for at least one to two episodes, usually later ones, in all countries. Trend output projected using the HP 16000 filter is much less likely to be below Ball's projection of potential output.

14 Zhang records a large negative sacrifice ratio for Italy in the 1970s and the UK in the 1980s

15 We experimented with estimating the 16 lag autoregression for the period up to the start of each disinflation rather than over the whole sample, however for the 1970s disinflation episodes in many countries there was insufficient data to generate trend output based on lagged values.

16 Sacrifice ratios cannot be calculated based on lagged values for Italy in the period 1963:4 – 168:4 and Australia in the period 1975:1 – 1978:4 owing to insufficient data. Comparisons between the standard method and Boschen and Weise's method are restricted to common disinflationary episodes.

17 In Japan the average duration of an episode from peak to four quarters after the trough is 27 quarters, more than double the maximum period applied by Boschen and Weise (2001).