

# **The Natural Rate of Unemployment in Australia**

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# THE NATURAL RATE OF UNEMPLOYMENT IN AUSTRALIA

Daniel McKay\*

## Abstract

This paper has two principal objectives: i) to discuss the empirical and conceptual strength of natural rate theory; and ii) to describe and review several methods of estimating the natural rate of unemployment in Australia. Three general criticisms of natural rate theory are outlined, and some policy implications are examined. The methods of estimating the natural rate of unemployment are shown to yield imprecise and substantially divergent estimates which display little practical value in policy formulation.

## 1 CONCEPTS

The beginning of theoretical and econometric work on Phillips curves and the natural rate of unemployment was marked by the seminal article of Phillips (1958), which first publicised the inverse historical relationship between unemployment and the rate of change of money wages in the United Kingdom. Natural rate theory proper originated with the work of Friedman (1968) and Phelps (1967; 1968), which argued that although Phillips' proposed relationship may hold in the short run, a long-run trade-off between inflation and unemployment is unlikely because it would require persistent money illusion on the part of workers. Despite the clear origins of natural rate theory, though, no single body of work today commands universal recognition by economists as 'the natural rate theory'. Brockway (1995, p.898), noting that there are "almost as many hypotheses as there are hypothesisers," describes natural rate theory as "the class of explanations of involuntary unemployment." A less accommodating (but more tangible) summary of natural rate doctrine is as follows.

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\*University of Melbourne. I would like to thank John Freebairn and the Faculty of Economics and commerce for funds provided to me as a Kinsman scholar. Thanks also to Beth Webster for her help with an earlier draft.

1. The natural rate of unemployment is the only rate of unemployment at which the rate of change of some measure of inflation (usually price or wage inflation) will be constant.
2. Although short-run fluctuations of nominal variables such as aggregate demand can influence the actual rate of unemployment, they cannot influence the natural rate, which is determined by real supply-side factors.
3. Attempts to keep unemployment below the natural rate through monetary policy manipulation will generate persistently increasing inflation. Likewise, attempts to keep unemployment above the natural rate through monetary policy manipulation will generate persistently decreasing inflation.
4. In the absence of exogenous shocks to the economy, the unemployment rate will tend to approach the natural rate.

These points are referred to below as Propositions 1 to 4 respectively.

Natural rate theory attempts to explain both the determinants of the natural rate of unemployment and, by reference to it and other factors, movements in the actual rates of unemployment and inflation. According to Friedman's well-known quotation (1968, p.8), the natural rate is influenced by 'the actual structural characteristics of the Labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and Labor availabilities, the costs of mobility, and so on'. Other recognised influences are technology and productivity, tastes, the legal framework, wage flexibility, labour costs, the industrial relations environment, structural change, unemployment benefits, the real exchange rate and the information available to labour market participants.

Although the terms 'natural rate of unemployment' and 'NAIRU' (non-accelerating inflation rate of unemployment) are often interchanged in the economic literature, they do not necessarily mean the same thing. Some (certainly not all) macroeconomists treat the

natural rate as a market-clearing concept and the NAIRU as the rate of unemployment that generates consistency between the target real wage of workers and the feasible real wage determined by firms' mark-up policies and labour productivity. In this view, the NAIRU is determined principally by the balance of power between workers and firms in imperfectly competitive markets (see Snowdon *et al.*, 1994). Thus, the NAIRU concept has been used to explain why an economy may fail to reach the natural rate of unemployment. Instead of maintaining this conceptual distinction throughout the following discussion, theories that seem to approve of Propositions 1 to 4 are treated simply as 'natural rate theories'.

## **2 ASSESSMENT**

The purpose of this section is to summarise some of the most commonly-discussed conceptual and empirical issues bearing upon natural rate theory. The issues relate to: i) whether the history of unemployment and inflation is consistent with natural rate theory; ii) whether there is a single natural rate of unemployment on the one hand, or a natural 'range' of unemployment or multiple natural rate equilibria on the other; and iii) whether the actual rate of unemployment is attracted to the natural rate, or whether the natural rate follows the actual rate.

### **2.1 *The history of inflation and unemployment***

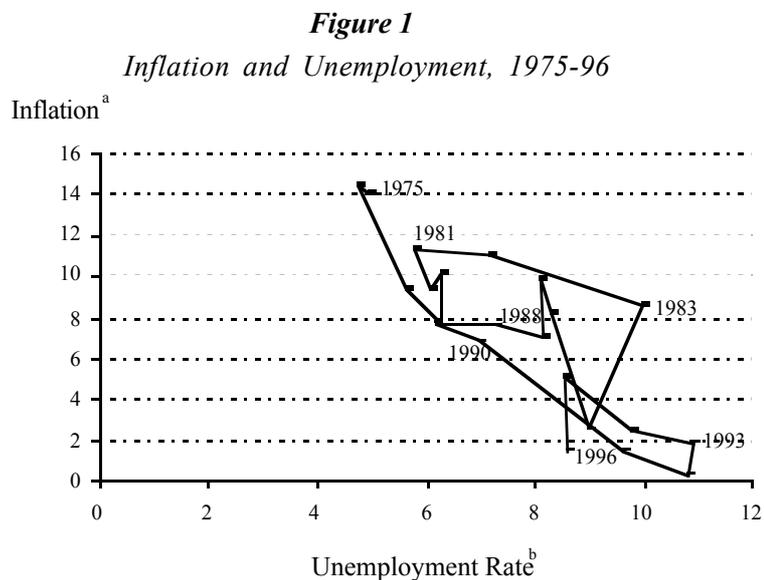
The economic literature tends to associate work on the Phillips curve and the natural rate of unemployment with the idea that inflation and unemployment will exhibit a negative correlation over time. This idea, according to some, does not fit the facts and has therefore been a major source of criticism of natural rate theory. As Crosby and Olekalns (1996, p.3) note, 'The lack of a negative correlation [between inflation and unemployment] over the period since the mid 1970s has led many macroeconomists to view the Phillips Curve as dead, and uninformative about the relationship between inflation and unemployment.' However, for at least two reasons, natural rate theory should not be understood to propose that inflation and unemployment will always exhibit a negative correlation.

First, simple aggregate-demand, aggregate-supply analysis with a vertical aggregate supply curve and perfectly flexible wages and prices suggests that whether prices are pro- or counter-cyclical depends upon whether economic shocks come from the demand or the supply side. To the extent that employment is pro-cyclical, an inverse relationship between unemployment and inflation will only exist when shocks to the economy come from the demand side. This result is perfectly compatible with natural rate theory, which holds only that demand-side (not supply-side) attempts to decrease unemployment below the natural rate will generate increasing inflation.

Second, even in an economy subject only to demand shocks, natural rate theory (as I have described it) holds that inflation and unemployment will exhibit an inverse relationship *only when unemployment is moving away from the natural rate*. To see this, suppose that unemployment is well below the natural rate. According to Friedman's theory of the natural rate, price and wage inflation (and the rate of monetary growth) must have increased far beyond their expected levels in order for this low rate of unemployment to exist. In order to sustain this low level of unemployment, an unexpected increase in the rate of monetary growth just as large as the last one must occur in the next period. If a relatively small and unexpected increase in the rate of monetary growth is imposed on the economy in the next period (so that the expectations gap is not quite as large), unemployment will increase (but not to the natural rate), as will inflation. That is, natural rate theory predicts a positive relationship between unemployment and inflation in these circumstances.

Thus, evidence of a positive relationship between unemployment and inflation is not, of itself, evidence against natural rate theory. More information is needed: first, have demand shocks or supply shocks been involved; and second, has unemployment been moving away from or towards the natural rate? Investigators tend to overlook these points when assessing the empirical validity of natural rate theory. Instead, the overall correlation between unemployment and inflation is often cited as telling evidence. For instance, evidence that the price level exhibits a pro-cyclical pattern in the United States is

given by Kydland and Prescott (1990). Blackburn and Ravn (1992) describe the conventional assumption of pro-cyclical prices as ‘a fiction’ (p.384) ‘which is overwhelmingly contradicted by the evidence’ (p.392). Brockway (1995) cites as evidence against natural rate theory the fact that in the United States, 1955 is the only year in which the Consumer Price Index has fallen since 1950 (the index fell from 26.9 to 26.8). In that year, therefore, inflation was falling, but unemployment also fell – from 5.4% to 4.3%. One might also refer to Figure 1, which shows that the calendar-year average levels of inflation and unemployment in Australia fell simultaneously in 1980 and 1984, and rose simultaneously in 1993.



<sup>a</sup> Cumulative change in price level over calendar year.

<sup>b</sup> Average over calendar year.

Source: ABS 6203.0 and 6401.0.

On the other hand, King *et al.* (1995) in the United States and Crosby and Olekalns (1996) in Australia find that the failure of many investigators to observe a negative correlation between inflation and unemployment is due to the different trend behaviour of the two time series. Crosby and Olekalns find that although the overall correlation between inflation and unemployment in Australia from 1959 to 1995 is 0.05, this is

because the negative correlation between the two series at the business cycle frequency is offset by the correlation in trends. When the data are filtered using the band pass filter technique so that low and high frequency movements in the series are removed, only medium frequency (i.e., business cycle) fluctuations remain, and a negative correlation between inflation and unemployment of -0.48 exists over the entire sample period. (Crosby and Olekalns describe the band pass filter technique in an appendix to their paper.) However, since these investigations do not attempt to uncover the source of shocks to the economy that have generated the movements in inflation and unemployment or to determine whether unemployment was moving towards or away from the natural rate, it is arguable that they reveal little regarding the empirical validity of natural rate theory.

The prediction of natural rate theory that inflation will increase persistently when unemployment is below the natural rate (and decrease persistently when above it) seems implausible to many economists. In particular, it is difficult for many to believe in a 'knife-edge' natural rate implying that small and sustained changes in the rate of unemployment can have such disastrous inflationary consequences (Tobin, 1995, p.40). Persistently increasing or decreasing inflation in developed countries has basically never happened. This is not strictly evidence against the natural rate hypothesis, since the unemployment rate may simply have reverted to the natural rate before the hypothesised inflation dynamics have had time to set in. A casual glance at Figure 1 indicates that the natural rate must have fluctuated quite dramatically for this explanation to hold. For example, assuming that inflation rises when unemployment is below the natural rate and falls when unemployment is above it, it seems that the natural rate was below 5.65% in 1977, above 8.28% in 1985, below 6.93% in 1990 and above 9.74% in 1994. Since natural rate theory denies that nominal demand policy can influence the natural rate, the theory requires that structural changes to the Australian economy must have caused these fluctuations. The difficulty of finding these explanations has led to the idea that the natural rate simply follows the actual rate (see Section 2.3).

Figure 1 also shows that inflation and unemployment have not exhibited a stable or predictable bivariate relationship over the last couple of decades. Econometric work that fails to find structural instability in a regression model relating inflation and unemployment over this time (e.g., Crosby and Olekalns, 1996) remains open to the criticism that structural stability is of little value in a model that makes unacceptably inaccurate forecasts. Obviously, more variables must be summoned to explain the variation in unemployment and inflation over time. Most modern macroeconomic models do just that. Since there is no reason why Propositions 1 to 4 cannot be produced by even the most complex macroeconomic model, this apparent need for more variables should not be interpreted as evidence against natural rate theory.

In summary, then, this discussion of the historical relationship between unemployment and inflation has attempted to establish the following points. First, empirical investigations into the correlation between inflation and unemployment tend not to look at the data in a very meaningful way. Second, since there is so little evidence of persistently increasing or decreasing inflation in Australia or elsewhere, the credibility of natural rate theory depends upon acceptance that the natural rate is subject to wide and high-frequency fluctuations that often avoid explanation in terms of structural change. Third, the relationship between inflation and unemployment is complex and seems to be influenced by the interaction of many other variables.

## ***2.2 Is there only one natural rate?***

Some economists argue that for intermediate rates of unemployment the short-run Phillips curve is quite flat (see, e.g., Tobin, 1995; McDonald, 1995). If so, it will be very difficult to tell how far the actual unemployment rate is from the natural rate, since estimates of the natural rate become very imprecise. There are numerous possible theoretical explanations why the short-run Phillips curve may be flat. For instance, there may be more than one rate of unemployment at which inflation is constant; that is, there may be a 'natural range' of unemployment rates, rather than a single natural rate. McDonald (1995) shows that several sets of reasonably plausible assumptions can generate a range of

equilibria. If there is an equilibrium range of unemployment rates under which inflation is constant, the scope for government and central bank intervention would be much greater than natural rate theory allows, since the authorities could attempt to encourage the attainment of what they see as the most desirable equilibrium outcome.

Another possibility is that there may be multiple unemployment equilibria. (This possibility differs conceptually from the concept of an equilibrium range of unemployment in that the hypothesis of multiple equilibria allows that there may be disequilibria between equilibria.) A simple model of multiple macroequilibria is developed by Diamond (1982). If the economy has multiple equilibria, the market may fail to end up at the ‘best’ one, and the government may be able to influence which equilibrium is chosen: ‘one of the goals of macroeconomic policy should be to direct the economy towards the best natural rate ... after any sufficiently large macroeconomic shock’ (p.882). Diamond argues that the failure of the authorities to intervene effectively after such a shock may induce the economy to settle at an equilibrium with an unnecessarily high rate of unemployment:

‘It seems to be a shared view that there would be no macroeconomic problems if prices and wages were fully flexible and correctly perceived. ... [But] once one drops the fictional Walrasian auctioneer and introduces trade frictions, one can have macro unemployment problems in an economy with correctly perceived, flexible prices and wages’ (p.881).

The simple and highly plausible idea that inflation may be stable at more than one single rate of unemployment implies that monetary and fiscal policy may influence the steady-state rate of unemployment. The dispersion and imprecision of estimates of the natural rate (see Section 3) can only support this view.

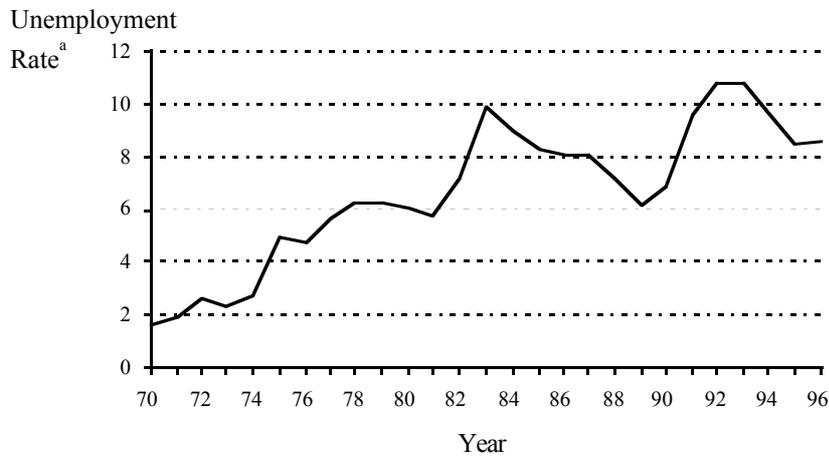
### **2.3 *Hysteresis***

The dramatic rise of unemployment rates in Australia (and the developed world in general) over the last couple of decades suggests that the natural rate of unemployment has also risen (see Figure 2). A large body of econometric work supports this view. A

potentially important source of increases in the natural rate may be structural change that has reduced the flexibility of the labour market (such as trade union power, unemployment benefits, government regulation and minimum wage laws). Many economists believe that these and other structural factors fail to account for the magnitude of increased actual and equilibrium rates of unemployment in recent times. Thus, the idea has arisen that the natural rate may depend to some extent upon the level of, and movements in, actual unemployment. This is the 'hysteresis' proposition. If nominal variables influence actual unemployment and actual unemployment influences the natural rate, then nominal variables influence the natural rate. This result obviously is anathema to standard natural rate theory (that is, it contradicts Propositions 2 and 3). Hysteresis renders quite meaningless the idea that there is a single rate of unemployment at which inflation will be stable (Proposition 1), since the natural rate moves with the actual rate. It also turns Proposition 4 on its head, since the natural rate follows the actual rate of unemployment.

Some natural rate theorists have attempted to incorporate hysteresis into natural rate theory. Perhaps the most prominent are Layard *et al.* (1991; 1994), according to whom 'there is short-term "hysteresis" ... But there is no long-term "hysteresis": there is a unique long-run NAIRU' (1994, p.14-15). If short-run hysteresis exists, there may be a short-run NAIRU which differs from the long-run NAIRU. For instance, they argue, some variables (such as the rate at which unemployment is changing and capacity utilisation) may affect wage and price setting and hence the short-run NAIRU when they are not equal to their long-run equilibrium values; but they may not affect the long-run NAIRU because they are endogenous. Since the long-run NAIRU is also 'subject to ... temporary change' (1994, p.15) by supply shocks, the story becomes quite confusing, and certainly far-removed from Friedman's original conception of natural rate theory. It also should always be borne in mind when considering such arguments that the long run is a sequence of short runs (Fair, 1984, p.31).

**Figure 2**  
*The Rate of Unemployment in Australia, 1970-96*



<sup>a</sup> Average over calendar year.

Source: ABS 6203.0.

One possible source of permanent hysteresis is suggested by insider-outsider theory, which suggests that the influence of employed workers over wage outcomes operates almost independently of the rate of unemployment. This implies that cost-push inflationary pressure may not vary much with the rate of unemployment. Another source of hysteresis is that, to the extent that labour skill is perceived to deteriorate progressively as unemployment duration increases, the natural rate of unemployment will be influenced by the proportion of the unemployed who are long-term unemployed. Since the unemployment rate is positively correlated with the ratio of long-term to total unemployment, a high unemployment rate implies that there will be many long-term unemployed people who may have lost many of their skills during their extended unemployment spell. It is almost as if the long-term unemployed did not exist as excess labour supply. Thus, as the unemployment rate increases, the workforce becomes less employable: both job mismatch and the wage pressure being exerted by employed workers increases, leading to an increased natural rate of unemployment. In other words, the greater the proportion of long-term to total unemployment, the higher will be the short-run Phillips curve for any given inflation expectation. For inflation to stabilise, the

economy must move further down this short-run curve to a higher rate of unemployment (see INDECS, 1995). Thus, an obvious policy objective is to increase the attractiveness of the long-term unemployed to potential employers. This was the principal focus of the Green and White Papers (Committee on Employment Opportunities, 1993; Commonwealth of Australia, 1994).

Other possible sources of hysteresis relate to persistence effects working through price-setting and labour demand. For example, firms' mark-up policies (of prices over wages) may be affected by fluctuations in demand. If changes in mark-up policy last for some years, this could influence equilibrium unemployment. Slow adjustment of labour demand – due, for example, to high costs of hiring and firing – will also tend to make unemployment persistent. It is, however, important to distinguish between slow adjustment of actual unemployment to a constant equilibrium on the one hand, and hysteresis – under which the equilibrium changes – on the other.

Cointegration analysis has been utilised to help with this distinction by testing whether a unique equilibrium relationship exists between unemployment and the structural characteristics of the economy (and, therefore, whether the hysteresis proposition can be rejected). Lewis and McDonald (1993) set out to apply this approach. They find, however, that the cointegrating framework is inapplicable, since the variables seem trend stationary. Another discouraging result is obtained by a study by Darby and Wren-Lewis (1993) which considers data from the United Kingdom over the period 1954 to 1989. The study finds no strong evidence of an equilibrium relationship between unemployment and the structural characteristics included in the model.

Another condition that should hold in order for hysteresis not to hold relates to the proportion of long-term to total unemployment. Flatau *et al.* (1991) test the suggestion by Cross *et al.* (1990) that there will be a tendency to converge on a unique duration composition of unemployment. They find that both unemployment and long-term unemployment are integrated of order one, but that there seems to be no equilibrium

relationship between the two variables. To the extent that long-term unemployed and short-term unemployed workers exert different effects on labour market outcomes, this suggests that there is no long-run equilibrium rate of unemployment and that the hysteresis account fits Australian data more accurately than the natural rate approach. Similar results are obtained by Karunaratne (1995).

Numerous studies have estimated the degree of hysteresis in unemployment. These studies tend to find that changes in the rate of unemployment exert a more significant influence on inflation than the actual level of unemployment (e.g., Gregory, 1986; Mitchell, 1987a; Watts and Mitchell, 1990; Alogoskoufis and Smith, 1991). The degree of persistence of unemployment is usually found to be quite high, although the degree of persistence differs significantly between studies (see Cromb, 1993). If changes in unemployment have an important effect on inflation, then inflation will tend to stabilise whenever the rate of unemployment is relatively stable, regardless of the actual rate of unemployment.

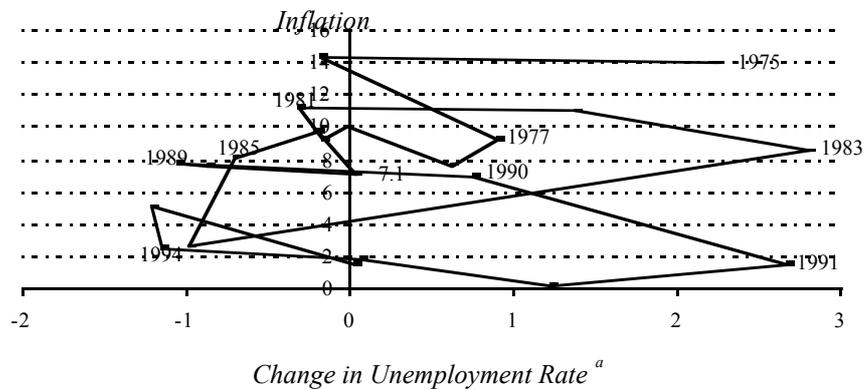
Changes in unemployment may influence wage outcomes for several reasons. Since increasing unemployment usually implies that more jobs are being lost than created, insiders may develop an increased fear of losing their positions and hence make less demanding wage demands. Changes in unemployment may also affect the duration composition of unemployment. The proportion of long-term to total unemployed tends to fall when unemployment is increasing. If the long-term unemployed put less downward pressure on wages than the short-term unemployed, wage pressure will tend to be less when unemployment is rising (see Cromb, 1993). A quantitative estimate of the effect of the duration composition of unemployment is given by Flatau *et al.* (1991), according to which a 10% increase in long-term unemployment increases the equilibrium real wage by about 0.3%.

The importance of the ‘change in unemployment’ effect is acknowledged by Layard *et al.* (1994), who note that the existence of effects of both the level of and changes in

unemployment on wages implies that a ‘speed limit’ applies to reductions in unemployment if wage and price acceleration is to be avoided. If this speed limit is exceeded, it will show up as unemployment being below the short-run equilibrium. Thus, ‘if last year we were above the long-run NAIRU and then fell back to it immediately, we would have rising inflation’. The authors cite three main reasons for this. First, in such circumstances, ‘very few workers need worry about their jobs and the fall in unemployment fuels wage pressure’. Second, there will be a backlog of long-term unemployed ‘who will not be perceived as desirable by employers’. Third, as unemployment is falling and the economy is expanding, ‘costs tend to be increasing sharply as firms move towards full capacity’ (*ibid*, p.14).

Figure 3 plots the relationship between inflation and changes in unemployment. It would seem quite uncontroversial to observe that Figure 1 (a plot of inflation versus the level of unemployment) exhibits a more regular pattern than Figure 3. Of course, this does not mean that the level of unemployment exerts a stronger influence over inflation than changes in unemployment, nor that hysteresis does not occur. What both figures do illustrate is that theories that attempt to explain macroeconomic fluctuations in terms of only a couple of variables are bound to be imprecise. Econometric models that yield meaningful results in general and a highly significant change of unemployment effect in particular tend to incorporate a number of variables other than inflation and unemployment (such as real GDP, technological progress, capacity utilisation, unemployment benefits and dummy variables for institutional changes and industrial relations outcomes).

**Figure 3**  
*Inflation and Change in Unemployment, 1975-96*



<sup>a</sup> Difference between average unemployment rate over current and previous calendar years. Source: ABS 6203.0 and 6401.0.

#### **2.4 Implications for natural rate theory**

The main conclusions of the preceding discussion are as follows. First, evidence regarding the relationship between unemployment and inflation is inconclusive and incomplete. Second, there may be more than one steady-inflation rate of unemployment. Third, through hysteresis, fiscal and monetary policy might be able to influence the natural rate by influencing the actual rate of unemployment.

The natural rate hypothesis holds that any sustained attempt to reduce unemployment below the current natural rate through aggregate demand management is futile and leads to ever-increasing inflation. If this view is incorrect, fiscal and monetary policy may have a greater potential role than natural rate theory allows. For instance, under hysteresis, policy should be geared to tackling an increase in the rate of unemployment as soon as it occurs, before it has time to drag the natural rate along with it. The presence of hysteresis suggests that although stimulatory monetary and fiscal policy may initially cause a higher rate of money and price inflation, inflation may

eventually stabilise at a lower natural rate of unemployment. As Tobin (1980, p.62) suggests,

It is possible that there is no NAIRU, no natural rate, except one that floats with actual history. It is just possible that the direction the economy is moving in is at least as important a determinant of acceleration and deceleration as its level. These possibilities should give policy makers pause as they embark on yet another application of the orthodox demand management cure for inflation.

Likewise, Watts and Mitchell (1990, p.161) argue that the implications of hysteresis 'point to the inappropriateness of counter inflationary policy based on deflationary monetary and fiscal policy.' Increasingly, temporary incomes policy is being seen as a more preferable way to restrain inflation and unemployment. For instance, Layard *et al.* (1991, p.485) argue that 'if unemployment is above the long run NAIRU and there is hysteresis, a temporary incomes policy is an excellent way of helping unemployment to return to the NAIRU more quickly'. Valentine (1993) also prefers wages policy over monetary policy. As well as 'nipping economic recovery in the bud', monetary policy is highly asymmetric in its social impact. For example, monetary tightening favours lenders – who generally don't need much help – over borrowers, upon whom the economy relies for entrepreneurship and who constitute the overwhelming majority of the population. Tight monetary policy also has an asymmetric impact on economic activity, in that tight monetary policy seems to be much more effective in achieving its objectives than easy policy. Valentine (1993) tentatively suggests that this may be due to effect of interest rates on firms' cash flows. An increase in the interest rate may put many firms in a position in which they barely have sufficient cash to cover existing commitments. A large proportion of the additional cash flow generated by interest rate reductions, on the other hand, seems to be used to pay off debt, with negligible positive effects on economic activity (see Reserve Bank of Australia, 1993). Economic expansion will be further impeded if firms expect the interest rate to rise again in the future (an expectation manifested by a positively-sloping yield curve).

A potential problem with wages policy, however, is that industrial awards tend not to cover high income groups. Thus, attempts to manage inflation and unemployment through wages policy may also have an asymmetric social impact, especially during economic downturns. Clearly it is not easy to find an approach to demand management that is unequivocally benign in distributive terms.

Natural rate theory occupies a central position in the policy formulation framework of governments and central banks around the world. Given this immense influence, it could only be expected that the theoretical and empirical validity of the theory be rigorously assessed. More surprising is the fact that natural rate theory has retained its prominence despite what seems to be a lack of convincing evidence in its favour. Perhaps this anomaly is partly due to the fact that the Phillips curve filled an important gap in Keynesian theory by providing a sub-full-employment link between output and inflation and was therefore enthusiastically embraced. Since then, Phillips curve and natural rate theory has been seen as the dominant macroeconomic unemployment theory against which others must present their case. Given the difficulty of establishing the empirical validity of any macroeconomic proposition, alternative theories may simply have been denied prominence because they failed to 'get in first'. Many economists are clearly frustrated by this state of affairs. According to Hughes (1994),

Since the early 1970s ... voters have been fed economic mumbo jumbo about 'natural' rates of unemployment, Phillips curves and the Non-Accelerating Inflation rate of Unemployment .... Unemployment is not simply (and not even mainly) the result of cost-push pressures in the labour market. A whole range of macroeconomic and microeconomic policies determine inflation trends.

Likewise, Mitchell (1987a, p.116) concludes that 'it is remarkable that the long-run properties of the NRU [natural rate of unemployment] models have retained credence.' Even Phelps (1979, p.103-4) argues that the natural rate hypothesis is only an approximation. Section 3 shows that even if we swallow the theory, the difficulties

associated with estimating the natural rate of unemployment are enough to raise serious questions regarding its practical value in policy formulation.

### **3 ESTIMATING THE NATURAL RATE OF UNEMPLOYMENT**

Conceptual and empirical evidence against natural rate theory neither logically nor historically precludes attempts to estimate the natural rate. Elmeskov (1993) illustrates this point well. The following quotes are taken from page 11.

- i) ‘Univariate time-series analysis of unemployment rates tends to support the notion that unemployment shocks persist, with relatively weak tendencies for unemployment to revert to its starting point.’
  
- ii) ‘In line with most theoretical and empirical work, this paper accepts the notion that there exists an “equilibrium” rate of unemployment (alternatively labelled the “normal” or “natural rate”), towards which economies gravitate’.

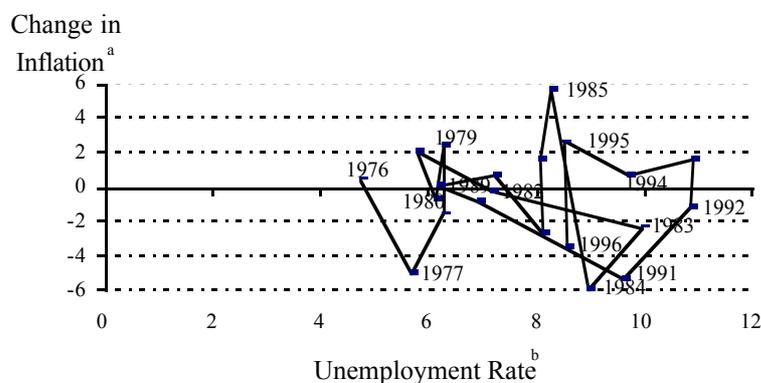
A significant problem associated with the estimation of the natural rate of unemployment is that the estimates are very sensitive to small changes in parameter estimates, especially when a model’s short-run Phillips curve is very flat. For example, in the Murphy model of the Australian economy (Powell and Murphy, 1995), the subtraction and addition of just one standard error to each of the parameter estimates in the model’s wage equation yields a lower bound for the natural rate of unemployment of 1.6% and an upper bound of 34.8% (see Section 3.4).

In this section examples of five general methods of estimating the natural rate of unemployment are discussed: rough graphical estimation, estimation assuming a stable short-run Phillips curve, estimation using a simple bivariate autoregressive model, estimation based on a wage equation, and estimation using a structural model of the macroeconomy. The natural rate of unemployment in Australia is estimated using all five methods.

### 3.1 *Rough graphical estimation*

A relatively simple way to obtain a rough estimate of the natural rate of unemployment is to plot unemployment versus the rate of change of inflation (Figure 4). If inflation is constant (or nearly so), this is an indication that unemployment is near the natural rate. Additionally, if inflation has risen in one year and fallen in the next (or *vice versa*), it seems reasonable to suspect that inflation may have been less capricious if unemployment had been somewhere between the levels prevailing in those respective years. Thus, the rate of unemployment at which the line connecting two consecutive data points in Figure 4 intersects the horizontal axis (representing constant inflation) gives an indication of the natural rate. As Figure 4 shows, this method of graphical estimation yields estimates of the natural rate ranging from around 5% in the mid 1970s to around 11% in the early 1990s. Between 1995 and 1996, the natural rate is estimated at about 8.5%.

**Figure 4**  
*Unemployment and Changes in Inflation, 1976-96*



<sup>a</sup> Measured as the change in the price level over the current calendar year less the change in the price level over the previous calendar year.

<sup>b</sup> Average over calendar year.

Source: ABS 6203.0 and 6401.0.

### 3.2 Estimation assuming a stable short-run Phillips curve

Elmeskov (1993) makes the following assumptions to estimate the natural rate of unemployment: i) the change in the logarithm of wage inflation is proportional to the gap between actual unemployment and the natural rate; and ii) the change in the natural rate between successive years is small enough to ignore. In other words, he assumes a stable log-linear short-run Phillips curve:

$$D^2 \log w = -a(u - u^*); a > 0 \quad (1)$$

where  $D$  is the difference operator,  $w$  is the wage level,  $a$  is a positive constant,  $u$  is the actual rate of unemployment and  $u^*$  is the NAIRU. Lagging by one period and ignoring any change in the natural rate between successive years,

$$D^2 \log w_{-1} = -a(u_{-1} - u^*) \quad (2)$$

Subtracting (2) from (1),

$$\begin{aligned} D^3 \log w &= -a(u - u_{-1}) \\ &= -aDu \\ \therefore a &= \frac{-D^3 \log w}{Du} \end{aligned} \quad (3)$$

Substituting (3) into (1),

$$\begin{aligned} D^2 \log w &= \frac{D^3 \log w}{Du} (u - NRU) \\ \therefore NRU &= u - \frac{Du}{D^3 \log w} \cdot D^2 \log w \end{aligned}$$

The time series are then smoothed to eliminate erratic movements. Giorno *et al.* (1995) apply this method to Australia. The resulting estimates are shown below.

<i>Year</i>	<i>Actual rate</i>	<i>Natural rate</i>
1990	7.0	8.3
1991	9.5	8.1
1992	10.7	8.0
1993	10.9	7.9
1994	9.7	7.8

### **3.3 Estimation using a simple bivariate autoregressive model**

Crosby and Olekalns (1996) follow the methodology of King *et al.* (1995) to estimate the NAIRU. They estimate the following equation using non-linear least squares:

$$\Delta\pi_t = \sum_{i=1}^p \beta_i (u_{t-i} - u_t^*) + \sum_{i=1}^k \gamma_i \Delta\pi_{t-i} + \phi_t$$

where  $\pi_t$  represents inflation,  $u_t$  represents unemployment,  $u^*$  is the NAIRU, and  $\phi_t$  are residuals. The authors' preferred regression equation includes three lags of unemployment and two lags of inflation. This procedure yields a NAIRU estimate over the sample period 1959-1995 of 7.70% (with a standard error of 5.42%), and of 9.57% between 1984 and 1995 (with a standard error of 2.96%). Thus, the 1984-1995 estimate has a 95% confidence interval of 3.7% to 15.5%. Accordingly, Crosby and Olekalns conclude (at p.11) that 'the NAIRU is difficult to estimate with much precision.'

### **3.4 Estimation based on a wage equation**

Empirical analysis of the process of wage determination in Australia is predominantly based upon the natural rate approach, with nominal wages expressed as a function of the level of demand – usually with the unemployment rate as a negative proxy – and inflation expectations represented by one of a number of alternative specifications, usually derived from previous movements in inflation (for a survey of such models, see Lewis and McDonald, 1993). The natural rate can be estimated from a wage equation by assuming

that the relevant equilibrium conditions hold and restricting the parameters of the estimated model appropriately. For instance, in the Murphy model of the Australian economy, the wage equation is estimated from quarterly data from first quarter of 1976 to the fourth quarter of 1991 as follows (Powell and Murphy, 1995, p.107):

$$\Delta \log W - B = -0.01113 + 0.612 \Delta \log P_{-3}^c + 0.388 \Delta \log P_{-1}^c - 0.942 \Delta u_{-1} - 2.077 [0.5(1-D)(u_{-2} - u_{-4})] + 0.000795 (u_{-4})^{-1}$$

where  $W$  is the money wage rate,  $B$  is the rate of Harrod-neutral technological progress,  $P^c$  is the Cobb-Douglas constant utility price index for consumption,  $u$  is the unemployment rate (as a proportion) and  $D$  is a dummy variable for the Prices and Incomes Accord (taking a value of 0 before 1983 and 1 thereafter). The natural rate is estimated by setting  $\Delta u$  at zero, setting  $D$  at one, assuming constant price inflation and setting the rate of growth of real wages to equal the rate of growth of labour productivity, so that:

$$\Delta \log W - \Delta \log P^c = B$$

Thus,

$$\begin{aligned} \Delta \log W - B &= -0.01113 + (0.612 + 0.388) \Delta \log P^c + 0.000795 u^{-1} \\ 0 &= -0.01113 + 0.000795 u^{-1} \\ u^* &= \frac{0.000795}{0.01113} = 7.1\% \end{aligned}$$

where  $u^*$  is the natural rate of unemployment. Of course, if the natural rate of unemployment has fluctuated significantly between 1976 and 1991, this estimate may not be particularly applicable to the Australian economy in 1991 – let alone 1997.

### **3.5 Estimation using a structural model of the macroeconomy**

The work of Layard *et al.* (1991; 1994) has been influential in natural rate circles. Their model of the labour market has the attractive property of explicitly incorporating both demand-pull and cost-push dynamics. The model employs an imperfect competition specification of wage and price setting behaviour in which the unemployment equilibrium

is determined by the absolute and relative magnitudes of wage and price pressures. The price, wage and aggregate demand equations in the simplified model are:

$$\begin{aligned} p - w &= \alpha_0 - \alpha_1 u + \alpha_2 (w - w^e) - \alpha_3 (k - 1) \\ w - p &= \beta_0 - \beta_1 u + \beta_2 (p - p^e) + \mathbf{z} + \alpha_3 (k - 1) \\ y &= \mathbf{x} - p \end{aligned}$$

where  $p$  is the price level,  $w$  is the money wage level,  $u$  is unemployment,  $w^e$  is the expected wage level,  $p^e$  is the expected price level,  $k$  is the capital stock,  $l$  is the labour force,  $\mathbf{z}$  is a vector of wage pressure variables (including trade union power, unemployment benefits and mismatch),  $y$  is aggregate demand and  $\mathbf{x}$  is a vector of variables affecting aggregate demand. All variables are measured in logarithms. Since inflation approximately follows a unit root process, it is assumed that

$$p^e = p_{-1} + \Delta p_{-1}.$$

It follows that

$$\begin{aligned} p - p^e &= p - p_{-1} - p_{-1} + p_{-2} \\ &= \Delta^2 p. \end{aligned}$$

In equilibrium,  $p = p^e$  and  $w = w^e$ . When these conditions are imposed on the price and wage equations, the NAIRU  $u^*$  can be expressed as

$$u^* = \frac{\alpha^0 + \beta^0 + \mathbf{z}}{\alpha_1 + \beta_1}$$

The authors' preferred estimate of the NAIRU in the United Kingdom, however, is not obtained from solving the complete structural model (which is an extension of the model above) for its steady-state value of unemployment. Given the problem of identifying and measuring all of the hypothesised explanatory factors, they prefer to infer the NAIRU from three principal indicators of inflationary pressure – actual price inflation, the size of the trade deficit and the change in unemployment. The coefficients and lags are implied by

the structural model. Thus, for example, the NAIRU for the UK in 1988-90 is estimated as follows (see also Cromb, 1993).

	<i>Percent</i>
Actual unemployment	7.3
The extent to which this differs from the NAIRU is estimated by the following inflationary pressures:	
a) related to price inflation ( $t - 1$ )	0.9
b) the trade deficit ( $t - 2$ )	1.4
c) less amount due to falling unemployment ( $t - 1$ )	<u>-0.9</u>
(Long-run) NAIRU	8.7

The estimate obtained in this way is over two percent higher than the estimate of 6.6% obtained from the structural model. Hence, a large part of the rise in equilibrium unemployment which is not captured by the structural model is allocated to ‘unmeasured’ variables. Increased skill mismatch is put forward as one candidate.

The equilibrium rates of unemployment in countries other than the United Kingdom – including Australia – are estimated using a single structural model (i.e., the same model, with the same parameters, is applied to all countries). Thus, the authors are quick to stress the unreliability of their estimates. Nevertheless, it seems worth producing the estimates ‘just to see if the numbers are sensible’ (p.435). The average value of equilibrium unemployment in Australia over the period 1980-88 is estimated at 6.10%. Even if this structural model were an accurate representation of the Australian economy during this period (and even the authors doubt that), its applicability to Australia in 1997 must be questioned.

### **3.6 *Are these estimates useful?***

This section has presented five methods of estimating the natural rate of unemployment in Australia. It is important to bear in mind that each method has been applied to a different time period. Still, the variability of estimates of the natural rate between different time periods and between methods remains quite striking. Most problematic for policy purposes, though, is the statistical imprecision of the estimates. Perhaps the most troubling implication of this imprecision is that it makes it very difficult to determine whether the economy is operating above or below the natural rate, especially when intermediate rates of unemployment prevail. Thus, in terms of natural rate theory, we cannot be sure whether to expect increasing or decreasing inflation under the current economic conditions and policy settings. In the face of this uncertainty, perhaps the most reasonable objectives for policy formulators to pursue are: first, in the short term, to use monetary and fiscal policy to ‘sustain reasonable price stability without unreasonably constraining activity’ (Fraser, 1993, p.3); and second, in the longer term, to oversee supply-side initiatives to reduce the natural rate of unemployment, regardless of what it is at the moment. Advocates of these policy objectives would obviously be relying very little on natural rate theory.

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