THE NAIRU, STRUCTURAL IMBALANCE AND THE MACROEQUILIBRIUM UNEMPLOYMENT RATE*

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I. INTRODUCTION

Recent policy orientation in the U.K., the U.S.A. and in Australia is based, it seems, on the view that inflation is the basic constraint on expansion (and fuller employment). A popular belief is that fiscal and monetary policy can no longer attain unemployment rates common in the sixties without ever-accelerating inflation rate of unemployment (NRU) which is considered to have risen over time. The non-accelerating inflation rate of unemployment (NAIRU) is a less rigorous version of the NRU but concurs that a particular, cyclically stable unemployment rate coincides with stable inflation. Labour force compositional changes, government welfare payments, trade-union wage goals among other "structural" influences are implicated in the rising estimates of the inflationary constraint.[1] The NAIRU has achieved such rapid status among the profession as a policy conditioning concept that it warrants close scrutiny.

This paper explores the idea that persistently weak aggregate demand creates a labour market which mimics features conventionally associated with structural problems (Okun 1973; Baily, 1982). The specific hypothesis examined is that the equilibrium unemployment rate is a direct function of the actual unemployment rate and hence the business cycle – the so-called hysteresis effect (Phelps, 1969; Hargreaves-Heap, 1980). An understanding of the labour market mechanisms which could promote the the hysteresis provides support to the conclusions of Burns and Mitchell (1985) who advocate aggregate policy expansion.

While the degree of slack necessary to control inflation may have increased, the underlying cyclical labour market processes analysed in this paper, can be exploited by appropriate demand policies to reduce the steady state unemployment rate. To the extent that the inflationary constraint operates through expectations of a minimum level of unemployment (say, 7 per cent) being built into individual behaviour within the economy (independent of whether a NAIRU actually exists or has increased over time), an explication of the possible cyclical influences could modify this source of rigidity.

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[1]The NRU and NAIRU both associate a particular level of unemployment with a stable inflation rate. The former is strictly confined to a Walrasian general equilibrium world. The NAIRU is less constrained and can be consistent with disequilibrium phenomena not arising from misperceptions or slow adjustment. The plausibility of the NRU hypothesis is widely challenged (see Tobin, 1980; Burns and Mitchell, 1983).

The plan of the paper is as follows. Section II shows that the conventional NAIRU estimates derived from aggregate wage equations may be influenced by the business cycle. It is plausible that rising estimates reflect prolonged recession rather than increasing structural rigidities in the labour market. Section III outlines the cyclical labour market adjustments which promotes the hysteresis effect and increasing structural imbalance at low levels of activity. Section IV seeks to link wage determination and inflation to these cyclical market responses by specifically examining the manner in which increasing structural imbalance in the labour market may affect wage movements. We outline a conceptual unemployment rate which is associated with price stability, in that it temporarily constrains the wage demands of the employed and balances the competing distributional claims on output. This macroequilibrium unemployment rate (the MRU) is importantly, sensitive to the cycle due to the impact of the cyclical labour market adjustments on the ability of the employed to achieve their wage demands. In this sense, the MRU is distinguished from the conventional steady state unemployment rate, the NAIRU, which is not normally conceived to be cyclically variable. Section V develops the formal properties of the MRU, particularly emphasising the hysteresis effect (that is, the cyclical sensitivity) to conceptually demarcate it from the NAIRU. It can be demonstrated that the MRU model yields the possibility of a long-run inflation-unemployment trade-off, a result not available in a conventional NAIRU model. Section VI and VII provide some supporting econometric analysis of the MRU model and tests the plausibility of the hysteresis hypothesis (that is, that cyclical labour market adjustments shift the MRU). The link between the MRU and wage determination is modelled with reference to Australian data.

II. Measuring The Nairu

Could the increasing NAIRU estimates reflect a decade or more of high actual unemployment rates and restrictive fiscal and monetary policies, and hence, not necessarily be indicative of increasing structural impediments in the labour market? The NAIRU is popularly derived by solving a system of difference equations (wage and price) for their steady state properties. The wage adjustment process is written as function of excess demand for labour, and usually, the unemployment rate is used as a negative proxy for the excess demand. Consequently, two mapping must be modelled. First, the wage-excess demand relationship and, second, the unemployment-excess demand relationship. Combining these relations produces the wage adjustment function, from which the NAIRU estimated. The following simple (linear) wage model is assumed:

$$\dot{w} = a_1 + a_2 Z + a_3 \dot{p}^e \tag{1}$$

where $\dot{w}$ is money wage inflation, Z is money wage inflation, Z is the excess demand for labour, $\dot{p}^e$ is inflation expectations and a_1 reflects forces which promote real wage growth independent of Z (like, productivity growth and variations in profit margins, both of which could be cyclically sensitive).[2] The unemployment-excess demand equation is:

[2]Assuming a simple price mark-up model, $\dot{p} = \dot{w} - \dot{g}$ if the mark-up (m) is constant. $\dot{w} < \dot{g}$ are fully transmitted into p through m. Firms facing quantity constraints in the product market may cut margins as wage pressures mount rather than lose their market share. Thus $\dot{p} = \dot{w} - \dot{g} + \dot{m}$, where $\dot{m}$ is normally assumed to be zero. The equilibrium real wage growth (assuming a simple Phillip's Curve) can be written as $\dot{w} - \dot{p} = (\dot{g} - \dot{m}) + f(u)$; $f(u) = 0.(\dot{g} - \dot{m})$ reflect forces which influence real wage growth independent of excess demand for labour. Other variables could add generality to the constant term (see Thirlwall, 1983).

$$u = b_1 - Z \tag{2}$$

where u is the unemployment rate, b_1 is the measure of frictional and/or structural unemployment (that is, labour market rigidities), and Z is scaled so that its coefficient is unity. Aggregate (1) and (2) gives:

$$\dot{w} = a_4 - a_2 u + a_3 \dot{p}^e \tag{3}$$

with $a_4 = (a_1 + a_2 b_1)$. Clearly, a_4 is a composite of structural and nominal demand influences, although separate identification is difficult. Solving for the steady-state unemployment rate, u^* yields:

$$u^* = (a_1/a_2) + b_1 \tag{4}$$

which shows the composite influence on the conventional measures of the NAIRU.

The strict NRU concept, faithful to Friedman insulates the NRU from aggregate demand influences. In this case $a_1 = \dot{g}$ and the influence of other variables like $\dot{m} \neq 0$. is not accounted for. We contend that a_1 is cyclically unstable and does not exclusively indicate productivity growth. Even if $a_1 = \dot{g}$, endogenous productivity changes (associated with labour hoarding, for example) allow the cycle to influence the estimated NAIRU (see Thirlwall, 1983).

Given that the rising NAIRU estimates have occurred over a decade of excess capacity, high unemployment rates, slack demand and low productivity growth it is plausible that these increases reflect cyclical forces rather than basic structural labour market changes. Recent work by Dornbusch and Fischer (1984) and Mitchell (1984) negates the view that major increases in unemployment are due to the structural changes like demographic changes or welfare payment distortions.

III. Hysteresis and Cyclical Labour Market Adjustment

The interaction between the actual and equilibrium unemployment rates has been termed the 'hysteresis' effect (Phelps, 1970; Hargreave-Heap, 1980; *State of Play* 3, 1984). The significance of hysteresis, if it exists, is that the unemployment rate associated with stable prices, at any point in time, should not be conceived of as a rigid non-inflationary constraint on expansionary macro policy. The equilibrium rate itself, can be reduced by policies which reduce the actual unemployment rate. We therefore use the term MRU, as the non-inflationary unemployment rate, as distinct from the NAIRU, to highlight the hysteresis mechanism. The idea is that structural imbalance increases in a recession due to the cyclical labour market adjustments commonly observed in downturns, and decreases at higher levels of demand as the adjustments are reserved. Structural imbalance refers to the inability of the actual unemployed to present themselves as an effective excess supply.

The non-wage labour market adjustment which accompany a low pressure economy which could lead to hysteresis are well documented (see Okun, 1985; Hargreaves-Heap, 1980). Training opportunities are provided with entry level (average) of the labour force declines as vacancies fall. New entrants are denied relevant skills (and socialisation

associated with stable work patterns) and redundant workers face skill obsolescence. Both groups need jobs in order to update and/or acquire relevant skills. Skill (experience) upgrading also occurs through mobility which is restricted during a downturn.

IV. Inflation, Wage Determination and Structural Imbalance

An extensive literature links the concept of structural imbalance to wage and price inflation. It can be shown that a non-inflationary unemployment rate can be defined which is sensitive to the cycle. The main strands of this literature are summarised below.

Inflation results from incompatible distributional claims on available income, unemployment can temporarily balance the conflicting demands of labour and capital by disciplining the aspirations of labour so that they are compatible with the profitability requirements of capital (Kalecki, 1971). The wage-price spiral lull could be termed a macroequilibrium state in the limited sense that inflation is stable. The implied unemployment rate under this concept of inflation is termed in this paper the MRU and has no connotions of voluntary maximising individual behaviour which underpins the NAIRU concept (Sawyer, 1983).

Wage demands are thus inversely related to the actual number of unemployed who are potential substitutes for those currently employed. Increasing structural imbalance (via cyclical non-wage labour market adjustment) drives a wedge between potential and actual excess labour supply, and to some degree, insulates the wage demands of the employed from the cycle. The more rapid the cyclical adjustments, the higher is the unemployment rate associated with price stability.[3]

Stimulating job growth can decrease the wedge because the unemployed develop new and relevant skills and experience. These upgrading effects provide an opportunity for real growth to occur as the cycle reduces the MRU.[4] Why will firms employ those without skills? An important reason is that hiring standards drop as the upturn begins. Rather than disturb wage structures firms offer entry level jobs as training positions. It is difficult to associate wage demands (in excess of current money wages) with the workforce.[5] While

[3]In the medium term, increasing labour market segmentation (more jobs subject to internal labour market arrangements) also promotes the wedge between potential and actual excess labour supply and thereby increases the upward bias (a ratchet) in the excess supply of labour-wages demand relationship.

[4]Okun (1973) and Vroman (1977) provide impressive evidence that the gains from mobility, skill acquisition and output by maintaining a high pressure economy are significant. Okun maintains this as the basic reason why government should eschew deflationary strategies.

[5]If firms are quantity constrained (excess capacity) and workers are not at their margin of indifference then both parties respond to increased demand for the output and/or services in quantity terms. With rationing a firms labour demand is not a function of the real wage. Dornbusch and Fisicher (1984) claim that Burns and Mitchell (1983) argue that current and expected sales, not wages determine employment. This misrepresents the argument which is contingent on the state of the cycle and the existence of positive adjustment costs. Some cost pressures may accompany an expansion (via OJT) but if involuntary unemployment exists the current real wage is sufficient to induce labour supply. Procyclical productivity growth would help offset any adjustment costs associated with a firm's labour force expansion.

the increased training opportunites increase the threat to those who were insulted in the recession this is offset to some degree by the reduced probability of becoming unemployed.

Phelps (1979), himself, argues that the natural rate hypothesis is only an approximation because it neglects feedback upon the unemployment rate from the variables that are explicitly recognized in the theoretical framework. Phelps, (1979), pp.103-104) says that a 'long-run Phillip's Curve cuts through the natural unemployment rate considered as a point, with the characteristically negative slope but only within some band roughly centred on the natural rate'. He concludes that the inadequacy of the NRU hypothesis (as an exact economic law) is just a reflection of the inadequacy of orthodox economic theory. One wonders why the NRU hypothesis has become so ingrained given Phelps's early belief in its approximate nature. James Tobin (1980, p.62) put it succinctly

> 'It is possible that there is no NAIRU, no natural rate, except one that floats with history. It is just possible that the direction the economy is moving in is at least as important a determination 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'.

V. The MRU Model

It can be shown that a long-run trade-off between inflation and unemployment exists, other things equal, if hysteresis is operating. The general wage adjustment function can be written as:

$$\dot{w} = a_4 - a_2 (u_t - u_t^*) + a_3 \dot{p}^e \tag{5}$$

where u^*_t is the current MRU, and all other things are defined as before. The hysteresis effect, that is, the tracking of the actual unemployment rate by the equilibrium rate of unemployment could be modelled in a number of ways. Coe and Gagliardi (1985) defined u^* as a distributed lag on past values of actual unemployment while Hargreaves-Heap (1980) represented u^* as a weighted average of the actual unemployment rate and the equilibrium rate in the last period.[6] The following adjustment model employs the latter specification and is a plausible, though and *ad hoc* representation of the hysteresis idea.

$$u_t^* - u_{t-1}^* = \lambda(u_{t-1} - u_{t-1}^*) \tag{6}$$

The value of λ measures the sensitivity of u_t^* to the state of activity.[7] The higher is λ, other things equal, the greater the capacity of aggregate policy to permanently reduce unemployment without ever-accelerating inflation.

[6]Hargreaves-Heap (1980) uses an equation like (7) to show that the 'natural rate' is not constant from one time period to another. He argues that a range of explanations (including neoclassical and neo-Keynesian) can be used to justify the hysteresis hypothesis. Our explanation is post or neo-Keynesian in flavour.

[7]Hargreaves-Heap (1980) draws an interesting comparison between λ and the adjustment coefficient found in adaptive price expectation model. In the same way that people may only begin to internalise inflation after several years of high inflation, ". . . it is plausible to argue that another year of high unemployment will increase the numbers structurally unemployed when there has been a recent history of high unemployment."

From (6) deviations of the actual unemployment rate from the MRU lead to changes in the MRU of the order:

$$u_{t-1} - u^*_{t-1} = (1/\lambda)(u^*_t - u^*_{t-1}) \tag{7}$$

This implies that (5) can be written as:

$$\dot{w} = a_4 - (a_2/\lambda)(u^*_{t+1} - u^*_t) + a_3 \dot{p}^e \tag{8}$$

For any given MRU, as long as $\lambda > 0$, a long-run trade-off between the inflation rate and the unemployment rate is implied by the MRU model, even if conventional homogeneity properties ($a_3 = 1$) are assumed. The orthodox NAIRU model is a special case of the general MRU model and requires λ to be constrained to zero.[8] While the traditional trade-off test involved questions about the magnitude of a_3, the relevant test between the NAIRU and the MRU models focuses on the values of λ.

The cyclical sensitivity of the MRU requires $\lambda > 0$. The MRU model suggests that a government can choose an inflation – unemployment combination subject to the value of λ and the sensitivity of $\dot{w}$ to deviations of u_t from u^*_t. The smaller the latter (say, via an income policy) the greater the ability of government to forge a real growth. By targeting a rate of unemployment ($t_u{}^*$) below the current MRU (u^*_t) some initial inflation occurs. Yet, due to the hysteresis the gap between $t_u{}^*$ and u^*_t progressively decreases, reducing subsequent inflation until convergence occurs (MRU $= t_u{}^*$) and inflation stabilises.[9]

VI. Estimation

To provide some empirical support for the MRU model (the hysteresis effect) an awards equation and an earnings equation are estimated. While desiring simplicity in our specification the unique nature of the Australian wage determination must be embraced. Estimating a simple expectations-augmented Phillip's Curve earnings model, as is conventional practice, would ignore the institutional richness of our system.[10]

(a) *The Awards Equation*

This equation is the basis for a complete wage-price model if the Arbitral Tribunals (which cover about 85 per cent of wage-earners) play a central exogenous role in the

[8]Even if $\lambda = 0$, the NAIRU estimates are cyclically sensitive as shown in Section II.

[9]Coe and Gagliardi (1985) estimate a wage equation for 10 OECD countries including Australia. They argue that the "implications of this hypothesis of hysteresis in the natural rate hypothesis: if the other structural factors affecting the natural rate are unchanged, then the disinflationary (inflationary) impact will disappear over time as the natural rate catches up with the actual rate (p.11)."

[10]Mitchell and Vella (1985) test rival explanations of award wage behaviour with an expectations-augmented Phillips Curve being outperformed in every guise by an institutionally specified equation.

determination of earnings. The specification of the MRU model estimated is expressed in quasi-reduced form with variables reflecting institutional, employer and employee behaviour. Thus:

$$\dot{w} = a_0 + a_1 \dot{w}_{t-1} + a_2 \dot{p}_{t-1} + a_3 \dot{rw}_t + a_4 S_{t-1} + a_5 (u^*_t - u_t) + a_6 DI + e_t \quad (9)$$

$$u^*_t = (1 - \lambda)\, u^*_{t-1} + \lambda u_{t-1} \quad (10)$$

where $\dot{w}_t$ is the four-quarter logarithmic change in award wages, $\dot{p}_{t-1}$ is the lagged four-quarter logarithmic change in the price index, $\dot{rw}_t$ is the four-quarter logarithmic change in real wages, S_{t-1} is the logarithm of the four-quarter moving-average of strikes, $(u^*_t - u_t)$ is the divergence between the MRU and the actual unemployment rates, DI is an incomes policy dummy.

A four-quarter change specification relies on certain assumptions about the timing of wage settlements. It may also induce serial correlation. The latter is an empirical question and should not constrain the specification. Unlike Kirby's work (1981), a simple quarterly model was found to be inferior in a statistical sense. The important issue is that the four-quarter model is a better depiction of successive wage rounds, given the lagged and staggered nature of awards determinations.

The Cyclical Sensitivity of the MRU.

Two effects are estimated in the wage equations. First, the influence of $(u^*_t - u_t)$, where u^*_t is modelled as a conventional, yet plausible adjustment function (10). There are several ways to estimate the wage equation – MRU adjustment mechanism. A common technique is to eliminate the unobservable u^*_t from the wage equation using a Koyck procedure. This transformation, unfortunately introduces a number of well-known econometric difficulties.[11]

To overcome these problems we use a grid search procedure inspired by Solow (1969). Instead of eliminating u^*_t from the wage equation and estimating λ indirectly from the coefficient on the lagged dependent variable we assume a range of plausible values for λ and simulate the MRU equation (17) to generate a number of MRU time series. In each case, the initial u^*_{t-1} value is chosen to equal the actual u for 1966 (1), which is far enough from the start of our estimation period to minimise its effect on each series. The MUG variable is the u^*_t series (for a particular λ) less the actual unemployment rate. A range of MUGs for each assumed λ was created.[11] The preferred equation is derived from the value of λ which

[11]We avoid the bias, non-minimum variance, multicollinearity (although unlikely with first differences) and any degrees of freedom problems associated with a Koyck Transformation. No overlapping residuals are constructed. A Koyck equation was estimated but matrix inversion problems associated with multicolinearity produced unreliable results. Both approaches were used successfully on UK data. Significantly, the estimated value of λ derived from the Koyck equation (1-coefficient on lagged dependent) was very close to the value of λ of derived from the grid search procedure. A number of starting dates were tried to test the sensitivity of the results. A complete description of the procedure including the various runs using different values of *lambda* is available from the author.

maximises the corrected R^2. Assuming the diagnostics reveal no serious specification errors, the highest $\bar{R}^2$ criterion generates the best parameter estimates.

Given the traditional role of the level of unemployment in aggregate wage equations one might argue that the MUG variable is just replicating the influence on wages of the actual unemployment rate. We nested both variables in the wage equations and the traditional measure (in various linear and non-linear guises) was never significant. A Koyck transformation would replace $(u^*_t - u_t)$ with the four-quarter change in the unemployment rate. The change and level variables were also nested in the same regressions and as before the level of unemployment was never significant (Harvey, 1980, p.177). This is in striking contrast to the findings of Dornbusch and Fischer (1984) among others (see Hughes, 1985, p.407).

Intertia

The lagged dependent variable is included to capture the effects of institutional lags, catch-ups, intertia and wage-wage interactions which typify a staggered wage-setting process. Submissions to wage cases focus on the path the economy has taken up to the hearings.

Forward-Looking Behaviour

Real wage resistance theories believe that workers expect that the purchasing power of their wages be maintained over time. The likelihood of productivity growth could also promote expectations that awards should increase independently of the price indexed component. To capture the forward-looking behaviour implied by these expectations the current four-quarter change in real awards is used. This variable is the proxy for expectations formed at the start of any bargaining period yet raises endogeneity considerations because it clearly is simultaneously determined by $\dot{w}$ and $\dot{p}$. Single equation OLS estimates are biased and inconsistent and two-stage least squares (2SLS) is used to remove the inconsistency.

An interesting point emerges quite apart from the econometric justification for using 2SLS. We use $r\dot{w}_t$ as the proxy for forward-looking behaviour. The expectations are exogeneous (predetermined) in the current period but are dependent on the current values of the variables in the system. The instrument (fitted value) for $r\dot{w}_t$ is the best linear combination of the exogenous variables implied by the wage-price system and could be interpreted as the efficient (but not perfect) expectation of $r\dot{w}_t$.

Expectations

Modelling price expectations in wage equations has been a major preoccupation of applied economists since Friedman (1968). Many *ad hoc* hypothesis have been tested with varying sucess. We use a simple expectations-generating hypothesis in our model.[12] The

[12]The available macro data inhibits our ability to develop sophisticated expectations variables. Kirby (1981) correctly notes that any test of an expectations coefficient involves a joint test of the parameter and the generating mechanism. Discriminating between the two is difficult. We experimented with Box-Jenkins model as a possible proxy expectations generator. The logic is as follows. Some unknown model generated the actual price series. If an adequate forecasting model can be discerned then via observational equivalence postulates it can be used as if it is the true model. The main conclusion by this author is that the actual series is virtually identical to the forecasts if the ARIMA process is identified properly. Given the paucity of economic meaning behind such modelling we did not use the forecasts in the subsequent estimation.

Arbitration Commission considers the immediate past price change as indicative of changes in the cost of living. Consistent with the aim of simple specification the one period lagged price change is included as the relevant price variable.

Strikes and Incomes Policy

The tribunals are an important arbitrator in industrial conflict and hence, the use of trade union power variables in wage studies has a long history. The measures used in this study, S, is the ratio of average working days lost to the number of civilian wage and salary earners.[13] A simple dummy, DI is used to test for shifts associated with incomes policy. It is equal to one for 1975(1) to 1981(2) and zero otherwise.

(b) *The Earnings Equation*

The estimated equation took the form of:

$$\dot{E} = b_0 + b_1\dot{E}_{t-1} + b_2\dot{w}_t + b_3\,(u^*_t - u_t) + e_t \qquad (11)$$

where $\dot{E}_t$ is the four-quarter logarithmic change in earnings. Earnings inflation can be expressed as the sum of awards inflation and the rate of change in drift. The awards-earnings relationship is the subject of an ongoing debate. Three distinct positions are identifiable. First, market forces determine price changes and arbitration is a rubber stamp – a chimera of authority. The rate of awards inflation, being itself a function of excess demand, has no independent place in the earnings equation (Challen and Hagger 1979). Second, award wages are determined exclusively by non-market (institutional) forces. The awards variable is constrained, *a priori*, to unity in the earnings equation, which, therefore, becomes a wages drift equation (Klein and Ball, 1959). Third, the earnings equation includes the four-quarter change in awards as an independent but may be associated with a decrease in the over-award component (Johnson, Mahar and Thompson, 1974). The awards equation then includes variables reflecting inertia, wage relativities and other institutional forces in addition to quantity constraints imposed by the level of activity. By adopting this approach our earnings equation reflects the view that the arbitral Tribunals are a dominant influence via their Tribunals are a dominant influence via their award decisions. *A priori*, we expect the awards variable to have a positive (but less than one) coefficient. Unfortunately, no acceptable technique is available to categorically decide the question of causality.

The inclusion of the lagged dependent variable and MUG is justified as before. As MUG increases the probability of unemployment falls, although the potential excess more closely approximates the actual unemployment. A variety of other variables in level and rate of change form were tested, including productivity, vacancies, hours, prices and overtime. None were satisfactory. Prices appear to impact via awards. The other variables may be reflected in the lagged dependent of in MUG.

[13]Non-wage strikes were excluded with no noticeable changes. One clarification is necessary. If $u^*_t = u_t$ (MUG zero) then by definition the inflationary impulses emanating from the bargaining process are zero. S represents bargaining conflict and shows of strength by workers to the Commission. If S entered the wage equation in its current form a zero restriction must be placed on it when $u^*_t = u_t$. by lagging S we avoid this complexity and maintain our general 'inertia-lagged impact' approach.

VII. Results

Both models were estimated on quarterly data from 1969(3) to 1983(4). The awards results are presented in Tables I to IV and the earnings results in Table V. The principal findings are summarised as follows:

A value of λ between 0.5 and 0.6 was associated with the best specified awards equation. The sensitivity of the equilibrium unemployment rate to movements in the actual unemployment rate, implied by λ, is lower and the lags more complex in the earnings equation. The hysteresis hypothesis is thus not inconsistent with the data in both

Table I
Awards Equation $\lambda = .5$ 1969(3) *to* 1984(4)

	1.1 OLS	1.2 2SLS	1.3 2SLS	1.4 OLS	1.5 2SLS	1.6 2SLS
Constant	0	-0.008	-0.007	-0.004	-0.009	-0.01
	(0.11)	(1.15)	(1.09)	(1.07)	(1.69)	(1.88)
$\dot{w}$ (-1)	0.15	0.42	0.46	0.27	0.52	0.59
	(2.43)	(5.42)	(5.6)	(4.78)	(8.13)	(8.41)
$\dot{w}$ (-1)	(0.74	0.54	0.49	0.70	0.56	0.51
	(6.52)	(4.39)	(3.91)	(9.62)	(5.75)	(5.11)
$r\dot{w}$	0.85	0.44*	0.41*	0.82	0.55*	0.54*
	(11.87)	(3.36)	(3.00)	(13.61)	(5.22)	(4.80)
S	0.10	0.17	0.18	0.06	0.08	0.07
	(2.34)	(2.64)	(2.61)	(1.80)	(1.46)	(1.21)
MUG 5	0.03	0.07*	0.06	0.04	0.06*	0.07
	(2.24)	(2.46)	(3.18)	(3.35)	(2.87)	(4.67)
$D1$	-0.006	-0.02	-0.019	-0.004	-0.01	-0.01
	(1.66)	(3.60)	(3.37)	(1.30)	(2.86)	(2.43)
$D2$				-0.03	-0.05	-0.06
				(4.82)	(5.33)	(5.73)
$\bar{R}^2$	0.96	0.94	0.93	0.97	0.96	0.96
s.e.(100)	1.00	1.00	1.00	0.80	1.00	1.00
D.W.	2.04	1.87	1.85	2.28	2.32	2.30

t Statistics in parentheses

* Instrument used in place of variable

equations.[14] With $\lambda = 0.5$ a one percent increase in the actual rate of unemployment increases the natural rate by 0.5 per cent by the end of the next quarter. This is a fairly rapid work skill attrition rate which requires more analysis elsewhere.

The awards equations are homogenous with respect to price variables and the appropriate restriction on nominal variables is data-accepted. The homogeneity restriction on the awards variable was rejected in every earnings equation. This implies that while award wages are fully indexed in the long-run and pass on to earnings quickly they impact by reducing drift.

Even with homogeneity, the innovative nature of the MRU model yields a long-run trade-off between award inflation and divergences between the actual unemployment rate and the MRU. A similar earnings inflation-MUG trade-off is also not inconsistent with the data.

In all equations the coefficient signs are *a priori* consistent and the simple diagnostics are favourable. Table I displays the results of OLS and 2SLS regressions of awards with the value of λ constained to equal 0.5. Equation 1.2 assumes that $\dot{rw}$ and MUG5 are endogenous and uses instruments for both. 1.3 more realistically only instruments $\dot{rw}$. While 1.2 and 1.3 are similar, suggesting that MUG5 is presenting no endogeneity problems, taken together they are substantially different and superior to the OLS equation 1.1.

Table II presents the restricted regression results for awards. Given the asymptotic estimation technique used, an F test based on small sample properties can only be approximately relied upon. A χ^2-test ($-2 \log (SSRU/SSRR)$) is used instead and the restrictions were accepted in every case (Dawson, 1981).[15] The summed coefficients on the lagged nominal variables are never significantly different from unity (at 5 per cent).[16] Unrealistic coefficients values on the other variables may indicate misspecification despite the strong homogeneity. In Equation 1.3, for example, a 10 per cent increase in strikes leads to a 1.8 per cent increase in awards. The long-run value is 3.3 per cent. The indexation dummy indicates a small constraining influence on wage inflation. These results seem reasonable.

Interpretation of the coefficient on MUG5 in 1.3 shows the unique features of our model. The long-run elasticity of wage changes with respect to MUG is 0.11. If from equilibrium, the actual rate of unemployment is pushed below the current MRU by say, 1 per cent, award wages inflate by 0.11 per cent, a fairly flat response. However, given the value of λ (0.5) the next period MRU is 0.5 per cent is consequently smaller. Importantly, the acceleration of award wage inflation is finite as u^* converges on the actual unemployment rate. Table III depicts this process.

[14]The results with $\lambda = 0.6$ were similar and indicate that the properties of the model were not predicated on a convenient value of λ. Values below 0.5 and above 0.6 produced poor results. The stability of the MUG5 equations could indicate that λ itself does not fluctuate within the sample period.

[15]SSRU is the unrestricted sum of squared residualss and SSRR is the restricted counterpart. The ratio is asymptotically distributed as χ^2 with degrees of freedom equal to the number of imposed restrictions (Dawson, 1981).

[16]Estimated coefficients on lagged dependent variables are generally biased downwards in small samples and no attempt is made to gauge the extent of the bias. The bias decreases proportionately with the number of observations, but expands proportionately with the number of observations, but expands proportionately to the order of lag. Overlapping lags thus maintain the bias even though quarterly data is used.

TABLE II
Awards Equation $\lambda = 0.5$ 1969(3) *to* 1983(4)

	Restrictions imposed			
	1.2R 2SLS	1.3R 2SLS	1.5R 2SLS	1.6R 2SLS
Constant	-0.008	-0.008	-0.007	-0.009
	(1.27)	(1.20)	(1.48)	(1.68)
$\dot{w}$ (-1)	0.42	0.45	0.51	0.58
	(5.45)	(5.65)	(8.07)	(8.36)
$\dot{p}$ (-1)				
$r\dot{w}$	0.45*	0.42*	0.52*	0.50*
	(3.57)	(3.20)	(5.11)	(4.63)
S	0.16	0.16	0.12	0.12
	(2.94)	(2.81)	(2.54)	(2.60)
MUG 5	0.07	0.06	0.05*	0.07
	(2.96)	(3.55)	(2.67)	(4.49)
$D1$	-0.02	-0.02	-0.01	-0.01
	(4.14)	(3.95)	(2.66)	(2.18)
$D2$			-0.05	-0.05
			(5.22)	(5.65)
$\bar{R}^2$	0.94	0.94	0.96	0.96
s.e.(100)	1.40	1.00	1.00	1.00
D.W.	1.89	1.88	2.28	2.28

t Statistics in parentheses
* Instrument used in place of variable
1. Restriction took the form of $\alpha\dot{w}(-1) + (1-\alpha)\,\dot{p}\,(-1)$

Equation 1.6 includes an additional dummy, $D2$ (taking value of unity in 1975(3) and zero otherwise). All the equations underpredicted (significantly) the actual rate of change in awards for 1975(3). An institutional approach allows non-economic factors to impact on the variables in the model and this irregularity is considered the result of extraordinary political instability during that quarter. Indeed, industrial disputes increased by 192 per cent between June and July 1975. This view is reinforced by the reduced significance of S when the dummy, $D2$, is included.[17]

[17]Mitchell and Vella (1985) use an interactive variable to test for non-linearities in the strike response. It successfully subsumes the strike and dummy variables into one variable.

TABLE III
Hysteresis and Cumulative Inflation

Time	$u_t^* - t_u$ (per cent)	cumulative $\dot{w}$
t	-1.0	+0.11
$t+1$	-0.5	+0.1600
$t+2$	-0.25	+0.1875
$t+3$	-0.125	+0.2012
$t+4$	-0.0625	+0.2080
$t+5$	-0.0313	+0.2114
$t+6$	-0.0156	+0.2131
$t+7$	-0.0078	+0.2140
$t+8$	-0.0039	+0.2144

Table IV replaces MUG5 with the change in the unemployment rate. Recall that this variable would have appeared if we had have eliminated u^* by a Kyock transformation. The equation indicates that a change in actual unemployment would be only mildly inflationary (long-run coefficient of 0.04). The level of unemployment was never significant when nested in this equation.

The overlapping rate of change specification increases the possibility of our serial correlation whose existence would indicate mispecification. In our equations the *DW* statistic is not strictly valid although it can alert us to severe problems. Autocorrelation functions were examined and a series of residual regressions (on lagged residuals and other variables used in 2SLS equations) were performed. Only 1.2 and 1.3 showed any evidence of autocorrelation, where small fourth-order spikes were present.

Within-sample stability tests (Chow) were satisfactory for all the equations in Table I.[18] Desirable within-sample properties may be the result of extensive data searches and still be associated with poor structural approximation. Out of sample error calculations help to detect misspecification. We use the Salkever method (1976) to generate 'out-of-sample' forecasts and evaluate the prediction errors. The regressions were re-estimated with three 'forecast' dummies included each to correspond to the last three quarters of our sample. Each was set to unity for the relevant data point and zero otherwise. The coefficient for each dummy equals the forecast error for that quarter. A simple t-test on each coefficient determines the significance of the error. No significant (at 5 per cent level) forecast errors were detected.

[18]The Chow f statistics were very low but are only an approximate guide due to the large sample estimation technique employed.

TABLE IV
Awards Equation $\Delta u(-1)$ 1969(3) *to* 1984(4)

	Unrestricted		Restriction imposed	
	3.1 OLS	3.2 2SLS	3.1R OLS	3.2R 2SLS
Constant	0	-0.002	0	-0.002
	(0.23)	(0.40)	(0.12)	(0.38)
$\dot{w}(-1)$	0.22	0.51	0.23	0.51
	(3.97)	(7.26)	(4.11)	(7.31)
$\dot{p}(-1)$	0.73	0.51		
	(9.56)	(4.87)		
$r\dot{w}$	0.85	0.53*	0.86	0.52*
	(13.84)	(4.54)	(13.92)	(4.63)
S	0.04	0.05	0.04	0.06
	(1.02)	(0.80)	(1.10)	(1.39)
$\Delta u(-1)$	-0.01	-0.02	-0.01	-0.02
	(2.55)	(2.33)	(2.79)	(2.33)
$D1$	-0.002	-0.01	-0.003	-0.009
	(0.70)	(1.98)	(1.08)	(1.95)
$D2$	-0.02	-0.04	-0.02	-0.04
	(2.89)	(3.70)	(3.09)	(3.74)
$\bar{R}^2$	0.97	0.95	0.97	0.95
s.e.(100)	0.90	1.20	0.90	1.10
D.W.	2.02	2.19	2.07	2.19

t Statistics in parentheses
* Instrument used in place of variable
1 The homogeneity restriction took the form of $\alpha\dot{w}(-1) + (1 - \alpha)\,\dot{p}\,(-1)$

Table V displays the earnings equation results. Each equation reveals a relatively large degree of inertia. Award wages appear to be a positive but restraining influence on total earnings inflation. The best fitting equations (that is, the best specified) required MUG to enter in a lagged form. The resulting dynamics are therefore more complex. The lower sensitivity of λ (between 0.6 and 0.8) means that for any given deviation of the actual unemployment rate from the MRU the convergence is lower and the long-run earnings adjustment function steeper (relative to the awards equations). The impact elasticities of

TABLE V
Earnings Equations – 1969(3) *to* 1983(4)

	2SLS				ARI (Cochrane-Orcutt)		
	6.1	6.2	6.3	6.4	6.5	6.6	6.7
Constant	0.02	0.02	0.03	0.03	0.02	0.02	0.02
	(3.15)	(3.24)	(3.87)	(3.97)	(3.53)	(3.17)	(3.55)
$\dot{E}(-1)$	0.36	0.35	0.35	0.34	0.46	0.42	0.39
	(3.24)	(3.25)	(3.40)	(3.39)	(4.98)	(4.05)	(3.80)
$\dot{w}$	0.49*	0.49*	0.49*	0.49*	0.42*	0.46*	0.48*
	(5.76)	(5.89)	(6.12)	(6.24)	(6.15)	(6.05)	(6.25)
MUG6(-1)	0.05	0.05					
	(2.44)	(2.39)					
MUG8(-1)			0.05	0.05	0.05		
			(3.19)	(3.16)	(3.96)		
MUG8						0.04*	0.03*
						(2.29)	(2.00)
DX		0.03		0.02	0.02		0.03
		(1.98)		(2.03)	(1.68)		(1.83)
Rho					-0.22	-0.15	-0.16
					(1.74)	(1.10)	(1.26)
$\bar{R}^2$	0.81	0.82	0.82	0.83	0.84	0.80	0.81
s.w.(100)	1.90	1.90	1.80	1.80	1.80	2.00	1.90
d.w.	2.01	2.15	2.31	2.28	2.06	2.06	2.04

t statistics in parentheses
* instrument used in place of variable

MUG on earnings are very small and even though convergence is slower the actual inflation generated by the deviation is not substantial.

One signficant residual error (1981(1)) was detected in all equations. This corresponds in a timing sense to the large Metal Trades award in that quarter. A dummy, *DX*, was included to proxy this influence. Autocorrelation functions were examined and no evidence of significant error was detected. Some marginal first-order serial correlation was found in equations with MUG8(–1). Within-sample stability tests (Cusum, without the dummy and Chow) were favourable. The Salkever test was repeated to investigate post-sample forecasting capabilities and revealed no significant (at 5 per cent level) forecast errors.

VIII. Conclusion

Theoretical and empirical doubt has been cast on the concept of the NAIRU. The alternative model, the MRU, employs plausible notions of labour market imbalances and cyclical adjusment processes and explains how these mechanisms condition wage determination. The hypothesis that these mechanisms contribute to a cyclically sensitive, macroequilibrium unemployment rate is not rejected by the data.

The NAIRU hypothesis suggests that any aggregate policy attempt to permanently reduce the unemployment rate below the current natural rate inevitably is futile and leads to ever-accelerating inflation. The vertical Phillips curve is accepted by most economists, monetarists and Keynesians alike (see Tobin, 1980; Lucas, 1981). Lucas (1981, p.560) argues that the major macroeconomic research in recent years has tried to combine a plausible account of cyclical behaviour with the 'long-run' NRU hypothesis. We suggest that a short-run analysis based on non-NRU concepts is inconsistent with a Friedman long-run. The long-run is a sequence of short-runs (Fair, 1984, p.31). Given our analysis it is remarkable that the long-run properties of the NRU models have retained credence. This implies that the 'major macro-research efforts' have been misdirected. Indeed, the evidence would suggest that the NAIRU-NRU concepts do not provide a robust foundation upon which useful theory can be built.

Appendix

The following data was derived from NIF-105 Model Data Base (ABS 1313.0). All data is seasonally unadjusted.

w – log of adult weekly award wages

P – log of all groups CPI on a weighted average capital cities basis

E – log of average weekly earnings of non-farm wage and salary earners

U – ABS survey unemployment rate

Other data:

S – log of average working days lost to number of civilian non-farm wage and salary earners, ABS 6322.0, 6203.0 respectively.

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