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NAIRU: Concepts,
Measurement and Policy
Implications

**Chris Melliss,
A. E. Webb**

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**THE UNITED KINGDOM NAIRU:
CONCEPTS, MEASUREMENT AND POLICY IMPLICATIONS**

by
Chris Melliss and A.E. Webb

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ABSTRACT/RÉSUMÉ

The behaviour of unemployment in the UK is of particular interest in the light of the far reaching programme of reforms introduced since 1980. The paper first outlines the main theoretical ideas behind the concept of equilibrium unemployment, drawing a distinction between the factors which may cause transitory, albeit long lived, departures from the short run NAIRU, and those which influence the long run NAIRU. Both are unobservable. The last decade and a half has seen substantial changes to the institutional structure of the UK labour market, such as the decline in the strength of trade unions, and the introduction of government policies to increase labour market flexibility. The impact of these on the NAIRU is assessed. Estimates of the NAIRU are discussed. The general picture is that, whether a reduced form fundamental supply equation or structural approach is adopted, the UK's NAIRU reached a peak in the mid 1980s and has subsequently fallen, more in the case of the long run than the short run. Also, the labour market now seems to adjust more rapidly to the output cycle.

L'analyse des déterminants et de l'évolution du chômage au Royaume-Uni est particulièrement intéressante du fait de la mise en oeuvre depuis 1980 d'un vaste programme de réformes. Cet article insiste tout d'abord sur les principales idées théoriques sous-jacentes au concept de chômage d'équilibre, en établissant une distinction entre les facteurs qui peuvent provoquer de façon transitoire, mais durable, une variation du NAIRU de court terme, et ceux qui influencent le NAIRU de long terme. Ces deux concepts sont inobservables. Au cours des 25 dernières années, d'importants changements de la structure institutionnelle du marché du travail britannique ont été enregistrés comme la baisse d'influence des syndicats de travailleurs et la mise en place des politiques gouvernementales d'accroissement de la flexibilité du marché du travail. L'impact de ces changements sur le NAIRU est analysé. Des estimations du NAIRU sont évaluées. L'image générale qui se dégage, que l'on utilise une équation fondamentale d'offre de forme réduite ou une approche structurelle, est qu'après avoir enregistré un pic au milieu des années 80, le NAIRU du Royaume-Uni a ensuite baissé de façon plus prononcée en ce qui concerne le NAIRU de long terme que celui de court terme. En outre, le marché du travail semble désormais s'ajuster plus rapidement à l'évolution cyclique de la production.

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THE NAIRU: CONCEPTS, MEASUREMENT AND POLICY IMPLICATIONS¹

Chris Mellis and A.E. Webb*

1. Introduction

1. The Non-Accelerating Inflation Rate of Unemployment is a concept which is theoretically ambiguous and difficult to measure². Why has so much intellectual effort been devoted to it? The short answer is that it is the labour market equivalent to sustainable capacity utilisation in the goods market. The longer one is that with very high rates of unemployment in many OECD countries, and a realisation that conventional Keynesian demand management is not an option, the only way to reduce unemployment on a sustainable basis is to attempt to reduce the NAIRU by working directly through labour market institutions and the wage bargaining process (OECD (1994)).

2. The UK is a particularly interesting case, since, as we will show, the 1980s saw a coherent and wide ranging programme of labour market reforms and deregulation which reduced hiring and firing costs and swung the balance of bargaining strength decisively away from trade unions towards employers. Since most of these reforms were completed by the late 1980s they might now be expected to show up in employment, real wages and unemployment.

3. In Section 2 of the paper the concepts needed to understand the NAIRU are outlined. Particular attention is given to the long-run and short-run distinction. Most of the discussion is within the familiar Layard-Nickell (1991) bargaining framework and extensions of it to cover the effects of productivity and terms of trade changes. However, we start with the new classical model associated with the money neutrality ideas of Friedman (1968) and Lucas' rational expectations. We also discuss the possible effects on the NAIRU of the sharp changes in participation rates in recent years. Possible reasons why real interest rates may affect the NAIRU are given. Section 3 describes the changes in UK labour market institutions, and the role of benefits, mismatch and other microeconomic factors in determining the NAIRU. Section 4 looks at the wide range of estimates of the UK NAIRU produced by academic studies and presents evidence on the performance of the UK labour market over the last five years or so. Section 5 discusses the policy issues arising and concludes.

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1. The authors are most grateful to members of the Treasury's Academic Panel on Labour Markets, in particular C. Bean, R. Cross, P. Minford, S. Nickell, and D. Snower for stimulating discussion and comment on an earlier version of this paper. The usual disclaimer applies. They would also like to thank Treasury colleagues, especially C. Kelly, for their help in its preparation.
 2. Strictly the concept should be described as the steady or non-increasing inflation rate of unemployment (SIRU).

2. Concepts

4. The basic Layard-Nickell framework has proved a durable analytic tool which captures the bargaining process between monopolistically competitive firms and trade unions well. In this framework it is easy to accommodate both the *insider-outsider* model, Lindbeck and Snower (1989), where incumbent workers have advantages over the unemployed and *efficiency wage* models. In the version put forward by Shapiro and Stiglitz (1984), employers pay above market clearing rates to establish employee loyalty and raise productivity. More specifically, in tight labour markets, with plenty of alternative job opportunities and a high exit rate from unemployment, firms are assumed to pay profit maximising high efficiency wages to prevent shirking and to encourage good quality applicants for any vacancies. Efficiency wage models, like the Layard-Nickell model, therefore predict a procyclical path for real wages³. Any realistic theory of the NAIRU needs to account for the slow way in which, especially in Europe, labour markets have adjusted to changes in the factors which have caused changes in the long run NAIRU. The main idea here is that of the *short run NAIRU*, arising from *hysteresis*. This says that while inflation is stable, unemployment and real wages are still moving towards their steady state equilibrium and yet price and wage expectations are fulfilled.

5. An important component of the bargaining model is that employers and employees may have different views about the real wage to be paid. So a *gap* between the *real wage target* of workers and the *feasible or warranted real wage* of firms may arise, at least in the short run, and this manifests itself in changes in unemployment. Reductions in the strength and persistence of *real wage resistance* effects may be the main route by which labour market reform effects show themselves, essentially by reducing the ability of workers to hold real wages above the warranted real wage⁴.

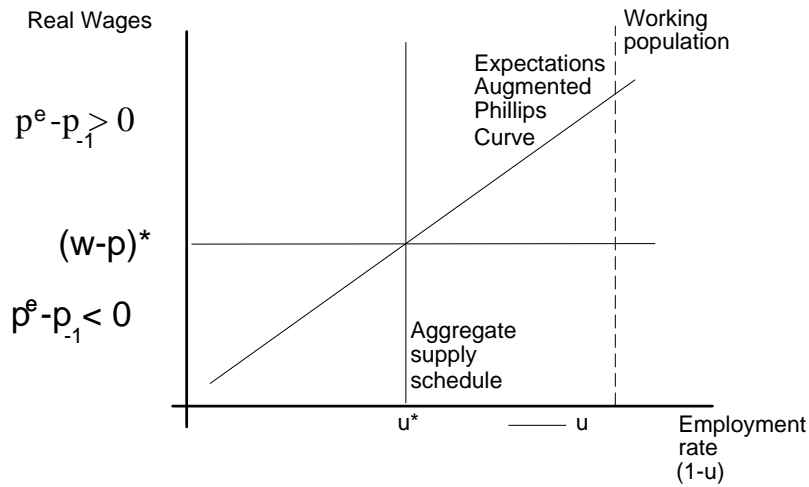
The new classical model

6. A useful starting point is the new classical model of Lucas (1972), building on the earlier work of Friedman (1968) and Phelps (1968). This combines the hypotheses of rational expectations -- economic agents avoid predictable errors in prices, wages and other nominal variables -- with the natural rate hypothesis under which all markets, including that for labour, are assumed to clear. One version of this is illustrated in Diagram 2.1. An expectations augmented Phillips curve combines with a vertical aggregate supply curve in employment real wage space. When expected and actual rates of inflation are equal the economy is at its natural rate of unemployment and output consistent with rational, forward looking, expectations. Since product markets are assumed to be perfectly competitive, firms have no influence on

3. Efficiency wage and insider outsider models rest on different behavioural assumptions and are seen as distinct by Lindbeck and Snower (1989).

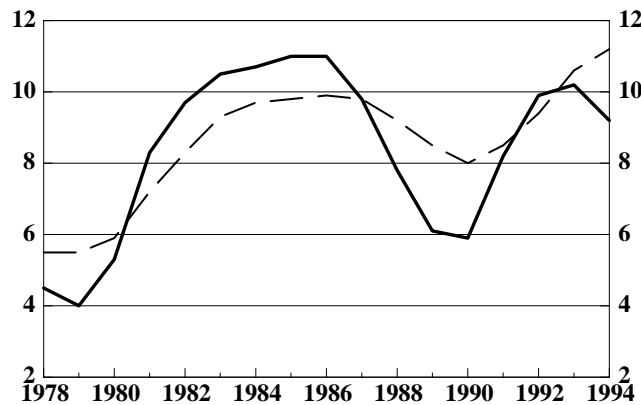
4. Real wage resistance is a different concept from the wedge, which may be defined as the difference between the real product wage (employers' real wage costs) and the post-tax consumption wage. However, changes in the latter, induced for example by tax changes, may have the strongest effects in the presence of real wage resistance.

Diagram 2.1



their mark-ups. Workers decide how much labour to supply, according to their perceived work-leisure trade-off. The upward sloping expectations augmented Phillips curve relates deviations from the natural rate to price surprises. Positive ones, assuming that nominal wages are set to clear the market, induce firms to hire more labour since real wages have unexpectedly fallen. Equally, workers willingly offer more labour because they expect real wages to be higher than they prove to be. So unemployment falls below the natural rate⁵. Without these misperceptions the economy remains at its natural rate, or on the vertical variables. To capture observed slow moving changes in unemployment, which are assumed to be voluntary, new classical theory has evolved to allow for changes labour supply brought about by shifts in peoples' intertemporal substitution between work and leisure⁶. (One possible mechanism is sketched under the discussion of interest rate effects.)

Chart 2.1: Unemployment Rates



5. Some new classical authors draw a distinction between the natural rate, by which they mean equilibrium unemployment, where misperceptions are absent and adjustment costs have been unwound, and the NAIRU, which is predicated on a framework of adaptive expectations.
6. In years or periods when the real wage is perceived as being above its long run average, labour supply rises and unemployment falls, and conversely when real wages are below average.

7. It would be comforting to believe the new classical story, but there are reasons for doubting it, at least as applied to European labour markets. Price and wage misperceptions, and hence deviations from the natural rate, should be reasonably quick to correct. And it is difficult to believe that changes in work-leisure choices, which might be reflected in hours rather than employment, can explain the large and very slow moving changes in unemployment throughout the OECD area, Chart 2.1. As we shall see in Section 4, the persistence and strength of such shocks is an important point of issue.

A bargaining model

8. The essential features of this model are an upward sloping wage-setting relationship, based on the view that real wages are the outcome of a negotiation between employers and workers able to exert some market power, combined with a downward sloping price setting or labour demand relationship. The model predicts that positive demand shocks, which for example raise labour demand or the price mark-up, lead to an increase in inflation but leave the NAIRU unchanged: adverse supply shocks raise the NAIRU and reduce employment, while inflation would rise.

9. Formally, real wage demands are negatively related to unemployment and positively related to wage push (Z) factors such as union power, the generosity of benefits and the degree of mismatch, all of which are discussed in detail in Section 3.

$$(w-p^e) = \gamma_0 - \gamma_1 u + \gamma_2 Z \quad [1]$$

where w and p^e are the logs of the levels of wages and price expectations. This equation can be seen as a “demand for jobs” relationship or the target real wage sought by employees.

10. On the employers’ side of the bargain, two different types of approach have been adopted. Conceptually the more transparent is one where the price mark-up rises with the level of activity. The equation for this can be interpreted as a feasible real wage relationship and may be specified as follows:

$$(p - w^e) = \beta_0 - \beta_1 u + \beta_2 X \quad [2]$$

where X is a vector of variables such as the capital stock, productivity growth and product market competition which condition the mark-up. The negative sign on the coefficient β_1 indicates that the price mark-up falls as unemployment rises, the pressure of demand effect.

11. In equations [1] and [2] wages are set as a mark-up over expected prices and prices as a mark-up over expected wages respectively. This reflects the nature of the bargaining process, in which prices are unknown when the nominal wage bargain is struck, and the outcome of the wage bargain unknown when prices are set. Rational expectations would therefore be an implausible assumption to make. Empirically, the measurement of expectations is problematic. A common solution is to use $\Delta^2 p$, the change in the rate of inflation, as a proxy for price surprises⁷. Setting $p=p^e$ and $w=w^e$ and noting that $w-p=p+w$, gives:

$$u^* = (\gamma_0 + \beta_0) / (\gamma_1 + \beta_1) + \beta_2 X / (\gamma_1 + \beta_1) + \gamma_2 Z / (\gamma_1 + \beta_1) \quad [3]$$

The NAIRU, u^* , increases with the strength of the wage push factors Z , and the X variables from the price equation, the ‘battle of the mark-ups’. A greater degree of real wage flexibility (a rise in γ_1) or in the

7. The rationale for this is that inflation follows a unit root process, so $p = \Delta p_{-1} + u$, where u is a white noise residual. So $p^e = \Delta p_{-1} + p_{-1}$ which implies $p-p^e = p-p_{-1} - \Delta p_{-1} = \Delta^2 p$.

sensitivity of the mark-up to demand pressure (a rise in β_1) both appear to reduce the NAIRU. But changes in them may also affect other parameters, for example the constant terms in the wage and price equations which are themselves representations of “deep structural” parameters. The inference that greater flexibility as measured by γ_1 and β_1 , can be equated with a lower NAIRU, may therefore be unwarranted⁸. X and Z are exogenous to the labour market, so that the NAIRU is sometimes considered neutral in the sense that it is determined only by technology and preferences, for example, between work and leisure.

12. The parallel with the new classical model is clear. In the absence of expectational mistakes, unemployment converges to the NAIRU, which is equivalent to the natural rate, although the NAIRU in a bargaining framework is likely to be higher because of the monopolistic element. In the new classical model, markets are assumed to be competitive so the labour supply curve, replacing the wage setting curve in Layard and Nickell, is perfectly elastic.

13. In Minford’s (1983) model, labour is either in a competitive or in a unionised sector. But the labour market behaves as if it is fully competitive, to the extent that equilibrium employment is determined by the reservation wage in the competitive sector. Anything, such as a fall in benefit levels, which lowers the reservation wage, will also sharply increase labour supply, since labour supply is assumed to be highly elastic in the region of the reservation wage⁹. The structure of the unionised sector is similar to the aggregate in the bargaining model. Where behaviour differs is in the assumption about expectations. The labour market forms part of a macro model which is solved under forward looking rational expectations. This helps to account for the differences between Minford’s numerical results and those of others (see paragraph 5.1)¹⁰.

14. It is also apparent from this, and subsequent formulations of the NAIRU, that it is a schedule in the sense that it is endogenous and related to a set of exogenous variables such as the capital stock, variations in which trace out different paths of the NAIRU.

15. Empirically, pressure of demand effects on price setting, β_1 , have been found to be weak, Bean (1994). For this reason some models, especially macromodels, use a conventional labour demand equation in place of the price equation:

$$n = \alpha_0 - \alpha_1 (w-p) + \alpha_2 K \quad [2']$$

where $n = \log$ of employment, and K is a vector of variables, which may differ from X , which influence employment.

Since $l-n \equiv u$ where l is the log of the workforce, [2'], can be rewritten as:

$$u = l - \alpha_0 + \alpha_1 (w-p) - \alpha_2 K \quad [2'']$$

8. This is a reason for attempting to model the micro foundations of the wage setting process.

9. Empirically this is captured by specifying the wage equation in logs, with the wage asymptotically falling close to the benefit level net of taxes as unemployment diminishes.

10. The speed of adjustment to a new equilibrium in a model solved under RE depends on the roots of the system: it need not necessarily be very rapid.

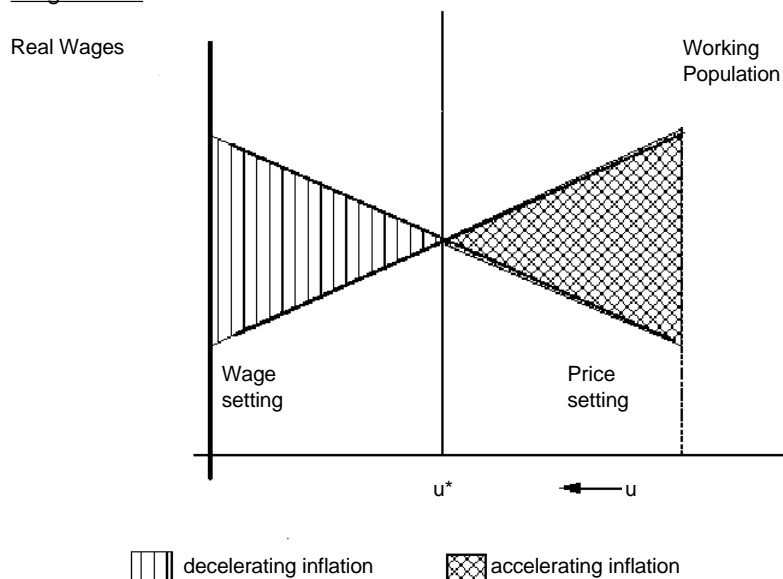
Equations [1] and [2"] may be solved for equilibrium unemployment in the absence of price surprises by rearranging [2"] and eliminating (w-p) as before giving:

$$u^* = (\gamma_0\alpha_1 - \alpha_0) / (1 + \alpha_1\gamma_1) + \gamma_2\alpha_1Z / (1 + \alpha_1\gamma_1) - (1-\alpha_2K) / (1 + \alpha_1\gamma_1) \quad [3']$$

This solution differs from equation [3] by including the K variables normalised on the workforce¹¹.

16. The economics here is that equilibrium unemployment can be defined in terms of the wage push factors and the conditioning variables in the labour demand equation. This may be illustrated in Diagram 2.2, where the price setting version of the model has been used. (The labour demand version would be equivalent in terms of the NAIRU, although the slopes of the price and labour demand schedules might differ.) A reduction in push factors leading to a downward shift in the wage setting schedule will reduce the NAIRU. Similarly an increase in, for example, the capital stock or productivity may also reduce the NAIRU, at least in the short run, since they both represent positive supply shocks. In this case the price setting schedule would shift up, raising profitability and the level of hirings. This diagram illustrates another important point: the slopes of the wage and price setting schedules need not affect the level of the NAIRU.

Diagram 2.2



Real wage resistance

17. To illustrate the ideas of real wage resistance and the wedge in a less abstract way an open economy target real wage equation can be written in detailed form as:

11. In the price equation version the sign on the X vector is positive because real prices are raised by an improvement in technology etc., equivalent to an upward shift in the price setting schedule in w-p, unemployment space, Diagram 2.2. This is exactly equivalent to the upward shift, -ve sign on K, in the labour demand version, [3'].

$$(w-p) = \text{prod}^T + t^d - \gamma_4(\text{prod}^T - \text{prod}) - \gamma_5 t^e - \gamma_6 v(\text{pm-p}) - \gamma_7 t^i - \gamma_8 t^d - \gamma_1 u + \gamma_2 Z \quad [1']$$

where p = value added prices; t^d = direct taxes; prod^T = log of trend productivity; t^e = employers' tax rate; prod = log of actual productivity; $v\text{pm}$ = consumption weighted import prices, t^i = indirect taxes and u and Z are as before. Trend productivity growth enters with a unit coefficient, although adverse shocks to productivity growth have some dampening effect on the target¹².

The feasible real wage may be written:

$$(p-w) = -\text{prod} - t^e - v(\text{pm-p}) - t^i \quad [2'']$$

In this case solving [1'] and [2'''] by eliminating $p-w$ the NAIRU is given by:

$$u^* = 1/\gamma_1 [\gamma_0 + \gamma_2 Z + (1-\gamma_4)(\text{prod}^T - \text{prod}) + (1-\gamma_5)t^e + (1-\gamma_7)t^i + (1-\gamma_8)t^d + (1-\gamma_6)v(\text{pm-p})] \quad [3'']$$

The first point to note is that compared with [3'], the K variables have been replaced by productivity. In the long run, trend and actual productivity are equal, so that this term has no effect on the NAIRU, irrespective of the size of the coefficient γ_4 . Equation [3''] also makes it clear that open economy effects, here captured by real import prices, are important. Jackman, Layard and Nickell describe the schedule relating unemployment equilibrium (domestic) and external equilibrium as the fundamental trade-off. This is described more fully in the Annex. The key point is that in the short run there can be an improvement in the inflation unemployment trade-off, i.e. lower unemployment for any level of inflation, from an appreciation of the real exchange rate, a fall in the term (pm-p) . Such a change will not be sustainable if it results in a trade or current account deficit. So in calculating the NAIRU, account has to be taken of the external position. Other things equal, a trade deficit implies that the real exchange rate is at too high a level, so that a real depreciation is required. This implies that unemployment is below its sustainable level and the NAIRU. There is only one point at which both the external balance condition and the NAIRU condition are met, as the Annex shows.

18. In [3''] the sum of the coefficients $\gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8$ measures the degree of real wage resistance. In the long run such effects are often assumed to be zero, and all the coefficients = 1, implying that the long run NAIRU is unaffected by taxes and import prices. Jackman, Layard and Nickell (1991) justify this on the grounds that in their model such effects would impinge equally on the feasible and reservation wage¹³. At issue is whether it is realistic to expect the reservation wage to rise in step with the feasible real wage. There are three reasons for thinking that this might approximate reality in the medium term: (i) in most countries, but not the UK, unemployment benefits have tended to rise in line with wages¹⁴; (ii) the reservation wage depends on the marginal utility of leisure, which in turn may rise with the productivity of marketed and home production, and (iii) the reservation wage depends on non-labour income, which will rise with labour income with neutral technical progress. In other words, neutrality depends on workers' marginal valuation of leisure, and hence their opportunity cost of working, being unaffected by wedge factors, or, put another way, that the elasticity of labour supply with respect to wedge factors is zero. Changes in wages relative either to the past or other groups would tend to violate this assumption. Of

12. Up to this point we have implicitly assumed that trend productivity entered the real wage, prices and labour demand equations with a unit coefficient.

13. In the absence of this assumption changes in e.g. the terms of trade or taxes would have permanent effects on the NAIRU, which is at odds with historical experience.

14. The failure of benefits and hence the reservation wage to keep up with the feasible wage in the UK is cited as an important reason for the supposed fall in the long run NAIRU.

course, few deny the significance of real wage resistance in the “short run”, but experience suggests that its effects can be very prolonged.

19. It is easy to see from this that the neutrality result depends on rather special assumptions. For example, if benefits or a minimum wage were to place an absolute floor to wages at the lower end of the distribution then employers might not be able to pass on an increase in employers’ taxes in the form of lower real wages, implying that $(1-\gamma_s)$ is non-zero. Under these circumstances variations in employers taxes and other non-wage costs such as social insurance contributions would affect the NAIRU. This is an important consideration for those European countries where these are at a high level.

The short and long run NAIRU

Hysteresis

20. The discussion so far has omitted any reference to time. Yet an important difference, both conceptually and empirically, can be drawn between the long run NAIRU, where both unemployment and inflation are stable, and the short run NAIRU, where there is stable inflation alone. This depends on the recent path of unemployment and the supply and demand shocks that have occurred. The important point about this short run NAIRU is that while it is a point at which inflation is stable, there would be rising or falling inflation if attempts were made to push to the long run NAIRU more quickly than the dynamics of the economy allow. The short run NAIRU is not necessarily equal to the actual rate of unemployment, where inflation may be either increasing or decreasing, although it will tend to be less divergent from it than the long run NAIRU. The short run NAIRU can be formalised by including a term in the wage equation for the change in unemployment. This is an *ad hoc* way of capturing the adjustment process: in reality dynamic effects arising from lags in real wages are also likely to be important, as may be asymmetries depending on whether unemployment is rising or falling.

21. After substituting $\Delta^2 p$ for p^e , [1] becomes:

$$w - p = \gamma_0 - \gamma_1 u + \gamma_2 Z - \gamma_3 \Delta^2 p - \gamma_4 \Delta u \quad [1'']$$

In the long run the NAIRU is defined where both Δu and $\Delta^2 p = 0$. In the short run, however, only $\Delta^2 p = 0$ is necessary. Setting $\Delta^2 p = 0$ and hence $p = p^e$, [1''] and [2] can be solved, after substituting $\Delta^2 p$ for p^e in [2], to give:

$$u^*_t = (\gamma_0 + \beta_0) / (\beta_1 + \gamma_1 + \gamma_4) + \beta_2 X / (\beta_1 + \gamma_1 + \gamma_4) + \gamma_2 Z / (\beta_1 + \gamma_1 + \gamma_4) + \gamma_4 u_{t-1} / (\beta_1 + \gamma_1) \quad [3''']$$

This shows that the short run NAIRU depends on past values of unemployment. Such a relationship might be explained by the idea that the long term unemployed exert less downward pressure on wages than the short term unemployed because they search for work less vigorously and become less close substitutes for those in employment as their skills decay. Such factors as the number of insiders, hiring and firing costs or capital scrapping may also strengthen hysteresis effects. The short run NAIRU may be positively related to the past actual unemployment. If there is full hysteresis, so that the coefficient on u_{t-1} equals 1, then the long run and short run NAIRU are the same and both are driven by shocks to the economy. In other words full hysteresis implies the absence of any mean reversion. Temporary shocks therefore have highly persistent effects. At the other extreme, equation [3'''] reduces to equation [3] when $\gamma_4 = 0$. A high wage elasticity, large γ_1 , and pressure of demand effects in pricing, β_1 , imply that the smaller will be the weight of the hysteresis term. This means that adjustment to any new long run NAIRU, which as we have

already seen in the labour and goods markets is determined by underlying ‘taste and technology’ factors, will be relatively rapid.

22. It is unlikely that lagged unemployment and real wage resistance are the only sources of persistence in labour market adjustment. Capital accumulation effects, lagged adjustment of employment, real wages and participation, and hiring and firing costs and various interactions between them are further factors which will lead to lagged adjustment, see Snower and Karanassou (1995).

Productivity

23. Unemployment dynamics may not be the only reason for divergences between the long and short run NAIRU. For example, trend productivity growth enters implicitly in equation [1] and into X and K in equations [2] or [2'] with unit coefficients. As equation [2'''] makes explicit, a slowdown will lead to a reduction in the demand for labour or, equivalently, in the context of Diagram 2.2 a downward shift in the price setting schedule. As a result the feasible real wage falls and the equilibrium rate of unemployment rises. Without adjustment on the part of wage bargainers, inflation increases, implying that the short run NAIRU moves above the long run NAIRU. Only a policy contraction, which raises actual unemployment and closes this wage gap, will stabilise inflation. This suggests a possible link between productivity growth and the level of unemployment, at least in the short term. A number of mechanisms can be envisaged. For example, rapid productivity growth raises the marginal productivity of new jobs, raises vacancies and hence lowers equilibrium unemployment, the “capitalisation” effect. Second, rapid productivity growth tends to raise future real wages, perhaps making workers less inclined to press for higher wages now, because the value of being an incumbent worker is raised. Offsetting this is the view that faster productivity growth comes about principally through “downsizing” and other “creative destruction” mechanisms so increasing the inflow into unemployment. The net effect of these is theoretically ambiguous and difficult to determine empirically. Productivity growth over the last 20 years or so has been faster in Europe than the US, where average unemployment has been lower, which might suggest that the latter effects predominated. Also, the slowdown in total factor productivity over this period was greater in Europe than the US, which would help to explain why the rise in unemployment, working through the capitalisation effect, has been greater in Europe than the US. A particular difficulty in making these comparisons is that total factor productivity, the true variable of interest, is unobserved, while output per head, the usual measure of productivity, is endogenous and will therefore be influenced by the outcome of the wage bargain. See Gordon (forthcoming) for a full discussion of the complexities.

24. In specifications such as equations [1'] and [2'''], productivity affects the target and feasible real wage one for one and the long run NAIRU is unaffected by a change in trend productivity. This is because, if total factor productivity growth is neutral, labour and capital are equally affected, so in terms of Diagram 2.2 both the price or labour demand and wage setting schedules shift, leaving long run equilibrium unemployment unchanged. The full effect is therefore borne by labour through a change in living standards.

Participation and the labour force

25. The UK has witnessed large changes in the labour supply and participation in recent years. The balance of falling participation by males, especially those over 50 and under 25, and rising participation by

females suggests that the trend labour supply has been falling since 1990, perhaps by about one eighth of 1 per cent per annum although recently the trend has levelled off, Chart 2.2¹⁵.



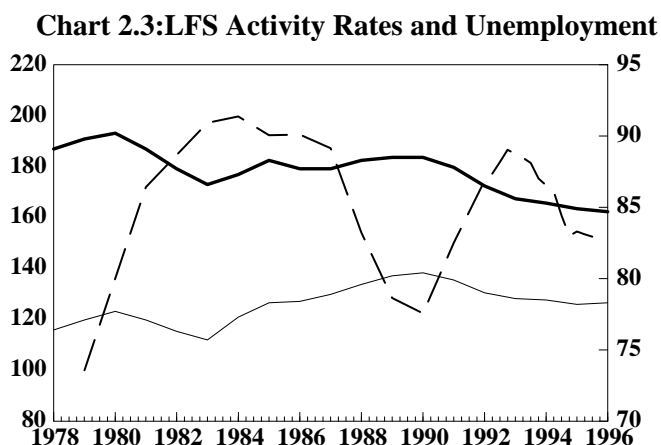
In the past little attention has focused in the literature on the relationship between participation and the NAIRU, mainly because the NAIRU is neutral with respect to the size of the labour force and the level of participation. (In equation [3'] a fall in l has no effect on u^* since it is assumed that n falls equiproportionately.) There has also been an implicit focus on non-employment rather than unemployment, for the reasons given in footnote 16.

26. To illustrate the neutrality of the NAIRU with respect to the labour force consider a fall in participation, for given output. This reduces unemployment in the first instance. From the wage setting equation inflationary pressures rise. This can be illustrated with a leftward shift in the vertical working population schedule in Diagram 2.2. Equilibrium can only be restored once unemployment has reached its former level, u^* , but with a lower level of employment than would have been the case had participation remained unchanged. So the long run NAIRU is unaffected, essentially because any fall in labour supply needs to be matched by an equal fall in labour demand, employment and output to keep inflation steady. Participation is therefore analogous to productivity growth. Empirically, the inflationary pressures resulting from falls in the labour force have been found similar to those from a rise in employment, which suggests that other than in the short run work sharing etc. is unlikely to contribute to a lower NAIRU.

27. However, in the short run participation and labour supply are endogenous and related to output. Chart 2.3 gives a strong hint of this for the UK. In this case the short run NAIRU depends on the response of participation to real wages and to unemployment, essentially the cyclical effect, as well as the usual

15. Precise figures depend on the source used and the assumption made about how much of any change in participation is permanent: the rise in the numbers economically inactive between 1992 and 1995 was about twice as large, 800 000, on an employer based measure, the Workforce in Employment, compared with 400 000 on the Labour Force Survey, which is a household based measure. More generally the measured labour supply may at the margin have an imperfect relationship with the effective labour supply; for example because some non claimants, e.g. married women, may be actively seeking work. The latest projections (Labour Force Trends, May 1996) show the population of working age growing faster from 1995-96 than from 1984-95.

coefficients in the price and wage setting equations. The cyclical pattern of participation probably reflects discouraged worker effects. If so, and the effect is reversible, there is no reason to suppose that the NAIRU will change as a result, other than in the short run.

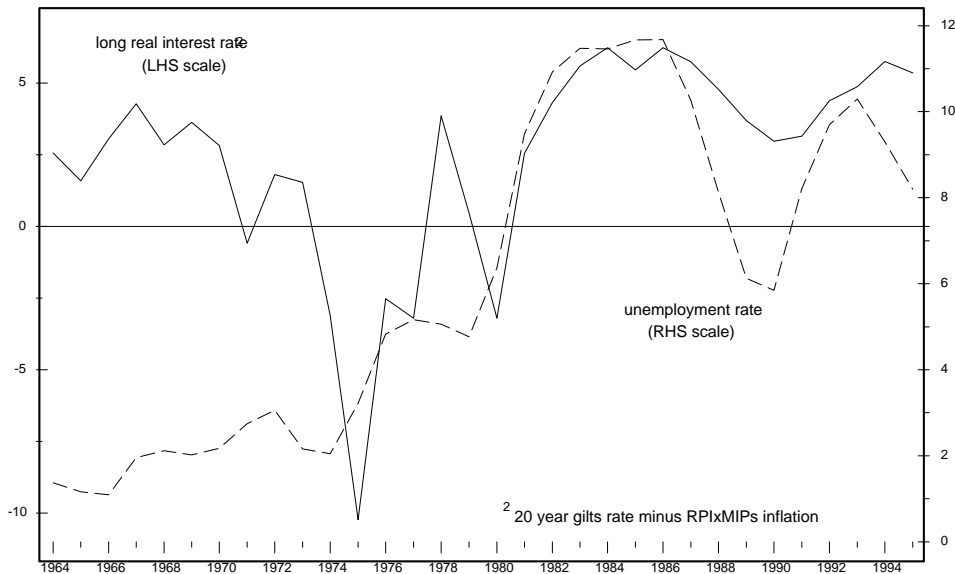


28. Any estimate of how much of any fall in participation is permanent is necessarily very tentative. The best approach is probably to consider each working population cohort separately. A substantial rise in student numbers and falling retirement ages for males imply that at least some of the fall in participation since 1992 may be permanent. But female activity rates have continued to rise, and more of the registered unemployed may be actively seeking work due to stricter enforcement of in-work benefit rules. Since different age groups may have different behaviour based on their past experience, this will further complicate any assessment of this factor. It is yet another reason for expecting the relationship between the short and long run NAIRU to be complex and attenuated.

Real interest rates

29. Recent attention, for example by Phelps (1992) and Manning (1993), has been drawn to possible linkage between the NAIRU and real interest rates, strictly real interest rates less the growth rate since the basic idea is one of intertemporal substitution. As Chart 2.4 shows, such a relation might help explain why unemployment remained high despite the labour market reforms and output growth above trend in the second half of the 1980s.

Chart 2.4: Long term real interest rates and unemployment



30. The theoretical justification for expecting a positive relationship between real interest rates and the NAIRU in a bargaining framework centres around the wedge between target and feasible real wages. Specifically:

- with usual assumptions about technology, CES or Cobb-Douglas for example, higher real interest rates raise the cost of capital and reduce the capital/labour ratio for given output so that production becomes more labour intensive. This reduces the marginal product of labour, and hence the feasible real wage. In a bargaining model the NAIRU will tend to rise. For how long depends on the response of the wage setting schedule. This is despite the neutrality of factor shares with this class of production function;
- in Phelps' (1992) formulation there is a downward sloping product demand curve for each firm motivated by imperfect knowledge by consumers, in contrast to imperfect competition among producers as in Layard-Nickell. With imperfect knowledge firms have a trade-off between a high 'customer base' and profits now for lower profits and customer numbers in the future. Higher real interest rates lead firms to raise margins over marginal costs towards those of a monopolist. Again, this is equivalent to a rise in the wedge caused by a reduction in the price setting schedule, requiring an increase in unemployment to bring real wages into line;
- in Manning (1993), the value of a job now compared with unemployment depends on benefits compared with wages, and the risk of future unemployment. If the real interest rate rises then this forward looking element has less weight, raising the current target real wage. A similar effect can be derived in an efficiency wage model through changing the balance between the current and future costs of shirking and risking losing one's job. A rise in the real interest rate reduces the weight on future income, which raises the current period's target real wage;

- the opposite to this last effect occurs in models which emphasise intertemporal labour substitution: a rise in the real interest rate reduces the present value of future wages, as before, but increases the present value of money on deposit. This leads to an expansion of labour supply today¹⁶.

31. More general reasons have been advanced for thinking that unemployment and real interest rates may be positively related. For example, high real interest rates may reduce labour hoarding and firms' willingness to train workers, and increase the required rate of return. Perhaps the most obvious reason for expecting real interest rates and unemployment to be positively related is simply that high real interest rates reduce aggregate demand. Of course such an effect can only be cyclical¹⁷. It is also a good example of the endogeneity of real interest rates, which makes interpretation difficult without knowledge of the factors driving the change. Chart 2.4 gives no firm evidence of a long term upward trend for the UK, although during the 1970s it is likely that there was a substantial unanticipated component in ex-post measures, such as that used in the chart. The "true" rise in real interest rates may therefore have been greater.

32. Empirically, estimates of the effects of real interest rates on the NAIRU have been varied, ranging from close to zero, Carruth *et al.* (1993) and Bean (1994), to 1 to 1.5, Barrell *et al.* (1994) and Manning (1993); see Coulton (1995) for a recent survey of both the theoretical and empirical literature. One possible explanation of the higher numbers is that real interest rates rose in the 1980s, partly because inflation was more fully anticipated, as the NAIRU increased. It is worth noting that while the rise in real interest rates in the 1980s, was a world-wide phenomenon, higher unemployment was not.

3. Microeconomic evidence

33. Factors which influence the operation of the labour market at the microeconomic level will affect the position of the NAIRU. In their survey of the literature on the NAIRU Coulton and Cromb examine the following structural factors:

- i) generosity of benefits;
- ii) mismatch; and
- iii) union power and the reform of industrial relations.

This section considers in addition:

- iv) labour market insecurity;
- v) the effect of taxes; and

16. Wars provide a stark example of this effect with labour supply increasing as people discount heavily the worth of their future incomes.

17. This can be seen from a standard aggregate demand equation: $y = -ar + b(e+p^m-p) + c(m-p)$. To keep $y=y^*$, i.e. at the NAIRU, the rise in r after a +ve shock implies either a depreciation of the exchange rate or a one off rise in real money balances to offset it. But both the real exchange rate and real money balances are affected by a change in r so to satisfy demand = NAIRU the change in r can only be temporary, i.e. as long as the shock persists.

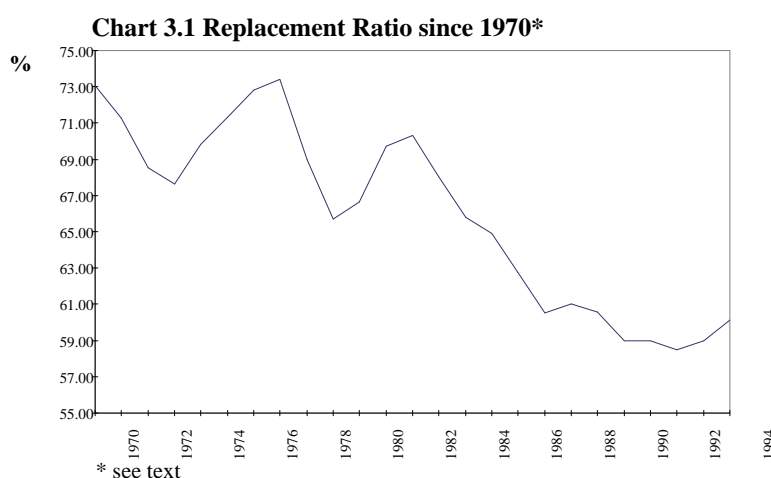
- vi) active labour market measures.

The impact of these factors, and how they have changed over time, is the topic of this section.

Generosity of benefits

34. The generosity of benefits will affect both the willingness of the unemployed to accept job offers, and the intensity of bargaining strength of workers and their trade unions. There are a number of relevant dimensions to the term “generosity of benefits”, the most important of which are the level of benefit payment relative to what the recipient could earn in work, the duration of benefit, and the ease with which it can be obtained.

35. It is customary to represent generosity of benefits by means of the “replacement ratio”, which is intended to express incomes out of work as a ratio of those obtainable in employment. Chart 3.1. shows the standard UK series for a representative family of a married couple with one earner and with two children, one aged under five, the other aged five to ten. The dominant feature is the fall in the replacement ratio from its mid-1970s peak, which was a consequence of the indexation of benefits to prices rather than earnings. However the long decline in the replacement ratio seems to have reached its lowest point (58.3) in the second quarter of 1992, after which there was a small increase, since when the rate has been stable. The increase was partly due to the recession, when the uprating of benefits in line with the RPI led in some instances to an increase relative to earnings, and partly due to an increase in child benefit, which had not been uprated for a number of years.



36. The use of the standard “replacement ratio” requires a number of strong health warnings:

- i) The use of a standard family group as a basis for the calculation of the ratio is to ignore the differences between benefit recipient groups with different characteristics, who may be differentially affected by benefit changes, and whose relative sizes may change over time. However the evidence of Table 3.1 indicates that the numbers facing very high replacement rates have been substantially reduced since the mid-1980s, and those who still have ratios over 100 per cent tend to be people with low earnings in work or with high mortgage costs.

- ii) Calculations of the replacement ratio are made using the earnings of those in work. It is much harder to estimate replacement ratios of unemployed people as we cannot observe the wages they might expect to obtain in work. It is reasonable to assume that many will have high replacement ratios as their earnings potential is limited. (A recent DfEE estimate suggested that around 15 per cent of the unemployed might have replacement ratios of over 80 per cent, although the system of in-work benefits should ensure that in most cases they are better off in work.) Once again it is possible that the effective replacement ratios may differ between groups of recipients, and over time.
- iii) The extension of the role of in-work benefits since the introduction of Family Credit (FC) in 1988, in recognition of the fact that even a full time job may not provide enough income to support a family with children if it is low paid, means that a replacement rate such as that in Chart 3.1, based on average male manual earnings may no longer provide an appropriate indicator of the opportunities facing low-skilled households. (This criticism does not apply to the data in Table 3.1 which assumes full receipt of benefit entitlement both in and out of work.) This topic is discussed further in paragraph 3.8 below.
- iv) The replacement ratio is at most only one dimension of generosity of benefits, and takes no account of such relevant factors as duration of payment and strictness of benefit administration.

Table 2.1. Replacement ratios for the working population

Replacement ratio percentage	1985		1992/93		1993/94		1994/95		1995/96	
	1 000s	per cent	1 000s	per cent	1 000s	per cent	1 000s	per cent	1 000s	per cent
100 and above	60	0.5	5	-	10	-	10	-	15	0.1
90 and above	210	1.15	35	0.3	40	0.3	35	0.3	35	0.3
80 and above	730	5.2	160	1.2	175	1.3	145	1.4	165	1.3
70 and above	1 870	13.4	445	3.2	465	3.5	445	3.8	510	4.2

Source: Social Security Departmental Reports

37. The impact of changes in the replacement ratio can be judged by considering the econometric literature surveyed by Coulton and Cromb. This indicated that either replacement ratios or real benefits played a significant role in 6 of the 9 wage equations reported, and that a percentage point change would cause a change in the NAIRU of up to 0.9. The evidence reported above is of a fall in the replacement ratio of about 20 per cent between 1980 and 1990, which on the basis of the Jackman Layard, and Nickell results would lead to a fall in the NAIRU of about 3.4 per cent.

38. This is, however, only part of the story. The UK is rare among advanced industrial countries in having flat rate benefits for unemployment, and also having, for many recipients, little variation in benefit by duration. Evidence of a correlation between duration of benefit entitlement and the duration of benefit spells has been provided by Heylen (1993), while microeconomic evidence from the US has shown a clear pattern of increased search intensity prior to the cut-off point. There is a conflict between the commitment to provide a reasonable standard of support for unemployed people, and an incentive for continued job search. The UK Government has sought to resolve this conflict by linking the payment of benefits more closely to job search activity. A central plank of this approach was the introduction of Restart interviews in 1986, under which unemployed people were interviewed (initially) every six months, and offered assistance with finding work and training. This approach is discussed in more detail below.

39. So although the replacement ratio has remained fairly stable at around 60 per cent since 1990 it is likely that measures to restrict the generosity of benefits and tighter application of the eligibility condition have led to further effective reductions in the NAIRU. The policy of linking benefit payments to job search activity will be further strengthened in October 1996, when the Jobseeker's Allowance will replace existing benefits for unemployed people. The NI contributors will get a personal rate for the first six months, after which it will be replaced by income based help to unemployed people and dependants according to need, paid as long as is required. The new benefit will emphasise that the receipt of benefit is dependant on the claimant being available for, and actively seeking work, and so will create a framework within which the Employment Service can give more effective help and advice to the unemployed, and provide support for active labour market policies. Although the sanction for refusal of employment is unchanged, those for refusal to take a place on a training scheme or employment programme will be enhanced. It is hoped that by providing more active support for the unemployed, and by emphasising the responsibility they have in finding work, the efficiency of the job search process will be improved, which will lead to a reduction of the NAIRU.

40. Another important strand of UK government policy has been the extension of the coverage of means tested benefits for those in work. The main means tested benefit for those in work, Family Credit, now assists more than 600 000 lower paid families, 44 per cent of whom are lone parents. Research on FC has shown that couples need assistance for only one or two quarterly periods, and the majority of couples leave the benefit due to improved circumstances, such as when the second partner obtains a job. The success of the scheme has led to the piloting of a new scheme, 'earnings top-up', which is modelled on FC, but payable to couples and single people without children.

Mismatch

41. The matching of jobs to workers, in the absence of full information on both sides of the market, will always be an imperfect process, so that in any dynamic economy there will always be some frictional unemployment. The size of this pool of unemployed people will depend upon:

- i) changes in the pattern of demand in the product market;
- ii) changes in the pattern of skills in the labour force; and
- iii) the efficiency of the matching institutions (such as the Employment Service).

While frictional unemployment, to a greater or lesser extent, is a universal feature of labour markets, particular groups within the labour market tend to be affected disproportionately.

42. A traditional tool for analysing frictional and structural unemployment is the Beveridge Curve, which is a downward sloping schedule relating unemployment to vacancy rates. Diagram 3.2a describes the way in which the Beveridge Curve (UV), which characterises equilibrium in the labour market, and the vacancy supply curve (VS), which describes the behaviour of firms as they set wages and the employment level, determine the observed combination of unemployment and vacancies. Within such a framework a north-east movement in the UV curve, implying that higher unemployment is associated with the same level of vacancies, would be a sign that mismatch was rising and search effectiveness was falling. However it would be unreasonable to expect to observe only smooth movements along the curves, such as from A to B in response to a disturbance in aggregate economic activity, or from A to C in response to exogenous structural or mismatch shocks. It is much more likely that an aggregate demand shock will generate a loop below the UV curve from A to B as vacancies fall immediately, and unemployment rises

in response to a reduced rate of job matchings. Furthermore, with hysteresis effects the system may generate open loops, proceeding to C, or even D, rather than returning to point A. The way different kinds of shocks may generate movements in the UV plane is discussed in detail in Jackman, Pissarides and Savouri (1990).

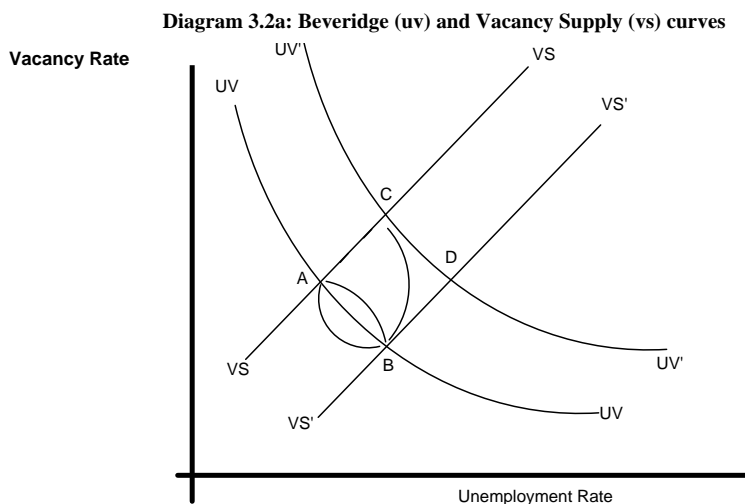
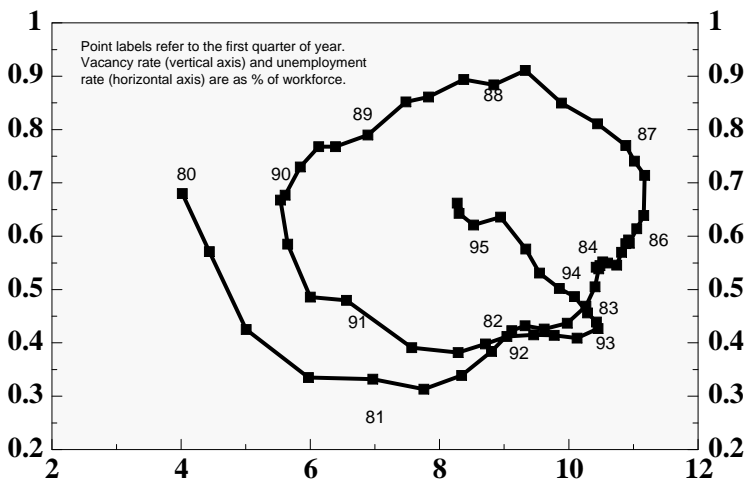


Chart 3.2b: Unemployment and Vacancies 1980-1995



43. Chart 3.2b shows loci of UV points for the period 1980-1995. Despite the difficulties in distinguishing between movements in the underlying UV and VS curves and the transitional dynamics, the outward movement of the relationship during the period 1982-1986 provides some *prima facie* evidence of increasing mismatch, and consequently a rise in the NAIRU. From 1986 to 1990, despite the fall in

unemployment, the vacancy rate continued at a high and increasing level. From 1990 to 1993 unemployment rose and vacancies fell, but since 1993 unemployment has fallen and the vacancy rate risen significantly. This could suggest that employers have become less choosy in filling their vacancies from the unemployed, or that search effectiveness has risen, both indicators that the labour market has become more efficient. The evidence of an inward movement of the curve between the late 1980s and the early 1990s is an indication of a possible reduction in mismatch, and consequently a favourable effect on the NAIRU.

44. Analysis of structural unemployment has traditionally been conducted in terms of location, industry or occupation, although recently there has also been an increasing interest in the age, gender, and racial dimensions. There is an important difference between these two sets of categories. In the latter case the categorisation is determined by purely demographic factors, while in the former the unemployed person has some, perhaps limited, ability to change his category by means of job-search, retraining, and migration. However a reduction in the degree of mismatch in whatever the dimension, will have a favourable effect on the NAIRU.

45. There has been a striking reduction in the dispersion of unemployment during the most recent recession, and the regional unemployment pattern changed significantly for the first time in 70 years (Evans and McCormick (1994) and Morgan (1996)). Evans and McCormick claim that the non-manual labour market is now flexible and geographically integrated, with a low dispersion of regional unemployment rates, increasing relative wages in the regions of relative employment expansion prompting in-migration, and significant flows of non-manuals towards growth regions. On the other hand the manual labour market remains spatially rigid, with neither fluctuations in relative regional wage levels nor migration playing a significant role in eliminating rising unemployment in regions experiencing persistent negative employment demand shocks. Instead, changes over time in rates of regional labour force participation appear to have played an accommodating role.

46. Appealing as the mismatch hypothesis is, analyses have not credited it with a major role in changing observed unemployment or the NAIRU. For instance Layard, Nickell and Jackman (1991) investigated whether the rise in European unemployment could be explained by increased mismatch. On the assumption that wage behaviour in each sector is caused by unemployment in that sector, and not in some leading sector, they are able to construct a measure of mismatch as half the variance of the relative unemployment rates. On this basis they found that mismatch had increased in none of the countries considered except Sweden. Nevertheless they point out that the *level* of mismatch in Great Britain explains at least one third of all unemployment.

47. There has been a good deal of variety in the indicators of mismatch used in the NAIRU estimation literature. One popular indicator, used for instance in the work of Layard and Nickell (1986), Bean and Gavosto (1989), and Jackman, Layard and Nickell (1991) is the absolute change in the proportion of employees in production industries: the so-called "industrial turbulence index". Although all the authors mentioned found a significant positive relationship between this series and the NAIRU, examination of the time series (Chart 3.3) suggests that there is a significant correlation between this series and the business cycle, although there may also be a declining underlying trend, indicating some favourable effect on the NAIRU.

Chart 3.3: Index of Industrial Turbulence



Absolute change in proportion of employees in production industries (000s)

48. It is worth noting a flourishing strand in the literature which suggests that since the mid-70s the demand for labour has increasingly tended to favour the skilled, to the detriment of the semi-skilled and unskilled. This literature has tended to focus on the widening dispersion in earnings, though it clearly has implications for unemployment, particularly where wages adjust with a lag and/or the benefit system imposes a lower bound on the earnings of the less skilled. It has been suggested that this feature accounts for the differing recent labour market experiences of the USA and Europe. The debate has concentrated on the causes of the phenomenon, in particular whether the prime mover is skill biased technical change or third world competition. Labour market deregulation (of which more below) also has a major part to play in the story, although whether as prime mover or as transmission mechanism is undecided. However, as far as the impact on the NAIRU is concerned the ultimate cause of the change in the pattern of labour demand is of less importance than the rate of change, and the policy response.

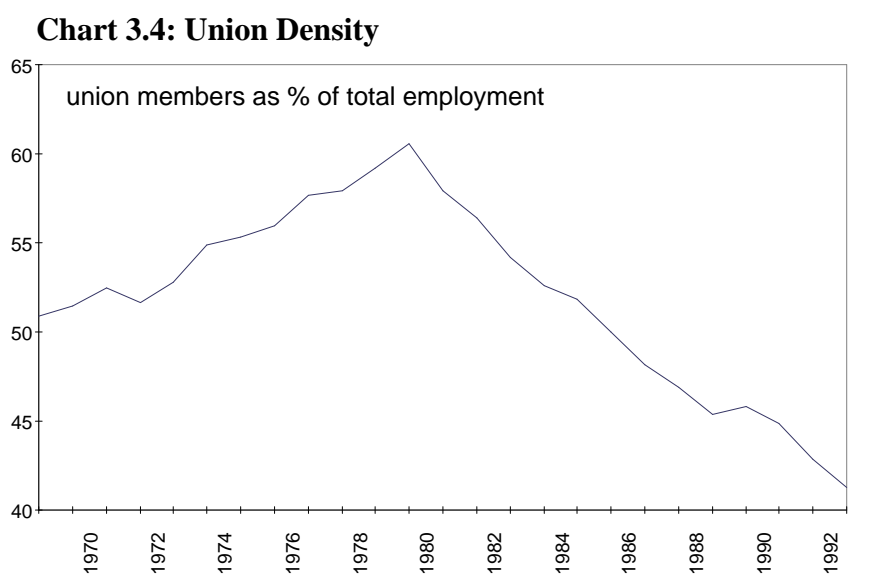
49. The decline in the demand for unskilled labour since the 1970s, insofar as wages have been unable to adjust to continually clear all sectors of the labour market, has led to “a race between the increase in demand for skilled labour and the supply of skilled labour”. (This metaphor is used by Jackman, Layard and Nickell, 1996.) If the supply of skilled labour fails to increase as fast as the demand, both total unemployment and the NAIRU will rise. Empirical work using this approach is still at an early stage, but work by Nickell and Bell suggests that on average one fifth of the rise in unemployment from the late 1970s to the late 1980s in Germany, Holland, Spain, UK and Canada was due to structural shifts in demand relative to supply. This result is consistent with the evidence that the Beveridge curve moved outwards in the same period, but analysts have not (yet) detected the decline in the degree of mismatch in the early 1990s indicated by the inward movement of the relationship.

Union power and reform of industrial relations

50. Union strength, and the framework of industrial relations will influence the bargaining ability of employees, and hence their ability to obtain higher wages, albeit at the expense of lower employment.

Again it is difficult to measure, and the usual union membership or density series fail to capture such things as militancy or the general climate of bargaining.

51. The econometric literature has usually employed union density as a measure of employee bargaining power, with those studies reported in the Coulton and Cromb survey having significant estimated impacts on the NAIRU with elasticities of between 0.4 and 0.7. Chart 3.4 indicates that the decline has continued into the 1990s at an only slightly diminished rate, while the number of stoppages and days lost also suggest that the bargaining power of trade unions has continued to decline. There is then reason to expect that diminishing union power will continue to have exerted a downward influence on the NAIRU.



52. However the particular proxy measures used should not be interpreted too strictly. For instance the variables may be partly endogenous. If unemployment changes affect the highly unionised sectors disproportionately, then higher unemployment will lead to lower union density, but on the other hand if unemployment pushes down wages more in the competitive sector than in the unionised sector, then the mark-up will increase. Some studies have attempted to allow for this simultaneity bias by using instrumental variable techniques, e.g. Manning (1992), but a positive impact on the NAIRU is still obtained.

53. A broadly similar picture is obtained from considering the size of the union mark-up, which a number of authors, including Jackman, Layard and Nickell (1991) consider as an alternative to union density. For instance Stewart (1995) has examined the Workplace Industrial Relations Surveys for 1984 and 1990, and obtained some quite dramatic results. His main findings are:

- i) the average union wage differential shows a fall from 10.5 per cent in 1984 to 7.5 per cent in 1990 for unskilled workers, from 10.5 per cent to 6.5 per cent for semi-skilled workers, and from 3.5 per cent to 1.5 per cent for skilled workers;
- ii) the differential where there is a closed shop or a strong recommendation of membership from management has declined more than the average;

iii) unions in 1990 had been unable to achieve positive differentials in new establishments, although the differential for older establishments (in existence in 1984) were much the same as they had been in 1984.

54. The picture that emerges is then that the decline of union differentials between 1984 and 1990 was due to the inability of unions to establish differentials in new establishments. Stewart has also shown that the union wage differential is relatively low, or non-existent for industries exposed to international competition. This suggests that the increasing openness of the UK economy, together with increased competition in the product market, will lead to further reductions in the NAIRU.

55. These changes are attributable not only to the changed macroeconomic environment but also to the changed legislative framework resulting from a series of Acts of Parliament in 1980, 1982, 1984, 1988, 1990, and most recently in 1993. In the 1960s and 1970s the emphasis in industrial relations had been on collective relations - pluralism in the workplace, corporatism at the national level, and a stress on institutions and procedures. The 1980s saw a restoration of management prerogatives, as managements extricated themselves from previous pluralist arrangements involving joint regulation with unions, as well as a spread of human resource management practices.

56. Particularly striking has been the decline in collective bargaining. Information from the 1990 Workplace Industrial Relations Survey shows that only a third of establishments employing manual workers and a quarter of those employing non-manual workers in the private sector still had their pay determined by collective bargaining, and these proportions are likely to have fallen further since 1990. Where collective agreements remain these are overwhelmingly single employer agreements rather than multi-employer national agreements (Metcalf (1994)). As a result there has been a transformation in pay systems away from the rigid regimes which prevailed under collective bargaining, towards more flexible systems which take into account performance (employees and/or business), the business climate, and local labour market conditions.

57. The move to more flexible forms of pay determination has also affected the public sector. The Civil Service is a case in point, where by April 1996 delegation of pay determination was universal except for the highest grades, entirely replacing central pay arrangements. The NHS has also recently embraced local pay bargaining, and local authorities are being encouraged to opt out of the national negotiating framework, particularly in low wage areas.

58. While persistently high levels of unemployment have no doubt weakened the bargaining strength of labour, and to this extent a fall in unemployment might be expected to reverse the process, there are grounds for believing that there have been fundamental changes in the structure of industrial relations. The adverse links between union presence and productivity and financial performance have been weakened, and it may be the case that unionised workplaces now have higher levels of productivity and investment than their non-union counterparts (Metcalf (1994)). This reduction in the monopoly effects of unions on company and workplace performance should permit the running of the economy at a lower level of unemployment without generating inflationary pressure, i.e. have a favourable effect on the NAIRU.

Growth of labour market insecurity

59. There is some evidence (e.g. Hedges (1994), Bacon (1995)) that employees feel that their jobs have become more insecure in recent years. In part this no doubt reflects cyclical features of the labour market, and may be expected to reverse themselves during the recovery phase of the cycle. However it

may in part be a consequence of some longer run factors and institutional changes which must be expected to persist, and consequently to exert downward pressure on the NAIRU.

60. A number of recent investigators (Gregg and Wadsworth (1995), and Burgess and Rees (1996)) have examined the tenure of jobs over the last couple of decades. There was little evidence that tenures had fallen, once allowance was made for cyclical factors, although there was some decline among males which was offset by an increase among females. UK job tenures remain substantially higher than those in the USA. However it must be borne in mind that this evidence is based on data showing elapsed spells, and that the completed spells of those in work may be different, and employees expectations of completed job spells still more different. Furthermore there is an inherent ambiguity in the use of job tenure as a proxy for job insecurity, as although the number of compulsory quits is likely to increase employee perceptions of job insecurity, it may also create a disincentive to quit voluntarily.

61. These results need to be placed in a wider perspective. In particular:

- full time employees as a proportion of the population of working age fell from 60 per cent in 1975 to 46.4 per cent in 1994;
- the proportions with “tenure”, i.e. rights of appeal to an Industrial Tribunal against unfair dismissal (the qualifying period for which has been increased from six months in 1979 to two years in 1985), fell from 55.5 per cent to 34.5 per cent;
- there has been a marked rise in self employment, part-time working, and temporary working;
- there has been a marked decline in union strength, an in the curtailment of union rights as a consequence of legislation (as discussed in the previous sub-section).

Together these suggest both a decline in employee bargaining strength and a fall in the hiring and firing costs of employers, at any given rate of unemployment, and consequently a fall in the NAIRU.

Active labour market policies

62. Active Labour Market Policies (ALMPs) must be expected to have an impact on the NAIRU, but they do not lend themselves to a time series treatment. Discussion has then to be based on first principles, bringing in elements of evaluation evidence as appropriate.

63. In the 1970s and 1980s the majority of ALMPs involved removing individuals from the unemployment count, with comparatively little longer run impact in terms of increased human capital. This was particularly the case for Community Programme, the scheme directed at the long-term unemployed, while at that stage the Youth Training Scheme (YTS) also contained a substantial “make-work” element.

64. In judging the labour market consequences of these measures it is helpful to separate the short run impact effects from the longer run human capital effects. In the short run the key issues are:

- i) **Additionality:** i.e. if these schemes did not exist, what would be the effect on the unemployment count? Are there reasons to believe that because of deadweight, displacement and substitution that there is a loss of ‘real jobs’? These are largely issues of programme design, and while steps were taken to ensure they were minimised, it is doubtful if they could be eliminated.

- ii) Effect on the NAIRU: i.e. to what extent would participants in these schemes otherwise be able and willing to participate in job-search, to what extent does their participation in the programme prevent them from doing so? What effects do the existence of such schemes have on the wage bargaining process? If effective competitors were being (temporarily) removed from the labour market, then the effect on the NAIRU would be unfavourable. If, as is more likely, they are not effective competitors, either because of their lack of skills, or of the time spent on the count, then their effect would be small.

65. The main schemes of this type are the adult scheme “Training for Work”, and “Youth Training”. Some participants in these schemes have contracts of employment, but those that do not reached a peak of 462 000 in 1989, since when the numbers have steadily declined to 237 000 in 1995. Such schemes are more precisely targeted than their predecessors, and their justification is sought much more in longer run effects on the quality of human capital than in the shorter run impact on the unemployment count or the NAIRU.

66. During the last decade UK unemployment policy has placed increasing emphasis on support for intensified job-search. This arose from the perceived success of the Restart Programme from 1986, under which unemployed individuals were initially interviewed every six months and offered assistance in finding work and training. The evaluation report (White and Lakey, 1992) indicated that individuals who went through the Restart process spent about 5 per cent less time unemployed the following year. The results of this microeconomic study have been broadly corroborated by econometric studies, e.g. both Gregg (1990) and Dicks and Hatch (1989) estimate that Restart reduced the claimant count by about 800 000 during the late 1980s, and Lehmann (1993) estimates that 35 per cent of the fall in long-term unemployment between 1984 and 1990 can be attributed to the introduction of Restart.

67. The success of the Restart initiative led to the extension of advisory interviews within Employment Service activity, and the closer linking of benefit payments with job search activity, as outlined in paragraph 3.4 above. The effect of this activity on the NAIRU is difficult to quantify, but fairly definitely favourable, particularly if those removed from the unemployment count are longer-term unemployed people whose presence on the count has little restraining effect on inflation.

4. Empirical evidence

68. As we saw in Section 2, the NAIRU is an unobservable schedule. Estimates have to rely on the results of econometric work, and so, with uncertainties about the correct specifications of the wage, price and employment models and the difficulties in measuring some of the structural variables, e.g. union power and mismatch, there is a strong likelihood of a wide range of estimates. Large-scale macroeconomic models can also be set up to yield estimates of the NAIRU. Also, since the NAIRU is a schedule rather than a scalar, it is important that the conditioning assumptions, especially for the external sector, are made explicit, since they can have a big influence on the numerical results whatever the method used. Models have typically been estimated for the UK over sample periods from the late 1960s to the mid- to late 1980s. The last five years are of most interest to us because it is where the effects of the labour market reforms might be apparent in macroeconomic data. They are typically not covered in data samples used in econometric work¹⁸. But even so it is probable that, because of the long lags in labour market behaviour referred to in the discussion of hysteresis, the effects on the NAIRU will be slow to emerge. It is also worth reiterating that changes in cyclical responses, for which there is some evidence, may have no implications for the level of the NAIRU. Econometric estimates of wage equations

18. Macroeconomic models are an exception here, being re-estimated on a regular basis.

especially are known to be unstable, Darby and Wren-Lewis (1993), so out of sample tests for structural change might not be decisive evidence of possible shifts in the NAIRU. Of course, the use of charts is no substitute, but they are one way presently available of inferring whether a break in behaviour may have occurred, and it is the one used here. We also have an interesting study by Morgan (1996).

NAIRU estimates for the UK

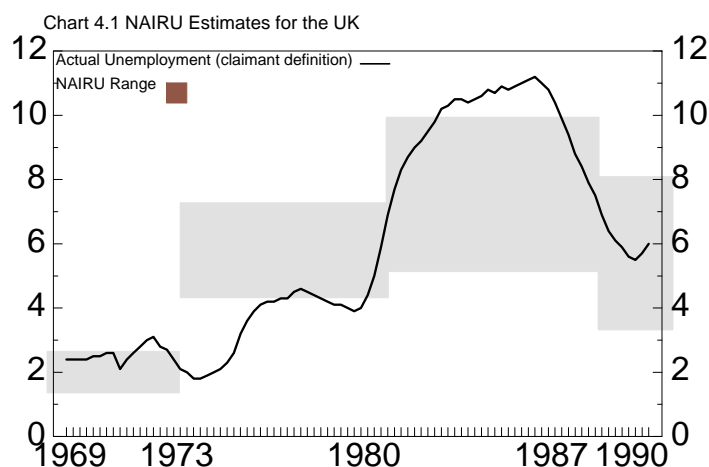
69. In Table 4.1 below the range and average NAIRU estimate, and actual unemployment for the eleven studies shown in Table 8 of Coulton and Crompton (1994) are given.

Table 4.1. **NAIRU estimates for the UK (claimant definition)**
(percentage)

	Periods within which the estimates fall			
	1968-73	1974-80	1981-87	1988-90
NAIRU range	1.6 - 2.8 ¹	4.5 - 7.3	5.2 - 9.9	3.5 - 8.1
Average NAIRU	2.4	5.7	7.0	6.1
Actual unemployment	2.5	3.8	10.1	6.8

1. Excludes study by Coe and Gagliardi.

Source: Coulton and Crompton, Table 8.



70. The range of the estimates is made for each of the sub-periods, and there is no consistent outlier study. The form of conditioning assumption for the external sector is not always explicit in Coulton and Crompton, and neither is whether these are predominantly short or long run estimates. Chart 4.1 also shows this information. The NAIRU peaked in the middle 1980s, having been above actual unemployment in the second half of the 1970s, and a little below actual for much of the 1980s. The table shows that for the latest period covered there seems to have been a fall in the NAIRU, although it is less than the fall in

actual unemployment. Only five studies are included in this period: three show little change compared with the preceding period, two indicate substantial falls¹⁹.

71. There is a variety of ways to estimate the NAIRU. Some studies use a *reduced form* equation for unemployment in terms of lagged unemployment, current and lagged changes in inflation, the trade balance condition and, in some cases, those Z factors for which time series estimates are available. One example of an estimate using the so-called ‘fundamental supply trade-off’ is given in Table 4.2 below. By setting the change in inflation terms equal to zero and plugging in period average levels of unemployment and the trade deficit an estimate of the NAIRU is obtained. The inclusion of lagged actual unemployment in the estimated equation provides a measure of the strength of hysteresis effects.

72. The majority of studies rely on direct estimates of equations such as [1] and [2] or [2'] above to give *structural* estimates of the NAIRU such as [3] or [3']. Given the parameter estimates and actual values of the determining variables, including unemployment and the change in inflation, it is possible to infer that level of unemployment which would have given stable inflation.

Identification

73. A particular problem with estimates of models such as [1] and [2] is that the wage equation is not identified. It fails to satisfy the rank condition since any multiple of equation [2] can be added to [1] without changing the structure; Bean (1994), Jackman, Layard and Nickell (1991), p. 405, and Manning (1993) discuss this issue. Moreover, equation [1'] implies that estimates of the wage equation should include the variables which influence firms' productivity and price mark-ups, i.e. the X variables in equation [2]. In practice they are usually excluded. To what extent the arbitrary exclusion restrictions invalidate wage equation estimates is difficult to say. Minford argues that by estimating unidentified wage equations, there is a serious danger of incorrect inference. Variables, especially supply side variables such as the replacement ratio, have been excluded incorrectly on the grounds of insignificance when the wage equation is a linear combination of the wage and price equation and fails the rank condition. However, Bean (1994) notes that if the error terms in the wage and price equations are uncorrelated, and the contemporaneous elasticity of employment with respect to the real wage is close to zero, then ordinary least squares estimates of [1] would be valid. The second of those two conditions implies that real wages can be considered as exogenous to the mark-up equation, and vice versa. What is clear is that none of this affects reduced form estimates of unemployment or the NAIRU.

74. One possible way of identifying the parameters of interest has been suggested by Manning (1993). Starting from structural equations for employment, profits, the union's utility function and a wage setting relationship reflecting Nash bargaining, a real wage equation is derived. This has real wages as a variable mark-up over the opportunity cost of supplying labour, represented by real benefits foregone. The important point for estimation is that starting from rigorous theoretical underpinnings, Manning shows that it is possible to derive a structural wage equation which is identified, but not on the basis of arbitrary exclusion restrictions. Moreover, the specification does not include productivity or mark-up variables. Applying this model to UK data from 1956 to 1987, tests of the sensitivity of the wage equation estimates to the inclusion of a productivity variable were conducted. Unsurprisingly, individual parameter estimates were found to be rather sensitive to the specification, for example whether or not productivity or lagged real wages were included or not.

19. The Liverpool macroeconometric new classical model and Joyce and Wren-Lewis (1991). The studies by Minford exclude hysteresis effects in the specification of the wage equation.

Reduced form and structural estimates

75. An example of a fundamental supply constraint estimate is given by Jackman, Layard and Nickell (1991), p. 445. Their estimate of the NAIRU for the period 1988-90 is made up as follows:

Table 4.2 **Estimate of the NAIRU**

	1988-90
Actual unemployment	7.3 plus
Change in unemployment	0.9
Change in inflation	-1.0
Trade balance	1.4
NAIRU	8.7

Source: Jackman, Layard and Nickel (1991).

The figures shown for the explanatory variables are the actual changes lagged two, two and one year respectively. The NAIRU results from plugging these into the reduced form equation: hence the column does not sum.

76. What this means is that the actual unemployment was below the long run NAIRU, and that this difference was accounted for by allowing the trade balance to move out of balance (in equilibrium the exchange rate would need to be lower), lagged unemployment to fall more quickly and inflation to rise faster than was compatible with stable inflation. (The change in inflation term is doing duty for price expectations.) If the unemployment inflation relationship were to invoke rational expectations then this effect, which is numerically large in the result above, might be attenuated, or at least changed.

77. Jackman, Layard and Nickell also give an example of a structural approach to the NAIRU, although not for the 1988-90 period. Actual values of the changes in the structural factors which are identified in an equation of the form [3"] are used to calculate the change in the long run NAIRU over the relevant period. As an example, the results for the period 1974-80 to 1980-87 are shown in Table 4.3.

Table 4.3 **Breakdown of NAIRU change**
(percentage points)

	1974-80 to 1980-87
<i>Cause:</i>	
Employers' labour taxes	-
Taxes	-0.3
Unemployment benefits	0.5
Union Power	0.1
Terms of trade	1.3
Oil	-2.6
Labour market mismatch	1.5
Incomes policy	-
Unmeasured ¹	0.7
Change in NAIRU	1.2
Change in Actual ²	6.0

1. The unmeasured component arises from taking the difference on the NAIRU levels estimated by the reduced form and structural approaches in the two periods. The positive implies that the estimated NAIRU rise from the reduced form approach is 0.7 percent points higher than from the structural approach. Jackman, Layard and Nickell (p. 446) ascribe this to failure to capture all the relevant exogenous factors at work, of which they suspect skill mismatch is the most important.
2. OECD standardised.

Source: Jackman, Layard and Nickell (1991).

Over this period the contribution of the tax wedge was small but negative, reflecting cuts in direct taxes. The positive terms of trade effect should be interpreted as saying that a lower real exchange rate was necessary to maintain external balance, although this was more than offset by the positive effect on the trade balance of North Sea oil. In terms of Annex 1 Diagram A1 the negative net effect of these two changes is a downward shift in the external balance schedule. Increased mismatch and changes to the levels of unemployment benefit tended to raise the NAIRU.

78. The econometric evidence on the tax wedge variables is difficult to generalise. As noted already, some investigators rule out long-run wedge effects on theoretical grounds. Coulton and Cromb survey the empirical estimates. Newell and Symons (1986, 1987), and Anderton and Barrell (1992), find that long run effects are not significant. In the vintages of the LBS and OEF models that Coulton and Cromb looked at, indirect taxes and employers taxes, though not direct taxes, had a significant impact. In the latest version of the Treasury model (Chan *et al.* (1995)) a composite tax wedge is used in the real wage equation. Freely estimated, the coefficient on the wedge variable takes a coefficient of 0.55, but when long run zero effects were imposed the term in unemployment became insignificant. One possible reason for the difficulty of estimating tax effects with any precision is that over the last decade and a half there has been a marked reduction in direct taxes from their mid-1970s peak, while indirect taxes have continued to increase. Employer taxes were at a peak (as a percentage of wages) in the early 1980s, since

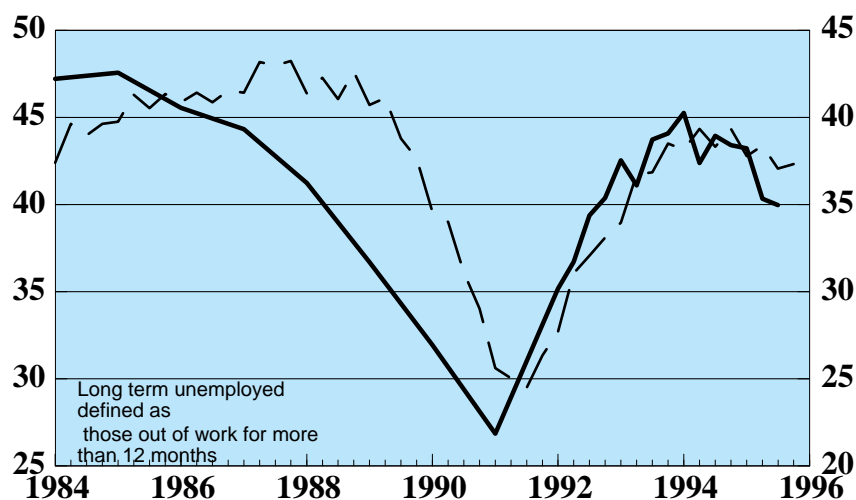
when they have stabilised (at about 14 per cent). Other elements of the wedge, such as mortgage interest payments and local authority taxes have experienced periodic peaks.

79. The importance of real wage resistance in the short run is less controversial. Even if the labour supply function is inelastic in the long run there is likely to be some intertemporal substitution in the short run. According to Coulton and Cromb's estimate, the wedge reached a peak of almost 60 per cent in 1982, but has since fallen to about 40 per cent. (The main component of the wedge has been taxes, although the terms of trade made a considerable contribution after the commodity price shocks of 1973 and 1979.)

80. There is common agreement that hysteresis and persistence effects have been important in the UK labour market, and there is some evidence, for example the reduction in the employment-output lag shown in Chart 4.4, that such effects are now declining. Reduced form unemployment equations estimated on data up to the mid to late 1980s typically found a coefficient on lagged unemployment of 0.7 to 0.8: Jackman, Layard and Nickell obtained 0.6 in the equation underlying Table 4.3. Structural wage equations also find statistically significant lagged effects. The range of estimate is wide, but the average is around 0.5, a little lower than the reduced form estimates. However, estimates of wage equations using data up to the mid 1980s with unemployment of greater and less than 26 weeks duration as separate regressors generally fail to find significant differences on the coefficients, thus tending to reject the duration story as a main cause of persistence, Darby and Wren-Lewis (1993). But this may reflect the relatively stable ratio of short to long term unemployed, see Chart 4.2. In their cross country study of the wage equation, Jackman, Layard and Nickell found that the long term unemployed (percentage with duration over one year) has an important influence on the hysteresis term, Δu , in the wage equations. Given the wide variation in duration across countries, these results may be more reliable than time series evidence from a single country. It is also possible that persistence in the wage equation is reflecting effects working through price setting or labour demand²⁰.

20. Persistence effects in the wage equation may also occur if for example the price mark-up depends on changes in real demand or, equivalently, the demand for labour adjusts slowly to its long run determinants. Bean (1989) cites capital shortages as a possible reason for this.

Chart 4.2: Ratio (%) of long term to total unemployed



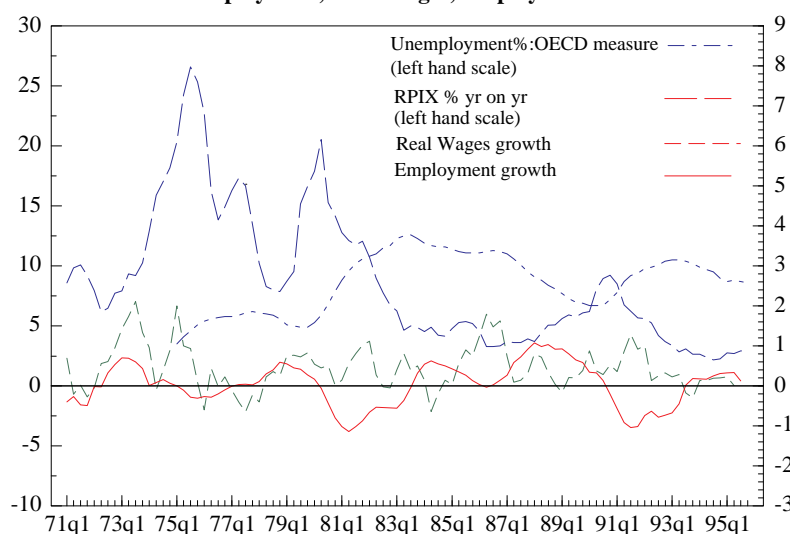
81. Simulations with empirical macroeconomic models are potentially another way of deriving estimates of the long run NAIRU, on which see Wren-Lewis (1995). The idea is to vary demand and hence unemployment to give stable inflation, with the effect working through capacity utilisation effects in the price equations and unemployment effects in the wage equations. Some external balance or exchange rate condition needs to be imposed, and results are sensitive to its precise form. A general finding of these studies, for example Fisher and Henry (1991), is that 'shifts in the real exchange rate overshadow other factors in [determining equilibrium unemployment]'. In common with others they find convergence to the NAIRU is slow²¹.

Recent evidence

82. Those empirical studies which extend through to the late 1980s show that the NAIRU peaked around 1985. But no published studies use data beyond 1990. Some indicators from the economic cycle which started with the peak in output in 1990 give reasons for supposing that a downward trend has continued. There has been little growth of real earnings since mid-1992. The economy has been recovering since early 1992, while inflation has been stable, see Chart 4.3. The current account, not shown, has been in deficit since 1987, and this means, other things equal, that inflation has been lower than would be the case in fundamental equilibrium.

21. The precise form of the wage and price equations, e.g. whether dynamic and static homogeneity is imposed is an important factor, also the strength of capacity utilisation in the price equations.

Chart 4.3: Unemployment, Real Wages, Employment & RPIX Inflation



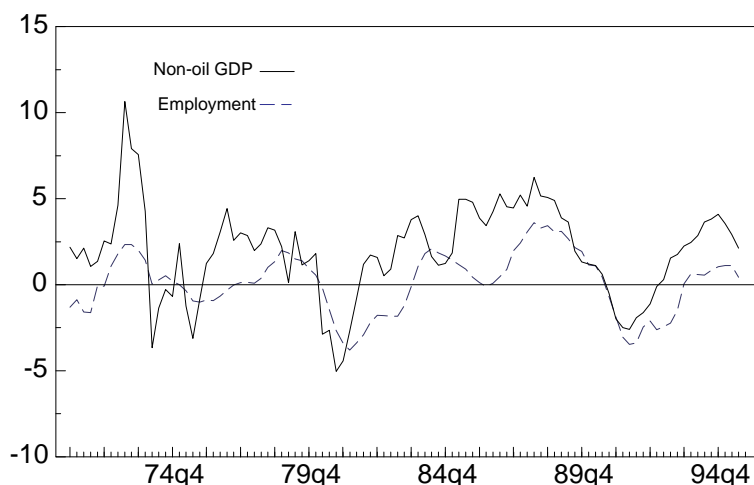
83. The unemployment rate has been falling since the end of 1992 and employment has increased by about 550 000 (2 per cent) between mid-1993 and the end of 1995²². Morgan (1996) has used the National Institute model to investigate whether the subdued growth of wages since 1992 represents a significant break with the past. He found that while the out-of-sample equation residuals were negative since 1993, showing wages were lower than expected on the basis of earlier behaviour, they were not significantly so.

84. There have been falls in the regional dispersion of unemployment, in the ratio of long term to total unemployment and reductions in skill shortages. These mismatch factors taken together suggest that the short term NAIRU has fallen. On their own they need not imply that the long run NAIRU has also fallen. Although the structural changes outlined in section 3 point in this direction, the unwinding of hysteresis effects is another likely reason for the current benign position.

85. Evidence also points to greater responsiveness of employment to changes in aggregate demand. In particular the lag between output and employment growth has become shorter, Chart 4.4, and productivity growth appears to have become less cyclical: compare, for example, implied productivity growth around the 1990 recession with the 1980 recession. Reduced labour hoarding would explain this.

22. The Labour Force Survey gives a figure of 730 000 (Labour Force Survey winter 1992-93 to winter 1995-96) while the Workforce in Employment shows a rise of 370 000 (December 1992-March 1996).

Chart 4.4 Employment and Output



86. It would be surprising if an increase in labour market flexibility had not occurred in view of the reduction in hiring and firing costs and lower levels of employment protection. However, only if these factors change wage and price setting will the NAIRU also be reduced. There is some reason to suppose that this has been the case. Increased hirings and separations, and the reduced power of insiders tend to reduce the target wage, and the warranted real wage schedule will shift out if average productivity is raised by lower firing costs²³.

5. Policy implications and conclusions

87. It is generally agreed that the UK has seen large reductions in the strength of the factors such as union power, the replacement ratio, a tightening in benefit administration and regional mismatch, all of which are included in Z. It follows that there should also have been a large reduction in the natural rate of unemployment. Some advocates of new classical theory, e.g. Minford in HM Treasury (1996) pps. 12-13, take this to its logical conclusion and say that there is now scope for a far more relaxed macroeconomic policy stance on the grounds that the NAIRU is 'well below the current level of unemployment' (perhaps similar to many US estimates of 5-6 per cent?), if not in the short term then within a few years. He reinforces this with the view that there has been a tendency recently for monetary policy to be tighter, repeatedly, than agents had expected.

88. The problem with this approach are two-fold. First, there remains a conflict of evidence about the NAIRU. A reworking of the estimate given in Table 4.2 by Nickell shows the NAIRU has changed hardly at all: the figure for 1991-95 remains at 8.7 per cent, above the current (September 1996) actual rate of 8.1 per cent on an OECD basis. The fact that inflation remains low is partly accounted for by the lagged effects of the trade deficit in this estimate. The absence of a marked fall in this estimate is not surprising, because such an approach cannot pick up the effect of the Z factors, unless they are taken account of in trend productivity. The Treasury's own estimates derived from a linearised version of the Layard-Nickell structural model show a sharp fall in the NAIRU, consistent with the intuition about the possible effects of the movements in the Z factors. But even here the distinction between the short and long run NAIRU appears to be important. The short run NAIRU estimate of around 5-7 per cent is well

23. However, in an efficiency wage model, increased labour turnover may reduce average productivity if there are adverse effects on firms' ability to screen out poor quality workers.

above a long run NAIRU estimate of 2-4 per cent currently, as might be expected from the earlier discussion of hysteresis. Once again, the wide range and great uncertainty of NAIRU estimates is shown, although it is probably fair to say that many economists interested in this area consider that it has fallen since the late 1980s. It would be a bold policy maker who chose to expand the economy on the basis of low short and long run NAIRU estimates. Recent research which allows for non-linearities in the output-inflation trade-off suggests that there should be a bias towards conservatism arising out of both the asymmetries and the uncertainties surrounding estimates of equilibrium unemployment, Bean (1996) and Laxton *et al.* (1994).

89. Second, it does not follow that because there may have been a large reduction in wage push that the economy now behaves as if labour and product markets were fully competitive. Collective wage bargaining at the firm level and incentives to pay efficiency wages remain important features in wage setting. And while there have been large changes in the Z factors, there may be a limit to the extent to which any UK government would be prepared to tolerate the possible effects on the real incomes of the poorest that any further reductions in income support and the replacement ratio might bring. One indicator of this is that since 1980 the real earnings of the lowest decile have remained static.

90. The UK is often seen as one of those countries, along with Australia and New Zealand, which has gradually aligned its labour market policies towards the US model and away from that of continental European countries. The fact that the earnings distribution has widened since 1980, albeit from a starting point which had been compressed artificially by the incomes policies of the 1960s and 1970s and which was relatively compressed by the standards of, for example France and Canada, although not Scandinavian countries, is often taken as an indicator of this shift. There are a number of possible reasons for this widening, much of which reflects a fall in the demand for the unskilled²⁴. Developing country competition as discussed in section 3 and technical change biased against the unskilled may both have contributed, although the jury is still out on the relative strength of the two effects, see Burtless (1995) for a survey. Deregulation and increased labour market flexibility have also undoubtedly played a part.

91. To date, the UK has been able to ameliorate some of the social costs of a wider earnings distribution by providing in-work benefits such as housing benefit and family credit to families with a wage earner and a child: half a million are covered this way. These policies are framed so as to ensure, as far as possible, that very high marginal tax rates for those covered are avoided.

92. In the future a continuation of the fall in demand for the unskilled might be more difficult to contain without allowing earnings at the bottom of the distribution to fall to what may be considered unacceptably low levels. Increasing the standard levels of basic education, together with improved training, are important policy responses, but they do little for older unskilled workers. So, if priority were to be given to distributional aspects in the face of falling demand for the unskilled, then raising benefit levels and similar policies, which inevitably increase the NAIRU above what it would otherwise have been, may be unavoidable. To put against this, it is important to bear in mind that social welfare relates to consumption per capita rather than output per employed person. If distributional questions can be put aside, a big if, any reduction in the numbers unemployed, provided it does not merely reflect falling participation, will be welfare improving, if labour's marginal product exceeds the social cost of working or if there is welfare from working. In this light the UK's policies aimed to lower the NAIRU can be well justified.

24. Nickell and Bell (1995) estimate that about one fifth of the rise in unemployment in the UK was due to a switch away from the demand for the unskilled.

ANNEX: THE OVERSEAS SECTOR AND THE NAIRU

1. Firms' price setting or labour demand decisions in an open economy are influenced by the strength of overseas competition. Equally, wage bargainers will attempt to maintain living standards when confronted by a rise in import prices such as happened with the two major oil price shocks, so there are clear influences running from the overseas sector to internal balance as measured by the NAIRU. External balance also needs to be considered: in the long run an economy cannot increase its external indebtedness or maintain an under or overvalued exchange rate indefinitely.

2. The simple versions of the wage and price setting equations in [1] and [2] may be used to show the relationship between competitiveness or, equivalently, the trade balance or real exchange rate, and the NAIRU. Rewriting [1] and [2] to include real import prices, we have

$$w-p^e = \gamma_0 - \gamma_1 u + \gamma_2 Z_w + \gamma_9 (pm-p) \quad [A1]$$

$$p-w^e = \beta_0 - \beta_1 u + \beta_2 Z_c + \beta_9 (pm-p) \quad [A2]$$

where Z_c are exogenous factors, such as non-price competitiveness²⁵ and Z_w now denotes domestic wage pressures. Subtracting [A2] from [A1] gives, after rearranging, an equation for the real exchange rate:

$$(pm-p) = (\gamma_0 + \beta_0)/(\gamma_9 + \beta_9) - (\gamma_1 + \beta_1) u / (\gamma_9 + \beta_9) + \gamma_2 Z_w / (\gamma_9 + \beta_9) - \beta_2 Z_c / (\gamma_9 + \beta_9) \quad [A3]$$

Since there is unlikely to be a one for one relationship between import price competitiveness and the trade or current account deficit, [A3] may also be written as:

$$(pm - p) = a_0 - a_1 u + a_2 Z_w - a_3 Z_c - a_4 td \quad [A4]$$

This equation shows that the trade deficit is negatively related to unemployment and competitiveness, but positively to the wage push factors.

Equations [A1] and [A2] can also be solved to give a relationship between unemployment, domestic inflation, and real import prices. After substituting $\Delta^2 p$ for p^e , we have:

$$u^* = (\gamma_0 + \beta_0) / (\gamma_1 + \beta_1) + \gamma_2 Z_w / (\gamma_1 + \beta_1) + \beta_2 Z_c / (\gamma_1 + \beta_1) \\ + (\gamma_9 + \beta_9) pm / (\gamma_1 + \beta_1) - (\gamma_3 + \beta_3) \Delta^2 p / (\gamma_1 + \beta_1) \quad [A5]$$

3. This equation is a formalisation of the fundamental supply constraint. It says that the higher are import prices the higher needs to be the level of unemployment consistent with stable inflation. In this respect import prices act in a comparable way to the Z variables, as a comparison of [A5] with [3] shows. A rise in import prices shifts upwards the locus of unemployment/real wage combinations consistent stable inflation.

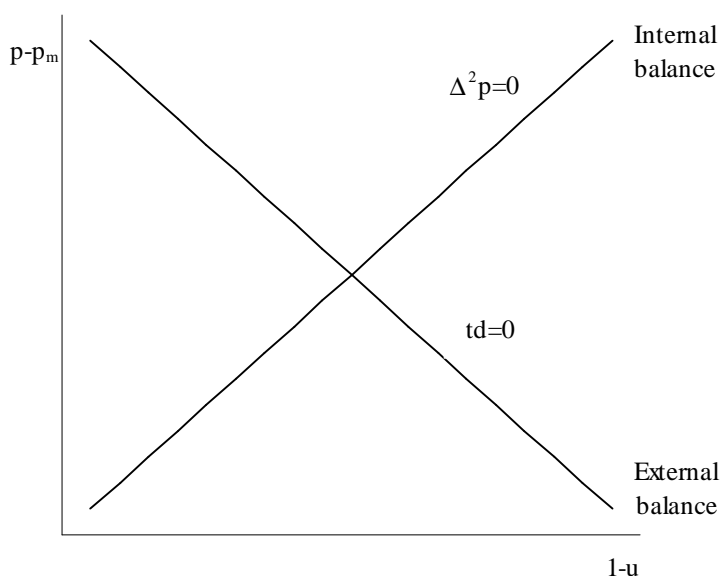
4. Using equations [A4] and [A5] it is possible to illustrate how external balance [A4] and internal balance [A5] interact. In Diagram A1, the ratio of domestic to real import prices, i.e. the inverse of real

25. Recall that pm and p are in logs, so that high values of $(pm-p)$, i.e. low $(p-pm)$, represents a low real exchange rate.

exchange rate, is shown on the vertical axis (higher values represent a depreciation) and on the horizontal axis unemployment is decreasing away from the origin. The schedule representing the zero trade deficit or external balance is downward sloping. The intuition is that as real demand rises (unemployment falls), the trade deficit, other things equal, will rise. To maintain the trade deficit at zero, the relative price of imports needs to rise, $p-p_m$ falls, i.e. there has to be a real appreciation, so the schedule slopes downward²⁶.

5. Internal balance requires that inflation is stable. At low levels of unemployment real wage demands are high, but stable inflation can be maintained only by having a high real exchange rate. So the locus of unemployment - real exchange rate combinations which deliver stable inflation is upward sloping. As Diagram A1 shows, there is only one point satisfying both internal and external equilibrium, with inflation stable and the trade deficit equal to zero.

Diagram A1: **The NAIRU and the real exchange rate**



26. This can be verified by rearranging (A4), $td = a_0 - a_1 u + p-p_m$.

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