The NAIRU: A Critical Appraisal[1]

by

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1. The policy importance of the NAIRU

There can be little doubting the central role which has been played in macroeconomic theory and policy by first the natural rate of unemployment (hereafter NRU) and more latterly the NAIRU (non accelerating inflation rate of unemployment).[2] Its influence on policy has arisen from its apparent message that demand reflation can have, at best, short lived beneficial effects on employment with longer term inflationary consequences, and that supply side measures may have some effect on the unemployment whereas demand side measures do not any long term effects. The fear of inflation, especially of rising inflation moving into hyperinflation, has then led to a reluctance (to put it mildly) to allow the level of unemployment to fall below the NAIRU.

This paper is concerned with the question of the relevance of the NAIRU for policy formulation. However that question leads to the following consideration. The estimates for the NAIRU are based on the econometric estimation of models of the economy. Particular models are used and particular interpretations are placed on the relationship between the variables which the model involves. Since the NAIRU can never be directly observed, resort has to be made to the econometric estimation of wage and price equations from which an equilibrium solution for unemployment is derived and labeled the NAIRU. It is therefore important to know how valid those models are and the estimates derived from those models. Whilst some have pointed to the unreliability of those estimates (e.g. Setterfield et alia, 1992) and others to the degree of uncertainty surrounding the estimates (e.g. Madsen, 1997), others have put a great deal of faith in specific estimates: for example the 'Tightness in the labor market is measured by the excess of CBO's estimate of the non accelerating inflation rate of unemployment (NAIRU) over the actual unemployment rate. It is an indicator of future wage inflation' (Congressional Budget Office, 1994, p.4), and that Office uses an estimate of 6 percent for the NAIRU. One expression of the belief in the NAIRU is given by Stiglitz when he writes that 'I

have become convinced that the NAIRU is a useful analytic concept. It is useful as a theory to understand the causes of inflation. It is useful as an empirical basis for predicting changes in the inflation rate. And it is useful as a general guideline for thinking about macroeconomic policy' (Stiglitz, 1997, p.3).

The focus of this paper is not on the reliability or otherwise of estimates of the NAIRU, but rather to evaluate the theoretical foundation of the models from which the NAIRU has been derived. For if those models are on some relevant criteria judged to be unsound, then estimates and policy conclusions derived are seemly unsound.

In the next section, we discuss what is meant by the notion of the NAIRU, and what could be considered the essential characteristics of the NAIRU. This is followed by a section in which we reflect on the relationship between economic models and reality. Section 4 provides a detailed critique of two approaches to the NAIRU which have been particularly influential, one more so in the United State (that of Gordon) and the other more in Europe (Layard, Nickell and Jackman). Following from that we argue that the mechanisms by which an economy would reach any NAIRU have been inadequately specified and can be subject to much criticism. The next section argues that the models underlying the derivation of a NAIRU have not only ignored the role of aggregate demand but have also (implicitly) invoked Say's Law that 'supply creates its own demand'. Section 7 provides a more formal treatment of the role of aggregate demand. In the next section, consideration is given to alternative views on how real wages are settled. In the last substantive section, we reflect on the reasons why it has often been observed that the estimates of the NAIRU track actual unemployment (albeit with some lag).

2 Defining the NAIRU

At one level, the definition of a NAIRU is (almost) self-evident namely that, within the context of a particular model, the NAIRU is the equilibrium solution (for unemployment) arising from the imposition of the condition that the rate of inflation is constant[3] (and the conditions usually also include that expectations are fulfilled). There are, though, a range of models from which such an

equilibrium rate of unemployment could be derived, and the question arises as to whether all such models (and hence all derived NAIRUs) would be usually included under the NAIRU 'umbrella'. There are common themes which enables us to say that the concept of the NAIRU conforms to the following:

(I) the NAIRU is an equilibrium rate of unemployment[4] based on supply side consideration only. In so far as aggregate demand is given any role within the model it does not affect the NAIRU, and this means that there is an essential separation of the supply-side and the demand-side (akin to the classical dichotomy) and the operation of some form of Says Law (further discussed below). 'Thus the natural rate hypothesis applies the classical proposition of monetary neutrality to unemployment, and in doing so yields the policy ineffectiveness proposition that aggregate demand policy measures cannot change the sustainable or equilibrium rate of unemployment' (Cross, 1995, p. 181 : note that Cross uses the term 'natural rate' more broadly than this paper does and as a synonym for NAIRU).

(ii) the NAIRU is not path dependent. This does not mean that the short term NAIRU is the same as the long term one for there can be effects of changes in unemployment on the pace of (wage) inflation (cf. Cross, 1995) but it does require that there is some effect of the level of unemployment on (wage) inflation and that there are no persistent effects arising from, for example, the level of aggregate demand and its effects on investment, capacity and labor force participation. The term hysteresis is often to used to refer to cases where there is some prolonged effect from, say, current unemployment but where the effect gradually wears off, and hence where there are no persistent effects. Apart from matters of accuracy in the use of words (noting that hysteresis in its application in the area of physics does involve persistent effects), it is important to note that the concept of the NAIRU precludes persistent effects arising from the path of aggregate demand..

(iii) the NAIRU is unique. This is not an intrinsic feature of the NAIRU and indeed there are models in which multiple equilibria are found (e.g. Manning, 1992). But the estimation of the underlying equations and the general discussion on the NAIRU proceed in a manner consistent with a unique equilibrium.

There are three other key aspects of the NAIRU. The first is that the NAIRU would usually be seen as a 'strong attractor' for the actual rate of unemployment (Phelps, 1995). The mechanism through which the NAIRU could be a strong attractor (and more generally the stability and adjustment properties of NAIRU models) is discussed below. However, others have adopted a rather different perspective ; for example, Blanchard (1995) remarks that 'the natural rate is at best a weak attractor' and that 'the natural rate is often as much an attractee as it is an attractor' (p.xiii). But if that were the case, the NAIRU loses most of its power as a concept even if it in some sense described an equilibrium outcome. Clearly if the NAIRU were a weak attractor (because, for example, the level of aggregate demand determined a quite different level of employment) and/or if it were an attractee (because, for example, the path of the economy influences investment which creates the level of capacity which in turn effectively determines the NAIRU)[5], then its operational power would be very small.

In a similar vein, as de Vroey (1996) argues, Keynes could have readily agreed with Friedman on the definition of the 'natural rate of unemployment' (as in the quote given below) as corresponding to full employment (taking into account frictional and search unemployment) but differed in the major respect as to whether there was a strong feedback mechanism leading actual unemployment to the natural rate. Keynes would view the forces leading the actual rate of unemployment towards the 'natural rate' as weak, and the achievement of the 'natural rate' would require a high level of aggregate demand. In contrast, Friedman would view the adjustment of real wages in the face of the excess supply of labor as the mechanism by which the unemployment moved rapidly to the 'natural rate'.

There is, though, a strong suggestion in the usual presentation of the NAIRU that actual unemployment is strongly influenced by the NAIRU (though this may come about through policy responses to divergences of unemployment from the perceived NAIRU). There is little hint in the discussion on the NAIRU of what would prevent actual unemployment veering towards the NAIRU. Specifically, and as further discussed below, this entails the assumption that aggregate demand will

readily adjust to a level appropriate for the NAIRU. It also presupposes that there are not other constraints on an economy reaching the NAIRU, and the one which comes readily to mind here would be a balance of trade constraint.

The second aspect is that the NAIRU can be viewed as an equilibrium level of unemployment with 'knife edge' properties in that any significant and prolonged deviation of actual unemployment from the NAIRU will involve continuously rising or falling inflation. Since the NAIRU is presented as a unique point (rather than, say, a plateau), this knife edge property appears to rule out even the smallest of deviations from the NAIRU. However, the rate of acceleration may not be that rapid : take, for example the coefficients estimated by Layard, Nickell and Jackman (1991) (hereafter LNJ) for the United States. Their figures suggest that for each 1 per cent unemployment is below the NAIRU, price inflation will rise by 1.4 per cent.[6] Hence at the end of five years with unemployment 1 per cent point below u*, inflation would be just over 7 per cent higher: according to the model, it would, of course, continue to rise. Gordon (1997) suggests that the rate of acceleration would be rather small, and postulates that unemployment 1 per cent lower than the NAIRU for starting at the end of 1997 through to 2005 would lead to inflation being 5.3 per cent higher in that year. These order of magnitudes leads Stiglitz to state that 'Contrary to the accelerationist view, not only does the economy not stand on a precipice-- with a slight dose of inflation leading to ever-increasing levels of inflation--but the magnitude by which inflation rises does not increase when the unemployment rate is held down for a prolonged period of time' (Stiglitz, 1997, p.9). He estimates that inflation rises by 0.3 to 0.6 per cent for each 1 per cent unemployment is below the NAIRU.

The third aspect is that the NRU is identified with a competitive equilibrium following the well known definition of Friedman for the NRU as 'the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is embedded in them the actual structural characteristics of the labor and commodity markers, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on.' (Friedman, 1968, p.8). As Pesaran and Smith (1995)

observe 'according to this definition, the natural rate of unemployment is not a constant or immutable rate, but is determined by a host of market and non-market factors.... Friedman's primary reason for introducing this concept ... was an attempt to 'separate the real forces from the monetary forces' that impinge on the market rate of unemployment.' (p. 203).

The view can be taken that the NAIRU is the general concept of which the NRU is a particular case when there is perfect, rather than imperfect, competition. This is then suggestive of the notion that unemployment above the 'natural rate' can be ascribed to imperfect competition : the 'imperfectionist approach' (Eatwell and Milgate, 1983). There are a variety of ways, though, in which the NRU (and the associated framework) differs from the imperfectionist NAIRU, and two are highlighted here. First, the role of unemployment is essentially different. In the NRU, unemployment is essentially search unemployment, and there is more or less unemployment than the 'natural rate' according to whether people (on average) spend more or less time on searching for improved wage offers. The appropriate measure of unemployment is then one which matches up with search unemployment. In the NAIRU, unemployment in equilibrium at the NAIRU is whatever is required to hold inflation in check, and does not carry any connotation of involving full employment or of arising from search. Unemployment is essentially a proxy for the factors which bear down on wage claims and measures of unemployment have to be considered in that light. The relationship between the level of unemployment and the factors bearing down on wage claims may change over time and this is reflected in a recent statement by Alan Greenspan, when he stated that 'heightened job insecurity explains a significant part of the restraint on compensation and the consequent muted price inflation' (Greenspan, 1997) and cites a survey which found that while in the recession year of 1991 25 per cent of workers feared being laid off this rose to 46 per cent in the relatively low unemployment year of 1996.

The NRU can be seen as an essentially micro phenomenon, in being based on individual search behavior, and derived from summation over individuals. In contrast, the NAIRU is an essentially macro phenomenon in that it is not based on the choices of individuals (except in the sense that

institutional arrangements which give rise to the NAIRU could be seen as having been collectively chosen). If the NAIRU does exist, it does so at the macro or systemic level, and there is no counterpart for the NAIRU at the micro-economic or individual level. It is not possible to observe mini-NAIRUs for each individual and to obtain the NAIRU through summation. It is ironic that the concept of the NAIRU should have become so central to mainstream economics which is otherwise based on methodological individualism.

3. On models and reality

Most, perhaps all, concepts in economics (and more generally in the social sciences) are not directly observable or measurable. However, for many concepts, there is a correspondence between the theoretical concept and statistical measures which bear the same or similar name : in the realm of macroeconomics concepts such as money, income, unemployment fall into this category. Even then, however, there are differences as to how the concept is characterized by different authors or paradigms, and questions as to the degree to which the statistical measure conforms to the theoretical construct bearing the same name. There are also a range of concepts (including utility, value) which are not expected to be directly observable[7] but which are thought to be useful in undertaking economic analysis (leaving aside the question of how usefulness is to be defined).

This situation is not unique to the social sciences, and there are many examples in the physical sciences of the use of concepts which were postulated to exist but which could not be directly observed. The example which comes to mind is the notion of the existence of the planet Pluto which was postulated to exist because of the movement of other planets before Pluto itself was observed. (Even here the question could be posed as to whether the observed Pluto conformed to the concept Pluto : e.g. the concept may have been given a particular mass and volume which may not have corresponded precisely with the observed Pluto (and even then there are clearly measurement problems). But for many of the example derived from the natural sciences it has been eventually possible to observe the postulated concept and confirm its actual existence.

It is argued here that the concept of the NAIRU falls into the category of concepts which are drawn

upon because they are deemed to be a useful aid to analysis but by their nature can never be directly observed. The underlying concept may or may not actually exist, and to some degree the users of the concept may not be too concerned as to whether the concept does actually exist, though they would be concerned that the events in the real world conformed to the predictions derived from that concept. The NAIRU can never be observed directly, though it may be possible to observe whether events in the real world (in this case the rate of inflation) do or do not conform to the predictions based on the NAIRU. Even if there is observational conformity between the real world and the NAIRU concept (which is little more than inflation rises when unemployment is below a particular level and falls when unemployment is above that level), this would not permit us to conclude anything about the nature of the NAIRU (and this leaves aside the well known difficulties in establishing whether or not there is conformity of the real world with the NAIRU). In particular, it could not be concluded that the level of unemployment for which inflation is constant is a NAIRU (which we take here to be supply-side determined).

The situation in the case of the NAIRU is further complicated by the following considerations. First, whilst there may be general agreement on the broad nature of the NAIRU (which we have sought to summarize in the previous section), there are a variety of different NAIRUs. It has already been remarked that the natural rate of unemployment (NRU) could be treated as a sub-species of the NAIRU (in the sense that both correspond to non-accelerating inflation and constant labor share) but that the NRU is based on competitive markets whereas as the NAIRU is generally not. The NRU is generally calculated as an equilibrium solution of the expectations-augmented Phillips' curve. We have, though, argued elsewhere (Sawyer, 1987) that the Phillips' curve itself has at least four interpretations, and hence any NRU calculated from a Phillips' curve has similarly different interpretations which can be attached.[8] More generally, any precise definition of a NAIRU depends on a particular economic model (or perhaps more accurately sub-model) along with the notion of equilibrium which is imposed (usually that expectations are fulfilled and that real wage grows in line with labor productivity).

Second, not only have estimates of the value of the NAIRU for any particular country varied according to the precise model specification which has been used, but estimates have (especially for most European countries) proved to vary over time. Indeed a number of authors who are favorable disposed to the NAIRU (e.g. Gordon, 1997, Giorno, Richardson, Roseveare, and van den Noord, 1995) have produced time varying estimates of the NAIRU. Whilst it is clearly possible that the parameters of the model from which the NAIRU has been derived change over time, and hence that the NAIRU changes, this would be a matter of faith (or assumption) which would need to be reinforced by good reasons as to why the underlying parameters had changed.

The fact that a concept cannot in its nature ever be observed does not mean that such a concept is wrong or useless. Whilst I would doubt the benefits which have come from the application of the concept of the NAIRU, I cannot doubt that it has been useful to policy makers (in the sense that they appear to have responded to the concept, though whether it has been useful for the health of the economy is a quite separate issue). It does mean though that care must be exercised in the use of that concept, and consider the assumptions and argument which lie behind the generation of that concept. In this regard, the NAIRU generally builds in two sets of assumptions, namely that the underlying equilibrium is supply side determined and that the appropriate equilibrium conditions include expectations being fulfilled and wages rising in line with prices after adjustment for productivity changes.

4. A critique of the models : price and wage equations

Different authors have proposed different models of the NAIRU. This itself is significant in that the models are often substantially different (rather than differing say in whether the economy is treated as open or closed, how far the government is included). Thus what can be said of one model may not be true of another. In this section we focus on two models which have been influential and which are broadly representative of other models. We first focus on the model of LNJ (1991) (which is a development of Layard and Nickell, 1985, 1986), as that has been probably the most fully articulated (and is similar to the one which underlies the model of the Federal Reserve.[9] In this discussion we will

concentrate on a closed economy version since consideration of an open economy complicates but does not basically alter the points we wish to make. The second one examined is the one which underlies the work of Robert Gordon (e.g. Gordon, 1982).

(I) model of Layard, Nickell and Jackman

In the LNJ (1991) model (as reflected in the equations which they estimate and in their discussion in Chapter 7[10]), the NAIRU is derived from the interaction of price and wage determination. The price equation is generally based on profit maximization under conditions of imperfect competition, and yields the well known relationship that price is equal to a mark-up over marginal costs where the mark-up depends on the elasticity of demand facing the firm. This can be re-written as real wage is equal to marginal revenue product of labor. This is often, though erroneously, described as a demand for labor curve (cf. Hahn, 1995, p.46: Sawyer, 1992).[11] It is not a demand for labor curve in two ways. First, the real (product) wage is not parametric for the enterprise but rather, since the price is set by the enterprise, it is endogenous at the enterprise level. Second, the profit maximization calculations would generate a point outcome (that is a unique level of output, employment, real product wage etc.). Different levels of real product wage, employment would only result if some variables exogenous to the enterprise change, and two notable ones here would be the level of aggregate demand and the competitors' prices (cf. Sawyer, 1992).

The equation based on the decisions of the firm on output and price which relates wage, relative to price, with employment offered (and which is often referred to as the demand for labor curve, erroneously as pointed out above) is generally drawn as having a negative slope, even though 'Under imperfect competition there is no compelling reason to suppose that the 'demand' for labor is negatively sloped nor is there any reason to suppose that it has only one intersection with the 'supply' curve. Increasing returns are quite sufficient to give us what we want here. ...Of course if there are multiple equilibria then even if we can be sure of convergent dynamic processes, initial conditions ('history') will play an important role in which equilibrium is eventually established.' (Hahn, 1995, p.47).

The price equation which LNJ (1991) initially derive (their eq. 10 p.364) postulates that price relative to wage depends on expected demand for output relative to the level of output based on full utilization of resources, and on planned output relative to the capital stock (reflecting effect of demand on mark-up and of output on marginal costs respectively). At a later stage, unemployment is taken as (negatively) related with expected demand for output relative to output based on full utilization of resources, and thereby price (relative to expected wages) becomes dependent on unemployment.

The wage equation is based on two elements (LNJ, 1991, pp.364-6).[12] The first is an insider/outsider argument whereby the enterprise decides upon the money wage which is consistent with the continued employment of those workers deemed to be insiders. The second is a wage for 'outsiders' which is based upon unemployment (level and changes), 'other factors such as generosity and coverage of unemployment benefits' (p.365) and the expected average wage. The average wage paid by the enterprise is then an appropriately weighted average of these two elements. The significant element here is that the equation for the insider wage element essentially repeats the price equation.[13] Apart from representing what is essentially one decision as though it were two, this approach also has the technical result that factors such as output relative to capital stock appear in the same way in both the price and wage equation, and when those two are solved out (for the equilibrium level of unemployment) those factors 'disappear'. The significance of this is that factors such as the capital stock depend on the level of aggregate demand through investment, and hence potential effects of aggregate demand are eliminated (as will be illustrated in the model developed below).[14]

From these pricing considerations, an equation can be derived which relates the price relative to wage (the inverse of the real product wage) to the level of (un)employment (and a range of other of other factors). This is sketched for the real wage as a function of employment in Figure 1 as the p-curve. The positively sloped section is possible under imperfect competition, and gives rise to the possibility of multiple equilibria and complicates consideration of stability.

Figure 1 near here

Two other approaches on the wage side lead to a relationship between the real wage and (un)employment, though the interpretation to be placed on the resulting equilibrium level of unemployment would be rather different.

The first possibility is the use of the aggregate supply of labor curve. It is widely recognized that placing a supply of labor curve alongside the price curve (which as we have argued is not a demand for labor curve but is a locus of offers of real wage and employment) the resulting equilibrium level of unemployment is one of full employment (almost tautologically since the equilibrium level of unemployment lies on the supply of labor curve). It is also recognized that such an equilibrium will involve less employment than an otherwise comparable position of perfect competition, and that there may be multiple equilibria which may be ranked.[15] However, whilst this approach has featured in the literature on imperfect competition, it has not, as far as we are aware, featured in the NAIRU literature.

The second possibility is a wage equation which is derived from the aspirations of workers and in that way is independent of enterprises pricing considerations. An example of this comes from Sawyer (1982) (and that was based on the wage equation estimated in Henry, Sawyer and Smith, 1976) where the wage change equation is of the general form:

$$Dw=a_0+a_1Dp+a_2U+a_3(w-p-T) \quad (1)$$

where D is the difference operator, w log of money wage, p log of price level, U the rate of unemployment, and T a target real wage. With the condition of $a_1 = 1$, the equilibrium condition of $Dw = Dp$ (assuming for convenience that labor productivity growth is zero) gives:

$$w-p=\frac{(a_0+a_2U-a_3T)}{-a3} \quad (2)$$

which is a negative relationship between real wage and unemployment and hence a positive one between real wage and employment. The relationship here between the real wage and employment

is drawn as the w-curve in Figure 1. The intersection of the two curves in Figure 1 provides an equilibrium level of unemployment which corresponds to a NAIRU.

(ii) model of Gordon

The approach of Gordon (1981, 1997) is rather different, and is concerned to derive a reduced form equation linking price inflation with unemployment. He argues that 'the earlier fixation on wages was a mistake. The relation of prices to wages has changed over time. ... The Fed's goal is to control inflation, not wage growth, and models with separate wage growth and price markup equations do not perform as well as the equation above [reported as eq.. 7 below], in which wages are only implicit.' (Gordon, 1997, p.17). Apart from an unease arising from the idea that reliance should be placed on a reduced form which in some sense works better than the underlying structural equations, it also means overlooking the implicit assumptions which are being made to arrive at the reduced form. We now seek to unravel those implicit assumptions by postulating some underlying equations. We begin with a Phillips' curve of the form:

$Dw = a + b\,Dp^e + c\,U$ (3)

Dp^e is based on past price inflation (4)

The price change equation is based on changes in unit labor costs and in material costs, modified by capacity utilization (assumed to influence the mark-up), i.e.:

$$Dp = e + f(Dw - Dq) + hDc + gCU \quad (5)$$

where Dc is change in log of imported material costs c, Dq change in log of labor productivity q and: other productivity assumed constant or absorbed into labor productivity. These equations would solve out to give:

$Dp = a + b$ lagged price inflation $- f\,Dq + h\,Dc + cU + g\,CU$ (6)

which simplifies to:

$Dp = a^* + b^*$ lagged price inflation $+ c^*\,U - f\,Dq$ (7)

with $g = 0$ or a time invariant relationship between unemployment and capacity utilization plus some

assumption on *Dc* would then give the estimated equation. In effect, the estimation of (7) with the maintained hypothesis that $b^*=1$. Set out in this manner, it is an easy matter to indicate what are (at least some of) the implicit assumptions which are being made in the estimation of (7). These would include:

(a) stability of the unemployment-capacity utilization relationship ;

(b) the absence of effects of changes in unemployment and in capacity utilization on wage and price inflation respectively ;

© the absence of error correction mechanisms in both equations.

(d) (although not self evident from the above equations) the assumption that the price index relevant for wage settlements is the same price index relevant for price determination equations.

We would argue that there is reason to cast doubt on each of these assumptions and note that many wage equations have found a role for changes in unemployment and for error correction mechanisms.[16]

It is possible to argue, as Gordon (1997) does and as illustrated in the quote given above, that what matters is the reduced form relationship between inflation and unemployment since it is inflation which the Federal Reserve (and others) targets, and unemployment is used as the indicator of future inflation from which the Fed and others can make decisions on interest rates (assumed to influence aggregate demand and thereby the rate of inflation). However, that argument requires that the 'equilibrium ' rate of unemployment which is calculated from the equivalent of eqn. (7) above provides an accurate estimate of the NAIRU. In order to arrive at eqn. (7), it is clearly necessary to make a range of subsidiary assumptions.

The purpose of this section has been to expose some of the weaknesses of two main approaches to the estimation of the NAIRU. We have done this in light of the arguments in the preceding section on the nature of the NAIRU concept. Briefly expressed, this is that since the NAIRU can never be directly observed, the estimation of the NAIRU (and associated belief in its existence) is only as good as the underlying model from which the NAIRU is derived. If those models leave out some significant

considerations, then the corresponding estimates will be misleading. We may wish to concur with Frank Hahn when he writes that 'Theories of the natural rate are amongst the class of shaky and vastly incomplete theories.' (Hahn, 1995, p.54).

5. Equilibrium, stability and adjustment mechanisms

It is usual for an investigator to produce a single estimate of the NAIRU (and it should be noted that such an estimate is usually produced as a point estimate without any accompanying estimates of the standard errors or confidence intervals of such an estimate). In doing so, two assumptions are being made. First, the levels of the exogenous variables are being set at some (often unspecified) level : for example in the model derived from Gordon (1982), some assumption has to be made about the rate of productivity growth. Second, and of more significance here, is that the assumption is made that the model provides a unique equilibrium outcome, and this assumption is generally introduced through the linearisation (in levels or logs) of the relevant variables. Even within the confines of a supply-side model (and so leaving aside questions of the role of aggregate demand and of hysteresis), the presumption of a unique equilibrium must be questioned. Let us first note that models have been presented which encompass the essential notion of a NAIRU (in terms of the interaction of wage and price setting behavior) and which generate multiple equilibrium (e.g. Sawyer, 1982, Manning, 1992). This arises in effect from the nature of the price equation whereby (inverse of) the real product wage is a non-monotonic function of capacity utilization (and thereby of unemployment. This can simply be a reflect of a u-shaped cost curve and that under imperfect competition enterprises may be operating on the downward portion of that curve (and not as under perfect competition barred from doing so by the thrust of the first-order optimization conditions). Further, in models such as that of LNJ (1991) outlined above, imperfect competition in the product market is assumed, and the single aggregate price equation is intended to summarize the many enterprise or industry level price equations (though there is rarely, if ever, any discussion of the problems of aggregation which would be entailed, bearing in mind that the material inputs of one enterprise are the outputs of other enterprises, whereas vertical integration is in effect assumed in the aggregate price equation). We are

not concerned here with issues on the use of aggregate price equations (though we may wish to note that price equations estimated at lower levels of aggregation suggest that the pattern of price formation varies between industries: cf. Sawyer, 1983). Instead we should point to the lack of any theoretical (since this is a theoretical matter) arguments as to the uniqueness of any equilibrium based on imperfect competition. Indeed the new Keynesian literature, which could be seen to have some overlap with the NAIRU, places some emphasis on possible multiple equilibria.

LNJ (1991) argue that 'of course, in this context, a unique equilibrium is ensured by the linearity of the model. However, there is nothing sacrosanct about linearity, and as soon as we recognize that the impact of unemployment on the price mark-up on wages ... can go either way, the prospect of multiple equilibria opens up.' (p. 370). 'It should, however, be noted that multiple equilibria of this type are rarely looked for, and never found, in any empirical investigation. For an extensive search, see Carruth and Oswald 1988'.

Equilibrium in economics is often associated (made synonymous with) market clearing, and as such each individual is also in equilibrium in the sense that (s)he is buying or selling what (s)he wishes to buy or sell at the prevailing (equilibrium) price. For the NRU, market clearing with realized expectations (on inflation) is the nature of the equilibrium. But the NAIRU relies on a rather different equilibrium concept. It is based on a macro requirement (that is one which has no individual counterpart and cannot be derived by summation from the individual level) that real wages rise in line with labour productivity, i.e. that labor's share in national income is constant. In the nature of these models any other outcome would be unsustainable since it would involve a continually rising or falling labor share (and hence one which would eventually exceed the feasible limits of zero and one).

The route through which equilibrium may be attained has not received much attention, and it is argued here that it is far from clear that, within the context of the models proposed, there would be a movement towards, rather than away from, the NAIRU. Stability appears to have two aspects. The first concerns the adjustment of demand to the supply side determined levels of output and unemployment, and the second the stability of the interaction of wages and prices. Here the second

of those issues is examined, leaving over to later a full consideration of the adjustment of aggregate demand. In an integrated model it would not be possible to make this separation but in the context of the models underlying the NAIRU it is (since some form of classical dichotomy operates). In effect, two separate questions are being asked: first, on the supply side, does the real wage move towards the rate which would apply in equilibrium, and second, does aggregate demand (which is assumed to set the level of unemployment in the short run) adjust towards a level consistent with the NAIRU.[17]

In the perfectly competitive model, the postulated adjustment process towards the NRU is clear : prices rise (fall) in the face of excess demand (supply). There are some well-known difficulties with this concerning the question of who is the price adjuster is a model with only price takers (Arrow, 1959). In the competitive case, it is then assumed that the aggregate behavior of the (average) real wage can be derived from a consideration of individual labor markets, and specifically that the real wage (relative to productivity) falls (rises) in the face of high (low) unemployment (as a proxy for excess supply of labor). It should also be noted that for consistency (and from the application of Walras' Law) excess supply (demand) in the labor market is matched by excess demand (supply) in the product market and hence that prices rise (fall) relative to wages in the product market when wages fall (rise) relative to prices in the labor market.[18] But that requires that excess supply of labour (high unemployment) is matched by an excess demand for output (high capacity utilization), whereas the assumption which runs through discussions of inflation and unemployment is the reverse, namely that unemployment and capacity utilization are negatively related, often expressed in terms of Okun's Law.

The situation is rather different when the imperfectly competitive case is taken. The NAIRU is intended to represent an equilibrium position from the interaction of wage and price setting. The two equilibrium lines are drawn from different considerations, and although they are placed together on the same diagram, the question is whether there is any 'market place' where they interact such that the NAIRU (and the corresponding real wage) can be determined. The usual case is the interaction

of the demand schedule for and supply schedule of a particular product where they meet in the market for that product, and the adjustment of price takes place in that market at a speed which depends on the extent of excess supply or demand. But that is not the case with the wage and price behavior. In this regard the p- and w-curves in Figure 1 are on a par with the IS-LM lines : they relate to the aggregate level, drawn from different considerations and await a specification of the disequilibrium behavior. In the case of IS LM, though, it is usually assumed that Y rises (falls) when Y is below (above) the IS curve, and r falls (rises) when r is above (below) the LM curve. For the NAIRU, the real wage adjusts on both the price side and the wage side, and the adjustment of the level of economic activity is left unspecified. The general notion is that when unemployment is below the NAIRU, wages rise faster than (expected) prices from wage determination considerations[19], but prices rise faster than (expected) wages from price determination considerations, giving rise to accelerating inflation. The overall effect on realized real wages clearly depends on the relative size of the wage inflation and price inflation (and could depend on the responsiveness of wages and prices to unemployment and capacity utilization respectively and on the accuracy of wage and price expectation formation). But it is also the case in the LNJ type model that, when unemployment is say below the NAIRU, the real wage may be higher or lower than the equilibrium real wage. The additional of an error correction mechanism for both wage and price equations could diminish the problem raised here though it does not eliminate it, in part because the value of the wage: price ratios towards which adjustments are made are different from each other and from the 'equilibrium' wage: price ratio.

In the model of LNJ (1991), from their eqns. 44 and 45 in Chapter 8, the NAIRU can be solved for (their eqn. 47) under the assumption of $D^2p = 0$, $Du = 0$ (hence constant inflation and unemployment). It is also possible to solve out for the equilibrium real wage. Now suppose unemployment is below the NAIRU, then their eqn. 48 clearly indicates that price inflation would rise. Whilst expectations and misperceptions will play a role, in the price adjustment equation, $p - w$ will be higher from lower unemployment by a factor β_1 times U and β_{11} times DU, and from the wage

equation w - p will be higher from lower unemployment by a factor γ_1 times U and γ_{11} times DU. The real wage may be rising or falling, and depending on its initial level moving towards or away from the equilibrium real wage.[20]

6 The role of demand and Say's Law

Although the NAIRU is derived from supply-side considerations, it still necessary in our view to ask the question as to whether there is reason to think that the aggregate demand will move to a level which is consistent with the NAIRU : in other words are there reasons to think that the wages and profits which would be generated from output at the NAIRU would lead to a level of expenditure which would willingly buy that level of output. The issues which arise here are by no means new, and indeed were a key element in the development of the neo-classical synthesis (following, e.g. Modigliani, 1944, Patinkin, 1951, 1965). It was generally considered then that there was a sense in which the real balance effect did permit the eventual restoration of full employment through higher levels of aggregate demand, but with the recognition that any such restoration would take a long time. The argument is well-known, namely that a lower price level raises the real value of stock of money, which through a wealth effect on consumer demand, stimulates a higher level of demand. There were always two important reservations to be made to this argument. First, it was concerned with the effects of a lower price level, but did not consider the effects of a falling price level, which is, of course, a necessary part of the achievement of a lower price level. The effects of falling prices on expectations, confidence and the stability of the financial system all suggested that the achievement of a higher level of demand through the real balance effect was not without danger. Second, the effect of a lower price level comes through its effect on the value of 'outside' money, that is money which has been created outside of the private economy and which constitutes net worth (for which there is no counterpart liability) for the private sector (Kalecki, 1944). Since credit money involves matching assets and liabilities, it does not constitute net worth for the private sector, and in industrialized economies 'outside' money is, at most, to be identified with government-issued money.

The central question concerning aggregate demand can be readily exposed by reference to the LNJ

(1991) model. When their model has been extended to encompass open economy and demand aspects, there are five basic equations (price equation, wage equation, link between output/capacity and unemployment, aggregate demand equation and competitiveness equation), from the equilibrium levels of the wage price ratio, output, unemployment and competitiveness and demand can be solved. The aggregate demand equation is:

$$y_d=\sigma_{11}x+\sigma_{12}r*+\sigma_{13}(m-p)+\sigma_{14}Dpe+\sigma_{15}c* \quad (8)$$

where x includes fiscal stance, world economic activity and world relative price of imports, the foreign real rate of interest is $r^* = I^* - Dp^*e$ (nominal rate of interest minus expected foreign inflation), $m - p$ is (log) real money supply, Dpe expected inflation and c^* expected long run competitiveness. Clearly if yd from the demand side is to adjust to the level of output as set on the supply side, one or more of the variables on the right hand side have to adjust. In the formulation of LNJ (1991) this would seem to be some combination of the fiscal stance, the real money supply and the expected rate of inflation. These variables present a number of rather different possibilities: clearly the first would involve adjustment by the government, the second through either monetary policy (m) or the price level and the third would serve to set the expected (and hence the actual) rate of inflation. The first cannot readily be seen as an automatic market adjustment mechanism, even if in practice deflationary policies are pursued with the intent of restraining inflation.

It may be interesting to note the following (in the LNJ approach): suppose that the fiscal stance is changed such that there would be a 1 per cent decrease in demand. Then prices have to fall to increase the real balance effect by a comparable amount. Further suppose that the size of the real balance effect on demand is 0.05. The real balance effect only arises from changing prices in respect of exogenous money, and this is taken to be equivalent to M0 (cash and reserves with Central Bank). The ratio of M0 to income is around 0.06 (for the United States), and hence prices would have to be 67 per cent lower to offset the 1 per cent decrease in demand from a change in the fiscal stance.[21] With an approximate coefficient on unemployment in the inflation change equation of 1.4 in the

estimates of LNJ (1991) for the United States, in year one inflation would be 1.4 per cent lower, 2.8 per cent in year 2 etc.. Prices will be 67 per cent lower than otherwise after around 9 ½ years (which assumes that not only would inflation be lower but would become negative). Assuming that during those 9 ½ years, the stock of money grew as it would have done otherwise, then after nearly a decade with prices falling (assuming that the initial rate of inflation was in single figures), the real value of the outstanding money stock would have tripled. This puts the real balance is its most favorable light, and takes no account of the dynamic effects of such a deflation nor the effects on the financial system. Other estimates of the effect of unemployment on the rate of inflation are lower than those of LNJ (cf. figures from Gordon, 1997 cited above), and the use of those figures would serve to reinforce the point being made here.

An alternative to an appeal to the real balance effect is one to Say's Law to the effect that supply creates its own demand, and hence there would then be no problem with aggregate demand sustaining full employment. This could apply in the case of the NRU. But the NAIRU is rather different in the sense that it does not correspond (in general) to a position of market clearing and there is involuntary unemployment. At the prevailing wages (where the real wage is presumed to be higher than that which would appertain in a comparable perfectly competitive case), the sum of notional (in Clower's terminology) demands will equal the sum of notional supplies. For individuals unable to effect their notional supplies, their actual supplies will be below the notional ones, and hence their actual demands below their notional ones. If Say's Law is taken to be that potential supply would create an equivalent amount of aggregate demand, and that potential supply corresponds to full employment, then when actual supply of labor is below the potential, we can speculate on how supply compares with demand. If their marginal propensity to spend is equal to unity, Say's Law continues to hold, and there is no problem : but note the assumption is required that the marginal propensity to consume equals unity. The conclusion which can be drawn from this discussion is that there is no convincing mechanism given by which aggregate demand would adjust to undermine a level of unemployment equal to any supply-side determined NAIRU.

7. The role of aggregate demand

The discussion above makes clear that aggregate demand plays no role in the determination of a NAIRU (indeed that has been part of our definition of a NAIRU). To reinforce the point on the neglected role of aggregate demand and its significance, a simple model is presented below which reflects some features viewed as significant in thinking about a NAIRU but generally absent from other models. The purpose of this model is not to claim that ours is the right one, and others wrong (for all these models should be regarded as figments of the imagination), but rather to reflect these influences so that others can judge their relevance. Variables have conventional definitions and are in logs (unless otherwise indicated), D is the difference operator.

The wage equation repeats eqn (1) above :

$$Dw=a_0+a_1Dp^{e}+a_2U+a_3(w-p-T) \quad (9)$$

From this bargaining approach, under the equilibrium condition of $Dw = Dp^e = Dp$, it can be derived that:

$$-a_3(w-p)=a_0+(a_1-1)Dp+a_2U++a_3T \quad (10)$$

The price equation is given by:

$$p-w=b_0+b_1CU+(\alpha-1)(k-l)+\log f' \quad (11)$$

where this is derived from profit maximization with a homothetic production function of the form $Y = f(L^{\alpha}K^{1-\alpha})$, $f'>0$, and the second derivative f" can be positive or negative depending on the returns to scale, CU represents capacity utilization, k is log of a measure of the capital stock and l is log of employment. In the price equation $\log f'$ can be positive or negative. The mark-up of price over marginal cost depends on the elasticity of demand, and variations in the elasticity of demand over the business cycle are reflected in term involving CU, and b_1 can be positive or negative. Capacity utilization can be thought of as measured against some convention of full capacity. The terms $k - l$

and log f' arise from the marginal productivity of labor term, and hence can be treated as reflecting marginal costs. As an approximation $k - l$ is equal to $k - n + U$ (where n is log of full employment) and U is the rate of unemployment (approximating log $(1 - U)$ by $-U$). The link between CU and U is written as $CU = -cU - e(k - n)$ (c,e positive) to reflect that CU can shift relative to U, depending on the level of investment.

Combining these equations (which at this stage appear to omit any reference to aggregate demand) yields:

$$=a_0+(a_1-1)Dp+a_2U+a_3T-a_3b_0-a_3b_1(-cU-ek+en)-a_3(\alpha-1)(k-n+U)-a_3\log f' \quad (12)$$

and re arranging gives:

$$[-a_2-a_3b_1c+a_3(\alpha-1)]U=a_0-a_3b_0+(a_1-1)Dp+a_3T-a_3(eb_1+(\alpha-1)(n-k)-a_3\log f' \quad (13)$$

In this equation, a_2 is negative, hence $-a_2$ positive, a_4b_1c can be of either sign, and $a_3(\alpha-1)$ is expected to be positive.

The effects of higher inflation is negative if $a_1 - 1$ is negative (unless $a_1 = 1$) and so higher inflation lowers unemployment at cost of lower real wage. The effect of a higher k depends on the sign of $a_3b_1e + (\alpha - 1)$ which we see as likely to be negative so that a higher k lowers U. The effect of n is the opposite of the effect of k (and hence is thought likely to raise the rate of unemployment). Finally, a higher value of f' is associated with higher unemployment.

Equation (13) clearly suggests that the level of unemployment (which could be described as a supply-side equilibrium level of unemployment based on the mutual consistency of wage and price behavior) depends on the rate of inflation, the target real wage, the log of the capital stock (k), the level of full employment and f'. A solution for the equilibrium real wage can also be derived from this model.

The significance of all of the variables included (other than the rate of inflation which would in any case drop out if $a_1 = 1$) is that they are likely to be both path dependent and to be influenced by the level of aggregate demand through its effects on investment and the capital stock. There is though

in this model a minimum level of unemployment which is set by the extent to which the capital-output ratio can be raised (and hence the real wage).

This model would still involve an 'equilibrium' rate of unemployment which reconciles wage and profit claims, and has some of the attributes of a NAIRU. However, it hopefully serves to illustrate the dependence of that 'equilibrium' rate of unemployment on the path of aggregate demand. Further, whether this 'equilibrium' rate of unemployment involves a significant degree of unemployment depends on the degree to which the real wage aspirations of workers can be fulfilled by a higher capital stock (which would serve to create a higher level of capacity and a higher capital output ratio).

8. How are real wages settled ?

The point was made above that, for a particular set of environmental conditions including the level of demand facing an enterprise and the prices charged by its competitors, there would be a point outcome for its decisions on variables such as employment, output, price (and thereby real product wage). Hence in order to map out a real product wage - employment relationship, it would be necessary to shift one of the environmental variables, and in particular variations in aggregate demand would lead to variations in real product wage and employment decided upon by the enterprise. This means that any point on the p-curve in Figure 1 has to be supported by an appropriate level of aggregate demand, but further for any equilibrium position, the level of aggregate demand generated by the resulting wages and profits would have to be equal to the initial level of demand.

The 'story' underlying a model such as that depicted in Figure 1 is one in which prices and wages are set independently (even though, of course, enterprises are involved in both sets of decisions) and the potentially conflicting implications for the real wage are 'resolved' through the level of economic activity (which was measured by the level of employment in Figure 1). However, there are many models of wage and price determination in which there is a sense in which prices and wages are simultaneously set. The simplest way of illustrating that point would be the case of highly centralized bargaining (at the limit one organization representing all employers and one representing all workers). In general, the real wage which would then result would depend on many factors such as the

bargaining strengths and skills of the two parties, which would not necessarily include the level of unemployment. At the agreed real wage, the level of employment would be determined by the level of aggregate demand. Whilst this example allows a clear statement of the issue, it is now useful to consider two classes of model which have been widely used but in the context of decentralized wage determination (for elaboration of these models in this context see Sawyer, 1997a). These are efficiency wage models and bargaining models. In both cases, there is a point outcome in terms of real product wage and the level of employment (as well as for other variables) arising from a particular economic environment. This environment though includes two variables of particular interest, namely the level of aggregate demand and the level of unemployment benefits. With regard to the former, variations in the level of aggregate demand would map out a relationship which was similar to that given as the p-curve in Figure 1. With regard to the latter, in both cases, (real product) wage is set at the enterprise level relative to some alternative wage, which is a weighted average of wages in other enterprises and of the level of unemployment benefits. Under the equilibrium condition, that wages in enterprises are equal, there is a relationship between the wage relative to the level of unemployment benefits and the level of employment (illustrated in Figure 2). In the context of these models, the key question concerns the determination of the level of unemployment benefits. Simply, if the State fixes unemployment benefits as a proportion of wages, then by doing so it in effect fixes the level of employment.[22] When unemployment benefits are set relative to the price level, then there is again only one level of employment which provides the same real product wage from the p-curve and from the wage-benefit curve given in Figure 2. However, as previously discussed, there would be no reason to think that the level of aggregate demand would adjust to support that level of employment.

Figure 2 near here

However, when the nominal level of unemployment benefits is taken as a given, and from which calculations on wages and prices are based, then the level of employment is not constrained by these decisions. In effect, it is envisaged that there is a point on the p-curve which is aggregate demand

sustainable : that is a level of demand which generates the given real wage, employment outcome and is generated by it.

9. NAIRU tracking actual unemployment

It has been observed (e.g. Worswick, 1985) that there is a tendency for the estimates of the NAIRU to move in line with observed unemployment.[23] One response to this would be that movements in the NAIRU are driving movements in the actual level of unemployment, that is the NAIRU is acting as a strong attractor. This argument runs into two particular difficulties. First, although I am not aware of any formal tests on this, it would seem that at most the change in NAIRU and the change in actual unemployment are contemporaneous rather than the NAIRU leading actual. Second, the point would be more convincing if there was supporting evidence that movements in the factors which are said to determine the NAIRU were consistent with the movements in the NAIRU. We have argued elsewhere (Sawyer, 1998) that the (rather limited) evidence on movements in variables such as level of unionization, unemployment benefits over the past 20 or so years should have reduced the NAIRU whilst most estimates of the NAIRU have risen. These two difficulties do illustrate that the NAIRU is obtained from estimated price and wage equations, and those estimates can only be *ex post*.

There are a number of reasons for thinking that estimates of the NAIRU will trail the actual experience of unemployment. The first arises from the observation that the NAIRU is also the rate of unemployment which maintains a constant labor share. It is generally observed that whilst the share of labor does vary over time (and has tended to decline in recent years) it does not move greatly. Thus an estimate of the rate which maintains a constant labor share is likely to fall within the range of experienced unemployment, and as the experienced rate of unemployment changes (and specifically if, as in most European countries over the past two decades) shifts up so will the estimated NAIRU. The second reason has often been placed under the label of hysteresis, whereby the path of unemployment influences the position of any equilibrium end-point. One mechanism which has been much discussed is that the experience of unemployment has persistent effects. For example, there are 'three main elements to the idea that the duration of unemployment can effect a worker's chance of

finding a job:

1. effects on job search;

2. effects on the worker's skill, motivation, and morale;

3. job screening and employer perceptions.' (LNJ, 1991, p.258)

Insofar as these factors lead to a combination of reduced effective supply of labor or a greater mismatch between supply and demand, they may lead to rising unemployment. It is in keeping with the NAIRU approach that this is an essentially supply-side explanation.

Another mechanism is the adjustment of the capital stock, which has been discussed above (see also Sawyer, 1997b). In terms of Figure 1 the p-curve will tend to shift inwards as capacity falls.

These considerations lead to a more significant one, namely how useful are the estimates of the NAIRU. Price and wage inflation and unemployment (and other variables which may be of relevance) fluctuate over the business cycle (and generally do not display any pronounced trend). Now suppose that the mechanism generating price inflation was quite separate from the mechanism which generates unemployment. A regression of price inflation on unemployment may or may not be successful (and it is known that there are many ways in which price inflation and unemployment can be measured so that cynically we may remark that only the successful regressions are publishable). Suppose it is successful (in the sense that it passes relevant statistical criteria, that the coefficient on lagged price inflation is not significantly different from unity and that on unemployment is negative and statistically significant), and an equilibrium solution for unemployment is derived and given the name of the NAIRU. What does it tell us ? The most it can tell us is that if over the estimation period unemployment had been at a particular level (the calculated NAIRU) then inflation would have been stable.[24] But it cannot tell us what are the determinants of the NAIRU, and in particular cannot tell us what would have happened if the level of aggregate demand had been higher (and we would expect that as a consequence investment and then the capital stock higher).

10. Conclusions

Two issues arise in respect of the NAIRU approach which should be kept distinct. The first is the

question of whether inflation (notably wage inflation) is negatively related to the level of unemployment (though other variables may be involved as well). Much empirical effort has been devoted to investigating the answer to that question (and I have participated myself, Henry, Sawyer and Smith, 1976). The second is the question of whether there is a level of unemployment for which inflation would be constant and if so what are the determinants of that level of unemployment. In particular, is any such level of unemployment to be regarded as capable of being shifted through changes in the capital stock, measures to arrive at a consensus over the distribution of income etc.. There is some link between these questions in that if the answer to the first question is no, then it is not possible to calculate a NAIRU.[25] The focus of this paper has been more on the second question than the first, which we would see as the much more important. For example, if the NAIRU corresponded to the NRU (in the sense of being a level of unemployment which was accepted as full employment), then we would observe the apparent trade-off between wage inflation and unemployment, but be quite relaxed about it for we would not wish to push employment past the full employment level. The relevant question would then be how strong an attractor is the NRU and what is the role of aggregate demand in reaching that point.

It is argued here that aggregate demand has be the disregarded guest at the NAIRU party. Aggregate demand has to be considered in deriving relationships between the real wage and employment, and in underpinning any level of employment (equilibrium or not) which could be achieved. Further, aggregate demand enters into the determination of the level of unemployment in two further respects, namely through its effect on capacity and in a range of cases where the relationship between price and wage is settled at the enterprise level.

Stiglitz (1997) elaborates three criteria for evaluating the NAIRU: 'does the derivation of unemployment from some natural rate provide a robust and useful way to predict changes in the inflation rate ? ... The second criterion [is] can economists explain why the NAIRU changes over time?... [T]he third criterion asks whether the NAIRU is a useful way to frame policy discussions despite all the uncertainty surrounding its precise level and direction of change'. (p.4) This paper has

only briefly touched on the first two criterion, and has considered matters which are relevant to the third criterion. With regard to that criterion, the basic arguments pursued in this paper are that there are a series of theoretical weaknesses with the approach to the NAIRU, and in particular there has been a rather cavalier dismissal of the role of aggregate demand. Specifically, if the notion that for some given set of institutional and other arrangements, there is a level of unemployment which would be consistent with constant unemployment, then it is necessary to explore the determinants of that level of unemployment, and the degree to which it can be shifted over time with appropriate aggregate demand, income distributional and supply-side policies.

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Endnotes

1. I am grateful to Philip Arestis for comments on an earlier draft.

2. The distinction is maintained between the 'natural rate of unemployment' (NRU) as defined by Friedman (1968) (see quote later in the text) as the level of unemployment which would correspond to a market clearing competitive labor market and the NAIRU as the level of unemployment at which inflation would be constant which would include the NRU as a special case where markets are competitive.

3. It can be noted here (as others have done) that the NAIRU is a misnomer in that it is the price level which is not accelerating rather than the rate of inflation (cf. Cross, 1995)

4. Any particular NAIRU is the solution to a particular model with the imposition of certain equilibrium conditions (e.g. that expectations are fulfilled). In the text the term equilibrium is used

in that limited sense as the property of a particular solution of a model, and it is not intended that the term carries any broader connotation such as market clearing.

5. For a model which leads to this type of conclusion see Sawyer (1997b).

6. The figures which LNJ (1991) estimate for the United States are β_1 3.10 γ_1 0.32 β_2 2.10 γ_2 0.37. From their eqn. (48) it can then be calculated that the implied coefficient on (u-u*) (actual unemployment minus the NAIRU) in the equation for the acceleration of inflation is then 3.42/2.47 which is approximately 1.4.

7. In the case of utility, it could be argued that since it is used in the context of an individual maximizing utility, each individual (and hence the users of the concept of utility) would know by introspection whether utility existed. Similar consideration would apply to rational expectations.

8. The four alternative interpretations are (I.) labor market adjustment with expected real wage changes a function of the excess demand for labor, and unemployment is a negative proxy for that excess demand, (ii) a trade-off between inflation and the level of economic activity, (iii) expected real wage changes are a function of unemployment, which operates as the 'industrial reserve army' of the unemployed, (iv) the 'surprise function' with movements in unemployment as a function of inflation surprises.

9. In the Federal Reserve macroeconomic model, there are two equilibrium relationships between the (log of the) real wage and the unemployment rate, one arising from the equilibrium money wage equation and the other from the equilibrium price equation. Dynamic adjustment equations for wage and price changes in terms of deviations of the actual wage (price) from the equilibrium level are estimated (Table 6, p.22) . The text calculated the NAIRU as 'a bit less than 6 per cent, currently, in terms of the civilian unemployment rate'. Source: A Guide to the FRB/U by Macroeconomic and Quantitative Studies, Federal Reserve Board, October 1996.

10. There are, in our view, some very considerable differences in approach as between what is said in Chapters 1, 7 and 8 of LNJ (1991) and in Chapter 2. In the former, they present a variety of models in which wages and prices are settled at the firm level and the relationship between wages and unemployment benefits is a crucial one. In the latter 'we do not propose to be too specific' (p.364), and aggregate price and wage equations interact to set the NAIRU, and there is no explicit mention of unemployment benefits.

11. For example, 'Equation (7) then becomes the marginal productivity condition and is a standard labor demand function ...' (LNJ, 1991, p.341).

12. They do, however, note that 'wages may be determined by a variety of methods and in this chapter we do not propose to be too specific. We see wages as being influenced by firm-specific or 'insider' factors, such as productivity and the well-being of the workforce, and by 'outsider' factors, such as wages paid elsewhere and the general state of the labour market.' (LNJ, 1991, p.364)

13. This problem is more severe in the case of Layard and Nickell (1985) where the price equation and the wage equation are essentially the same.

14. See the related paper Sawyer (1997b) for further discussion on the role of capital formation on the NAIRU.

15. There are also issues of the stability of an equilibrium and movement to equilibrium: cf., (Sawyer, 1992).

16. For example, we estimated the relationship between unemployment and capacity utilization for the USA and found the following:
A regression of unemployment on a measure of capacity utilization (deviations of output from trend) over the period 1967 qtr 4 to 1996 qtr 4 yields
Dependent variable Unemployment U

	D1	D2	U(-1)	CU	CU(-1)	D1*T	D2*T
estimated coefficient	6.624	8.047	0.791	-0.190	0.116	-0.00372	0.00902
standard error	1.559	2.067	0.064	0.015	0.024	0.00264	0.00417

rho = 0.396 (s.e. 0.124), R-squared = .9875, Adjusted R-squared = .9869, Durbin-Watson statistic = 2.0697
D1 = dummy value 1 from 1967(4) to 1980(4), 0 otherwise ; D2 = dummy value 1 from 1981(1) to 1996(4), 0 otherwise ; CU measure of capacity utilisation, T time
These suggest that over some lengthy periods there is a time trend in the relationship and further that the nature of that time trend shifts from period to period.
Gordon (1997) fn.4 reports that the relationship between unemployment and ratio of actual to 'natural real' GDP differed in the first half of the 1990s from most of the postwar period.

17. In models such as those of LNJ (1991), aggregate demand does not depend on the distribution of income or the real wage. This permits some degree of separation between the two aspects of stability considered in the text which would not be present when aggregate demand is dependent on the distribution of income (and hence on the differential movement of prices and wages)

18. The brief description in the text refers to the neo-classical view of the competitive labor market. A perspective based on Keynes (1936) especially chapter 2 would be rather different. Our point here is not that the neo-classical analysis of the labor market is right or wrong, but rather that it does have a clear adjustment process.

19. We seek to avoid the use of the term 'labor market' here since the wage setting processes have little in common with a market in which there are demand and supply schedules based on parametric prices.

20. For the United States, their estimates are such that higher unemployment would raise the real wage since the effect of unemployment in the price equation is much greater than the effect in the wage equation. However, the pattern varies considerably across countries (cf. their Table 2 p.406).

21. For a constant level of demand, with the change in fiscal stance equivalent to 1 per cent of income (0.01 Y), we have the following σ_{13} D(M - p) = 0.01 Y ; (not in logs). Putting σ_{13} = 0.05, (M - p)/Y = 0.1, then D(M - p)/(M - p) = - (0.01/0.05)/0.1 = 2 ; hence the real value of the money stock triples, and prices would be required to fall to one-third of their initial level. At end of 1996 monetary base was given as just over $450 billion and GDP in 1996 was around $7,500 billion : hence ratio of monetary base to GDP was circa 0.06. Within the monetary base, cash held outside the banks is given as over $395 billion, which implies an average holding of cash of a rather incredible near $1500 for each person in the USA. However, figures in *Survey of Current Business*, July 1997 suggest that at the end of 1996 more than half of the cash included in the monetary base is held outside the United States (nearly $210 billion were foreign holdings from a total of $398 billion).

22. Uprating unemployment benefits in line with wages or prices is not the same as fixing them relative to wages or to prices. The initial relationship between say benefits and wages could be set consistent with a high level of employment and then the relationship is maintained.

23. This may not have been so pronounced in the United States, where for a considerable length of time there was something of a consensus that the NAIRU was around 6 per cent, and where unemployment did not rise so dramatically after 1973 as in most other countries. Even so, the following figures do indicate some such effect:

	1960-68	1969-79	1980-88
Actual	4.74	5.85	7.38
Equilibrium	5.01	5.97	6.36

Source : LNJ (1991), p.436

24. Even that need not be the case for the inflationary (and other) implications of a constant level of unemployment of x per cent need not be the same as the inflationary implications of unemployment of x cent when unemployment is changing.

25. However if say wage changes (relative to expected inflation) were a positive function of the level of unemployment, one could impose the condition that wage change equals inflation equals expected inflation, and calculate a NAIRU. But such an estimated NAIRU would not have the usually implications for counter-inflation policy.

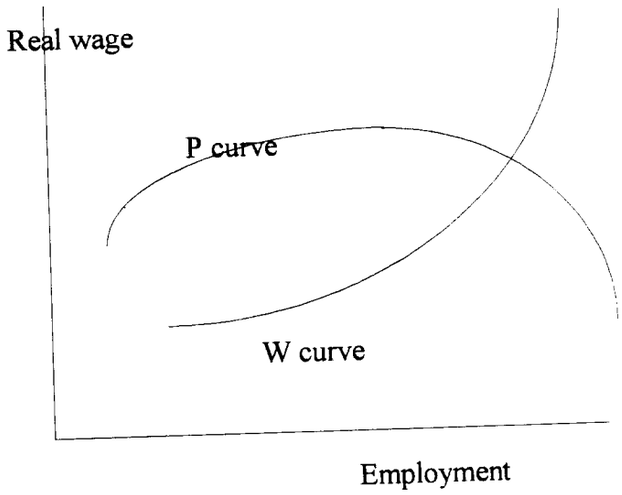

Figure 1 Interaction of p- and w-curves

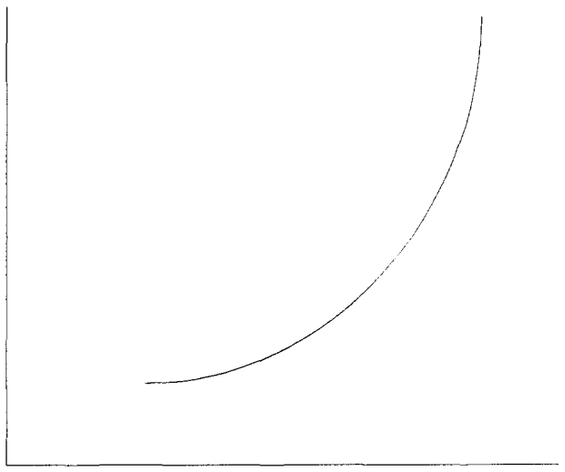

Figure 2 Relationship between wage:benefit ratio and unemployment