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Production Constraints and the NAIRU

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Abstract:

This paper argues that the production constraints in the basic NAIRU model should be distinguished by type: capital constraints and labour constraints. It notes the failure to incorporate this phenomenon in standard macro models. Using panel data for UK manufacturing over 80 quarters we show that capital constraints became relatively more important during the 1980s as industry failed to match the increase in labour flexibility with rising capital investment.

JEL: C23, D24, E22, E24

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Introduction

A recent and growing literature has attempted to directly model the time variation that may exist in the Non-Accelerating Inflation Rate of Unemployment (NAIRU). Notable contributions to this literature include Ball and Mankiw (2002), Staiger, Stock and Watson (2001) and Gordon (1998). These papers attempt to identify the time variation in the NAIRU by making a simple a-theoretical decomposition. Staiger et al. and Gordon both assume that the NAIRU is a random walk and that the other shocks affecting unemployment are stationary; they thus extract the non-stationary component and regard this as the NAIRU. Ball and Mankiw, on the other hand, apply a simple Hodrick-Prescott filter which again amounts to extracting the trend component of unemployment, but in a slightly different way. Our contribution addresses the issue from a more theoretical perspective. In particular, we advance a theory for why the NAIRU in the UK may have experienced a structural break during the 1980s.

In line with the authors cited above we too relax the assumption that the NAIRU is time invariant, but based on a more radical rationale. Whereas the traditional NAIRU model (Layard et al. 1991) focuses on a single factor labour in determining equilibrium unemployment, we include capital constraints on production. This broader approach has some support in the literature (Cecchetti 1995), but the implications for the NAIRU model have not been fully developed. An important point, that follows from consideration of multiple input constraints, is that time variation in the NAIRU can be induced by a structural shift in the relationship between these constraints.

The rationale for an exclusive focus on labour constraints in the literature, arises from the (often implicit) assumption that factor substitution allows full employment to be achieved with any capital stock. Under these conditions, the availability of labour does determine whether firms have the capacity to meet current demand levels, and the size of the capital stock has an influence primarily via the marginal product of labour, which determines the feasible path of real wages. However, insofar as the opportunities for capital substitution are limited, e.g. in much of manufacturing industry, productive potential may be constrained independently by capital and labour constraints. Survey evidence (see data appendix for source) shows low correlation between perceived labour constraints and capital constraints in manufacturing, with an average correlation coefficient of about 0.5 using quarterly data for 1996–2006. It has also been demonstrated that perceived capital shortage is surprisingly persistent. Using the methods in Clements and Hendry (1998) and the same data source as this paper, Driver and Meade (2001) show that perceived capital shortage in manufacturing sectors are predictable up to ten quarters in advance.

The structure of this paper is as follows. Section 1 proposes the rationale for our hypothesis of a structural break between labour and capital constraints, occurring in the UK in the 1980s. In Section 2 we develop a formal model in which the output gap in the economy reflects both labour supply constraints and capital shortages. Section 3 describes the data and tests for structural breaks in the constraints series. We use a panel data set from a business survey of UK industries, drawing particularly on unique Confederation of Business Industries (CBI) estimates of labour, capital and total output constraints in the economy, at sector level. The results, which are discussed in Section 4, confirm the existence of the hypothesised structural break. Sections 5 and 6 present some implications and conclusions.

1 Shareholder Value and Increased Capital Constraints

There may be several reasons for expecting structural breaks in the relationship between labour and capital constraints, including immigration and changes in labour participation rates, although we would expect these to be characterised by slower moving trends. Perhaps the main reason for the sharp break in capital constraints, is the increased emphasis on shareholder value, which caused a shift in managerial behaviour in shareholder-oriented economies in the 1980s.

Following financial deregulation in the US and elsewhere, managerial autonomy in the 1980s was circumscribed by greater pressure from investors resulting in stringent profitability requirements in appraisals of capital investment and a greater tendency for capital to be returned to shareholders. In countries characterised by a reliance on equity finance, beginning in the 1980s managerial focus on short-term performance increased (Nolan 2002). This was fuelled in part by a defensive reaction to takeovers and in part by the degree to which managerial compensation was becoming increasingly linked to current share prices. Also, some have argued that the increased gearing that accompanied this phenomenon reduced free cash flow and managerial autonomy. Whether or not this was the case, obligations in relation to future debt, focused attention on the scope for cost-cutting and the elimination of excess capacity.

The effect of these processes on capital investment in the Anglo-American economies is controversial (Shleifer and Vishny 1997; Stockhammer 2004a), but one view is that that they worked to contain capital expenditure and reduce the degree of slack in capital stock usage. It has been argued that the "ultimate purpose" of the restructuring that occurred in the 1980s was to improve performance by "reducing investment" (Donaldson 1994). This is underscored in writings such as Jensen (1997) where it is claimed that widespread overcapacity was partly eliminated in the 1980s. The retrospective conclusion appears to be that increased institutional investment "helped to eliminate excess capacity" (Holmstrom and Kaplan 2001, p.122). For the UK case, there is also evidence of an upward shift in manufacturing capacity utilisation from the mid 1980s, suggesting a more cautious stance towards capital investment or a greater tendency to retire surplus capital (Driver and Shepherd 2005).

It is, therefore, plausible in theory, and there is some empirical support for expecting that structural breaks occurred in the relationship between labour and capital constraints. However, existing theory does not address this possibility directly. Some authors have focused on the distinction between labour and capital constraints, but these are exceptions.[1] For the most part, standard theory tends to completely eliminate the role of capital in NAIRU, and often explicitly, concentrating instead on the role of the labour market and labour market institutions (Belot and Van Ours 2004).

Identifying structural shifts in the NAIRU is important for both theoretical and policy reasons. In macroeconomic theory, the exogeneity or otherwise of the determinants of equilibrium unemployment (the natural rate) feeds into controversies over the nature of the Phillips Curve (Ackerlof 2002; Franz 2005) and, in particular, whether there is a long-run trade off between inflation and unemployment (Mankiw

[1] We include here Blanchard (1990), Rowthorn (1995); Malinvaud (1977); Arestis and Biefang-Frisancho Mariscal (2000); Malley and Moutos (2001); and Arestis and Sawyer (2005). There has also been some discussion of the role of capacity utilisation in the determination of macroeconomic pricing pressure - see Wolfgang and Gordon (1993), Cecchetti (1995), Corrado and Mattey (1997) and Kennedy (1998).

2001; Karanassou and Snower 2004; Karanassou et al. 2005). In relation to labour market policy, research on time variation in the NAIRU has tended to focus either on hysteresis in labour market variables or shifts in other variables, such as taxes and import penetration. Here, we argue that the NAIRU is dependent on capital accumulation, for example, because higher investment relieves capacity constraints and lowers inflationary pressure. It follows that a policy focus on labour market institutions alone is inadequate and needs to be complemented by attention to public and private capital investment (see also, Stockhammer 2004b). Our approach is also consistent with those who have argued that the (secular) price markup in the NAIRU system of equations is affected by investment (Pickelman and Schuh 1997; Rowthorn 1995; Shepherd and Driver 2003); or by new entry induced by demand (Snower 1983).

2 The NAIRU with Capital and Labour Constraints

The standard NAIRU model may be represented (without dynamics or error terms) as:[2]

$$
\begin{aligned}
p_t - w_t^e &= b_0 - b_1 u_t^k \\
w_t - p_t^e &= g_0 - g_1 u_t^l
\end{aligned}
\tag{1}
$$

where p is the output price, w is the nominal wage, u^k is plant capacity slack, u^l is unemployment and superscript e represents expectations. We are of course abstracting from a number of other factors, which, in the real world, may also affect the NAIRU. These include such aspects as the tax and benefits systems, the strength of the unions, the legal bargaining framework in the labour market, amongst others, which are assumed to be part of the two constant terms above (b_0 g_0). Their inclusion in the constants does not affect our investigation of the implications of production constraints because, rather than estimating a conventional wage equation which would be severely affected by an omitted variable problem, here we carry out a direct analysis of the constraint relationship. This is not to deny the importance of these other factors; but in this study we have chosen to focus more directly on the constraint issue.

Consider first the labour market constraint. Although the standard model, as above, is often simply written as unemployment it should more correctly be a general measure of labour market disequilibrium, maybe the deviation of actual unemployment from the NAIRU, or a direct measure (as we apply). Similarly u^k is a measure of the constraints facing the firm on the capital side and this affects firms' pricing behaviour. An equilibrium solution to equation (1), where actual and expected values are equal, implies a relationship between the cyclical variables u_t^l and u_t^k.

The variables u_t^l and u_t^k may differ in levels or in growth. As our concern here is with long-run solutions, we focus on the case where the levels of the series differ by a multiple that is subject to a random break. Thus,

$$u_t^k / u_t^l = \eta_t \tag{2}$$

[2] Good introductory or intermediate level accounts of the NAIRU model may be found in Carlin and Soskice (2006, Chapter 4), Blanchard (1990) and Meliss and Webb (1997).

where $\eta_t \geq 0$ and

$$\eta_t = \eta_0 \text{ for } t < t_b$$

$$\eta_t = \eta_0 + \delta\eta_0 \text{ for } t \geq t_b$$

and where t_b is the time of a random shift break in the relationship between u_t^l and u_t^k

Thus, in the initial state $u_t^k / u_t^l = \eta_0$ and the NAIRU can be expressed as:

$$u^* = (b_0 + g_0)/(b_1\eta_0 + g_1) \tag{3}$$

Clearly, the bigger the relative degree of plant capacity slack, the lower the NAIRU. To see how the NAIRU responds to a change in η_0, we can differentiate $\log u^*$ with respect to η_0 to obtain a semi-elasticity:

$$\partial \log u^* / \partial \eta_0 = -b_1 / (b_1\eta_0 + g_1) \tag{4}$$

Where the adjustment coefficients of price and wages are approximately equal, we have $b_1 \approx g_1$ giving:

$$\partial \log u^* \approx -\partial \eta_0 / (1 + \eta_0) \tag{5}$$

The practice in most of the literature is to impose the restriction $\eta_t = 1$ for all *t* such that no distinction is made between the two cyclical measures of unemployment and plant capacity slack. It is rather surprising that these variables are conflated because they correspond to two different literatures. The unemployment variable relates to the labour market literature on the Phillips curve (see, e.g., Blanchard and Katz 1977 for a survey), or the 'wage curve' that is said to underpin the labour supply function (Blanchflower and Oswald 1994). The indicator for capacity slack refers to the literature on mark-up pricing and its cyclical or anti-cyclical behaviour (Bloch and Olive 2001, Small 1998, Lee 1993), which determines the labour demand equation in the NAIRU model.

It should be noted that discontinuities between the two cyclical measures can have reasonably large effects, which is some motivation for the empirical work described below. For example, a 10% increase in η_0 from an initial value of unity would increase the NAIRU to 1.05 of its value while a 50% increase in η_0 would raise the NAIRU by a quarter. In the next section we show how it is possible to test empirically for breaks between the cyclical variables.

3 Data and Estimation

As argued above the standard NAIRU model shows a relationship between labour and capital constraints, which, for stable parameters (which includes a range of other factors that may affect the NAIRU) gives rise to a constant NAIRU. However, if there are breaks in these parameters then the NAIRU will also break. In this section we evaluate the stability of the relationships between the constraints in the economy.

The variables u_t^l and u_t^k in the previous section can be proxied in a number of ways. Here we propose to measure them (inversely) using the indicators for skilled labour constraints and plant capacity constraints. We investigate the degree of labour and capital constraint in a large set of UK manufacturing industries over a long period using panel data methods. We use panel data for the three key variables defined as:[3]

CU capacity utilisation

LC labour constraints

KC capital constraints.

Our primary interest is in looking for structural shifts in the way labour and capital constraints affect capacity utilisation. We are searching for a structural break at some unknown point in the sample, in a panel data context. Moreover, we want to investigate a specific break in the relationship between capacity utilisation and either labour constraints or capital constraints; thus we are concerned with a parameter shift in this relationship rather than the more usual mean shift. To derive reliable estimates of these breaks it is important to have a model, which in all other respects is a good description of the data. The model, therefore, must be reasonably rich in terms of its dynamic specification and its use of other explanatory effects. It is well known that dynamic panel data models can lead to biased parameter estimates, therefore we employ the Generalised Methods of Moments (GMM) estimator for dynamic panel data models, developed by Arellano and Bond (1991). We want to test for a structural break in the parameters at some unknown break point. Our methodology is based on Andrews (1993), who defines the asymptotic distribution theory of sequential structural break tests. We apply this framework to our GMM panel data estimators. Similar techniques that extend this testing to the case of non-stationarity, include Zivot and Andrews (1992) and Banerjee, Lumsdaine and Stock (1992). In our case non-stationarity is not an issue. These techniques conventionally use a sequential dummy variable approach *i.e.* a sequence of full sample estimates is undertaken in which a constant shift is allowed for through a zero-one dummy, and the timing of the shift in the dummy is moved sequentially through the complete sample. Formal tests of the structural break are conducted by taking the supremum of the relevant test statistic (in our case the biggest 't' statistic) observed in the sample, which indicates the significance of the break and its timing. The tests are generally non-standard, due to the presence of a structural break parameter in the alternative, which is not present under the null. Andrews (1993) tabulates appropriate asymptotic critical values for this test. These critical values vary with the proportion of the sample that is being searched over, and are strictly undefined if the whole sample is being used for the structural break test. We search over a range that excludes the first and last 10% of the observations. The appropriate 5% critical value for a 't' distributed Wald test is approximately 3. In our application we interact the dummy variable with the labour and capital constraint variables. This implies a sequence of shifting parameter values on the two constraints and allows us to graph both the implied total parameter value and the associated 't' statistic based on robust standard errors (Arellano 1987) to depict the break point.

In order to ensure a sufficiently rich model we ran a dynamic two-way fixed effects panel with CU as the dependent variable and with the sequential dummy variables

[3] See the data appendix for exact definitions. The use of the manufacturing sector seems apposite as it shares the characteristics of the "primary" sector that the NAIRU model was originally designed for (Layard, Nickell and Jackman 1991).

interacted for both LC and KC. In addition, to control for any general cyclical effects, we included the growth rate of the aggregate economy. This model is run sequentially, with the time dummy updated for each run.

The exact specification for the panel estimation is:

$$CU_{i,t} = \beta_0 + \beta_1 CU_{i,t-1} + \beta_2 LC_{i,t} + \beta_3 KC_{i,t} + \beta_4 LCDUM_{i,t} + \beta_5 KCDUM_{i,t} + \beta_6 DUK_{t-1} + e_i + u_t + e_{i,t} \quad (6)$$

where the labour and capital constraint time dummy interactive terms are termed respectively as LCDUM, KCDUM and where DUK is the change in the log of UK GDP; e_i is the industry specific effect, while u_t is the time specific effect and e_{it} is the residual. The sample period is 1978Q1 to 1998Q4 and the panel is unbalanced; the longest time series is 84 observations, 48 industries are covered and the total sample size is 3,800 observations.

4 Results

The coefficients on KC and LC are 0.4 (robust 't' = 14.2) and 0.17 (robust 't' = 3.75) when the model is run without sequential dummies. This is not surprising; studies by CBI data managers suggest that the utilisation variable primarily reflects the incidence of plant constraints (Junankar 1990). The model is reasonably well specified and shows no signs of serial correlation, and the instrument set is accepted by the Sargan test of instrument validity.

We now turn to the main results of our investigation into the possibility of a structural break. We performed a sequence of 84 regressions[4] in which the interacting dummy variables were switched on at every possible break point. The graphs of the basic coefficients with and without the dummy effect included are shown in Figure 1. The significance of the dummy effects are depicted in Figure 2 for LC and KC.

These graphs need some interpretation. The sequential estimation takes place many times over, with the interacting dummy variables switched on together at every possible point in time. We use the 't' statistics in Figure 2 to judge the most likely break point for each parameter, by detecting the largest 't' value over the whole sample. This occurs in 1987 for Labour and 1982 for Capital. To judge whether these are significant structural break, we note that the appropriate critical value is roughly 3; we can see that both of the maximum 't' stats exceed this value. However, we know that the test does not perform well at periods close to the end of the sample and so the reliability of the timing of the capital break, which occurs very close to the beginning of the sample, might be in doubt. However, we believe that the timing is plausible because the early 1980s' recession had a severe impact on the output of the old capital intensive

[4] GMM was used with the following set of instruments LC_{t-1} LC_{t-2} KC_{t-1}, KC_{t-2}, DUK_{t-1}, DUK_{t-2}. These instruments passed the tests for independence with the error term and relevance, so the problem of weak instruments does not seem to be relevant here. The estimation included time dummies and cross section dummies and robust standard errors were calculated.

Figure 1: Sequential Coefficients on KC and LC

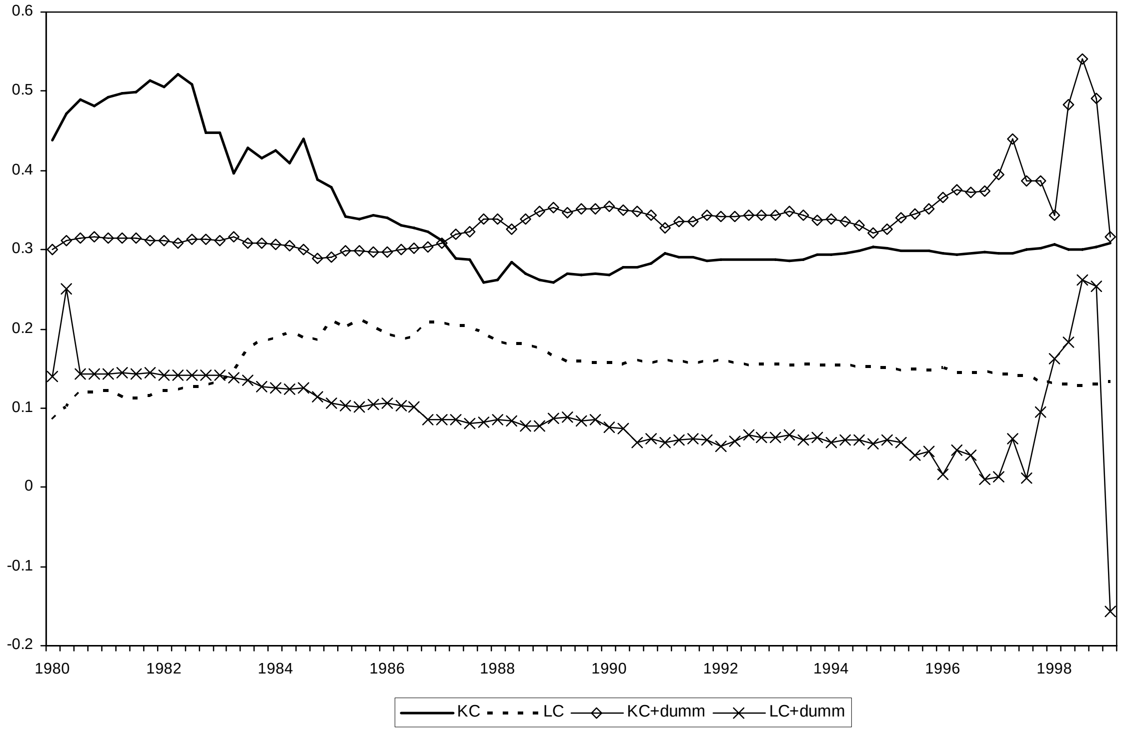
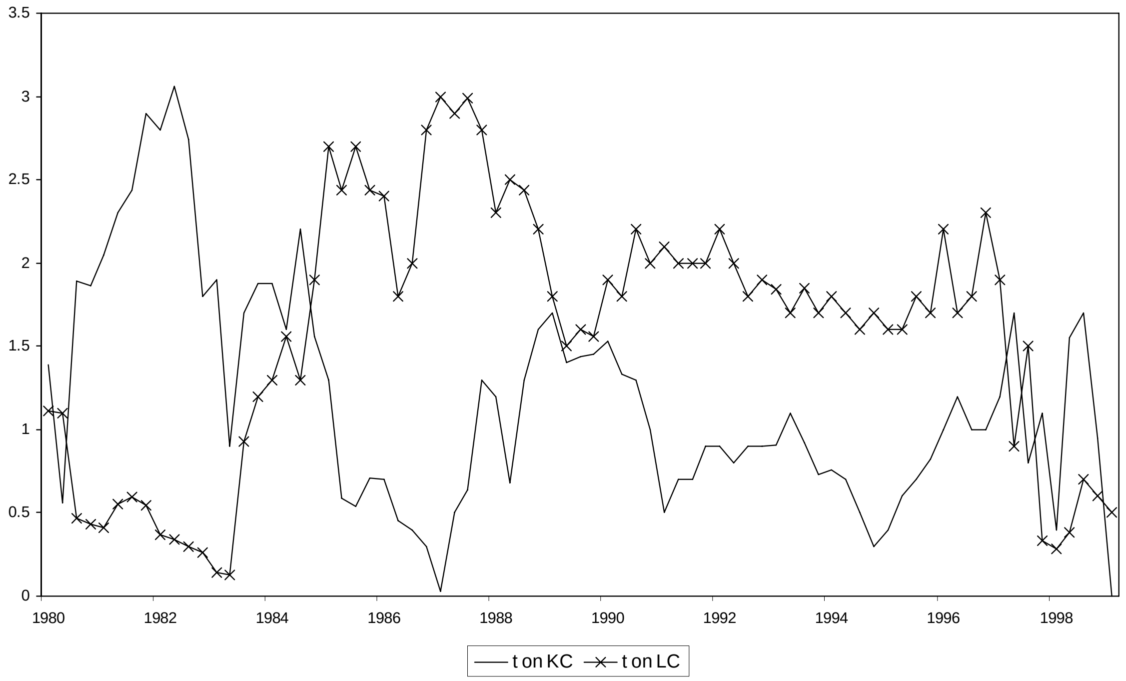


Figure 2: Absolute ‘t’ Statistics on the Sequential Breaks in KC and LC



industries,[5] which likely reduced the weight of capital as a component of capacity constraints.

Note that our testing procedure is an elaboration of the standard Andrews procedure in which we allow either coefficient to break at a particular time, regardless of whether or not there is a break in the other parameter. Further below we discuss a restriction (Figure 3) that imposes a common break on both parameters simultaneously.

Figure 1 depicts the value of the coefficient of labour and capital, (β_2, β_3). These coefficients are always derived over the whole sample, but are changing over time as the interacting dummy terms are switched on sequentially, thus, these parameters would be the effect before the break. Figure 1 also shows the combined effect of the variable with the interacting dummy effect $(\beta_2 + \beta_4; \beta_3 + \beta_5)$, which is the total effect of the variable in the equation estimated after the break has occurred. The difference between each pair of lines is the size of the break assuming that the break occurs at that point in time.

Focusing first on the LC variable, the coefficient on the dummy becomes negative and significant some time after the start of 1985 with a maximum t-value occurring in 1987Q2. The results of the KC variable are different. As noted earlier, there is an indication of significant t-statistics on the dummy in the early years, but this result should be treated with caution given that the coefficients on the dummy here are estimated with a small number of observations. Figure 1 shows that there was a gradual rise in the combined capital constraint plus dummy effect from the mid 1980s.

Overall, the results are consistent with a downward break in the effect of LC in the latter half of the 1980s, and a stable or slightly increasing effect of KC. From Figure 1 it can be seen that any breaks were concentrated in the 1980s. The general picture that emerges is of a failure to capitalise on improved labour practices by complementing them with rising capital investment sufficient to contain capital constraints on output (see also Driver et al 2005). Capital constraints began to rise after an early break which probably reflects the restructuring that occurred following the 1980s' recession.

A number of explanations can be advanced for the reduced relative importance of labour constraints at this time. First, labour market legislation would reduce restrictive practices. Second, tax and benefit changes, along with other social changes such as increased female participation, would increase the availability of flexible labour (Rubery 1989). However, these reforms were not accompanied by increased rates of capital formation in this period, resulting in higher capacity utilisation from the mid 1980s (Driver and Shepherd 2005).[6]

Finally, it should be noted that in performing the individual t test the other coefficient was assumed to be constant. For completeness, we performed a further test on the model to see whether *simultaneous* structural breaks occurred in the two parameters. Figure 3 depicts the results of a joint F test for the hypothesis that both parameters break at the same point in time. Figure 3 also shows the standard asymptotic 5% critical value for the test. For such a sequential testing procedure, this critical value should be larger than the standard value. Given the results depicted in Figure 2 it would

[5] The fastest growing sector of manufacturing in the first half of the 1980s was light engineering while the largest decline occurred in capital intensive transport equipment (Green ed. 1989)

[6] This focus on cost reduction reflected in part the increased power and influence of institutional investors and the erosion of managerialism (Chandler 1994; Stockhammer 2004a). See also the discussion in Holmstrom and Kaplan (2001) in respect of the US economy.

Figure 3: A Joint F Test of Simultaneous Breaks in Both Series

be surprising to obtain a significant simultaneous joint break and, indeed, the results provide no support for this. Although the test value is highest in the late 1980s, the null of no simultaneous structural break cannot be rejected.

5 Implications for the NAIRU

The implications for the NAIRU of the findings in Section 3 are quite straightforward. We identified a structural break in the relationship between the constraints and this by itself is sufficient to introduce time-variation in the NAIRU. We find that the ratio of capital to labour coefficients (taking account of the time dummy effect) more than doubled between the mid to the late 1980s and the late 1990s. In the simple model described in Section 2 this would have increased the NAIRU substantially unless mediated by other reforms. It seems surprising that the sensitivity of the NAIRU estimates to such a plausible phenomenon as a structural break between factor constraints has not emerged in the previous theoretical literature.

In some respects our conclusions and implications are similar to those in the works referred to in the introduction to this paper, which addressed the question of a time-varying NAIRU. Certainly, our approach, in common with other recent treatments, has a concern for productivity variables not included in earlier models (Layard, Nickell and Jackman 1991). In standard theory, productivity variables will affect the NAIRU only if the share of labour is affected by investment, or if there is a lag in the adjustment of real wages to productivity. This latter issue forms the centrepiece of some recent critiques of standard NAIRU theory (Ball and Moffitt 2001; Ball and Mankiw 2002).[7] The underlying argument here relies on sluggish adjustment of wages to higher productivity growth. If the equations in (1) are differentially affected by productivity growth, say because the outside wage is linked to productivity or, more generally, because of unspecified 'real wage resistance', then the numerator in (3) contains a productivity growth term, and the NAIRU itself will be negatively related to that growth.[8]

While accepting that wage adjustment lags can help to explain time variation in the NAIRUs, in this paper we pursued a distinct productivity-related approach to explain why the UK NAIRU may not have responded as was hoped to the labour market reforms of the 1980s. Our account is based on an observed break in the balance between capital and labour constraints in UK manufacturing, reflecting perhaps the combined effect of labour legislation and the impact on capital investment of increased financial discipline during the 1980s. Whereas authors such as Ball and Moffet analyse effects occurring through the wage equation, we focus on effects occurring through the price mark-up on wages. In essence, we suggest that weak capital investment, or tighter capacity utilisation in the UK, may have contributed to maintaining equilibrium unemployment at a level that was higher than necessary.[9]

Finally, our contribution provides another explanation for expectations of hysteresis in the NAIRU. A number of explanations for persistence in the NAIRU have been proposed in the literature e.g. insider-outsider models; models based on the atrophying skills of the unemployed; and, more recently, the interaction of shocks and institutions (Blanchard and Wolfers 2001). Empirically there is strong support for persistence, especially in some European countries.[10] Our contribution provides another explanation for this, given that a break in the NAIRU is easily conflated with a unit root.

6 Conclusions

Our focus in this paper has been quite specific. Rather than estimating and testing a model based on the NAIRU framework, which would be open to several criticisms (Pichelmann and Schuh 1997; Akerlof 2002), we chose a more direct test of one of the theoretical hypotheses viz. that the pricing and the wage equations can exploit the same cyclical variable. We find evidence for a structural break in these cyclical series over

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[7] Until recently, these issues have been sidelined in the literature. The former effect was generally circumvented in the standard model by using a Cobb-Douglas Production function: see Rowthorn (1999) for a critique. The importance of productivity growth was noted in Dreze and Sneessons (1995).

[8] OECD studies have tended to find lagged wage adjustment for European countries but not for the US. However, recent empirical results for the United States seem to confirm that 'changes in productivity growth appear to shift the inflation-unemployment tradeoff… In the future, (macroeconomists) should expand their scope to build and test models of inflation, unemployment and productivity' (Ball and Mankiw 2002).

[9] While the US also experienced a pruning of excess capacity in the 1980s this appears to have been compensated by new entry, unlike the experience in the UK (Holmstrom and Kaplan 2001; Driver and Shepherd 2005).

[10] Using a standard ADF test, stationarity in the NAIRU is accepted at 10% only for the US, Finland and Sweden. Using a test that individually tests the null of non-stationarity in the SURE framework, hysteresis is still found in half the countries studied. (Camarero and Tamarit 2004).

the period studied, in line with a priori beliefs about the role of managerial incentives and corporate behaviour in reducing the available slack in the capital stock.

As we have shown, the NAIRU is affected by the relationship between the degrees of slack in the supply of labour and capital. A rising relative influence of capital constraints can offset a potential fall in the NAIRU caused by increased labour market flexibility. We find that the capital coefficients to labour coefficient ratio (taking account of the time dummy effect) more than doubled from the mid-1980s to the late 1990s. This is a quite sizeable shift and, thus, attempts to base policy on a NAIRU estimated simply on unemployment or some other index of labour market tightness, could be very mistaken.

If, as argued here, capital investment is important for the NAIRU, this questions the focus on labour market institutions in addressing employment creation that has characterised UK policy in recent years. This policy approach stems from the theoretical work of Layard and Nickell in the 1980s and 1990s (Layard et al. 1991). While there is nothing wrong with an institutional approach to unemployment, the error in our view lies in the focus on labour market institutions only at the expense of other important influences, such as productivity, that require an integrated understanding of factor and product markets.

Data Appendix

Most of the data used come from the survey questions designed by the CBI. This survey has an excellent reputation, having run continuously since 1958. The data derived feed into the EU official data series and are regularly used in academic and policy studies. The sample size is large with over 1,000 returns, quarterly (European Commission 1997)

The CBI variables are defined as follows:

LCU is the percentage of respondents replying “NO” to the question “are you working below a satisfactory full rate of operation” (Q4B).

LC and KC are the percentage replies “Skilled labour” and “plant capacity” to the question “What factors are likely to limit your output over the next four month” (Q14B and Q14D)

The DUK variable is taken from the UK National Accounts

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