STRUCTURAL SHIFTS IN UK UNEMPLOYMENT 1980-2002: THE TWIN IMPACTS OF FINANCIAL DEREGULATION AND COMPUTERISATION

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Since the 1980s, rising and persistent unemployment in the UK has been fostered by two key changes: first, financial deregulation in the 1980s and second, the accelerating pace of computerisation in the 1990s. In this paper we argue that the conjunction of technological advances and financial deregulation has led to a shift towards increased capital gearing, increasing firms' mark-ups over unit labour costs and thereby contributing to rises in unemployment. We develop a model of the relationships between computerisation, financial dereg7ulation and unemployment, and estimate it using a vector error correction techniques and UK unemployment data.

Keywords: Unemployment, Financial Deregulation, Computerisation, Structural shift
JEL classifications: E24, E60, G38, O33

I. INTRODUCTION

Since the collapse of Bretton Woods and against a background of rising unemployment throughout the OECD, UK unemployment has risen steadily. As shown in Figure 1, overall rises in UK unemployment rates (ILO definition) were particularly persistent during the early 1980s and early 1990s and whilst the mid-late 1980s and mid to late 1990s were accompanied by falls in unemployment rates, these were falls from historical highs. By 2005, unemployment rates still remained above rates observed in the early 1970s. In explaining this record, recent academic debate has focussed on the relationships between labour market rigidities, aggregate demand, institutions and unemployment (e.g., Blanchard and Wolfers, 2000 and Layard et al, 2005). Emphasis has moved away from focussing on labour market flexibility as the sole solution to unemployment problems and from looking to the US as a benchmark for decentralised and efficient labour market institutions. For example, Layard et al (2005, p.2) observe that US unemployment rates are now higher than in many European countries. Nonetheless, in policy debates, the view remains that decentralised labour markets moderate real wage rigidity and encourage flexible real wage adjustment so improving labour market flexibility has been embraced as a policy goal in the UK (DTI 2004, pp. 95-96).

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Figure 1: Unemployment, 1971-2005
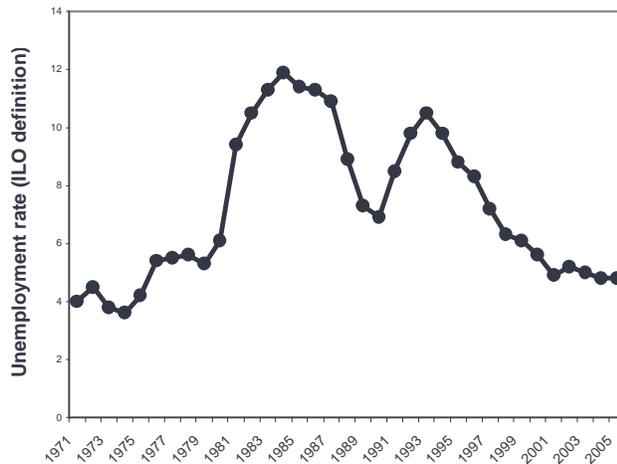
Source: ONS

This paper argues that a powerful explanation for the long-term shift in unemployment patterns may lie in the impacts of structural shifts and institutional change. For the UK, the last thirty years has coincided with a number of structural shifts, with de-industrialisation being identified as an important source of economic decline in the 1970s and 1980s (Corden and Neary, 1982, Crafts, 1990). Corden and Neary (1982) show how this pattern of economic decline can be explained by booms in the traded goods sector, an analysis that is consistent with the idea that the discovery of North Sea oil precipitated recession and rises unemployment in the UK. This paper concentrates on two more recent sources of structural change: first, the institutional changes associated with financial deregulation in the 1980s; and, second, developments in the technological, knowledge-based 'New Economy'. This paper investigates how these sources of structural change have affected unemployment performance. By developing evidence about the coincidence of falling capital accumulation and unemployment (Rowthorn, 1995, 1999; Baddeley, 2003; Arestis et al, 2005a, 2005b), we link these structural changes into unemployment via investment and capital accumulation. We argue that financial deregulation has affected the financing of capital accumulation and computerisation has affected the speed and character of capital accumulation. These changes have interacted, generating feedback effects: the technological shifts associated with the evolution of the New Economy have meant that productivity in the financial services sector has increased substantially over the last decade as computerisation has allowed the streamlining of administrative tasks; similarly, the increasing gearing rates encouraged by financial deregulation have fostered the rapid development of new high-tech industries.

In Section II, a baseline labour market model is constructed to capture the factors commonly assumed to affect labour demand and labour supply in a world of imperfect competition. In Section III, this theoretical approach is extended to introduce the impacts of financial deregulation and computerisation. In Section IV, the empirical patterns in capital gearing, rates of return, financial instability, technological change and unemployment (the latter smoothed using a Hodrick-Prescott filter) are analysed. In the final part of the empirical section a model of smoothed unemployment is estimated in attempt to give some evidence about the

impacts of financial deregulation and computerisation on unemployment. A Vector Error Correction (VEC) model is constructed to separate out the influences. In Section V, conclusions and policy implications are outlined.

II. A BASELINE LABOUR MARKET MODEL

In this section a baseline theoretical approach is introduced. This model is developed to identify some of the key factors traditionally associated with imperfect competition models of the labour market, for example those of Layard et al. (1991/2005, 1994).

Labour demand and the price setting relationship

Layard et al (1991/2005, 1994) assert that imperfectly competitive firms will adjust their prices (p) in response to wage expectations (w_e) according to the following price-setting equation (PSE):

$$p - w_e = \beta_0 - \beta_1 u \qquad (1)$$

where β_o is the price push parameter, β_1 is the price flexibility parameter and u is the unemployment rate. In a flexible wage determination setting, firms will elastically adjust their mark-ups downwards in the face of high unemployment, thus moderating tendencies for wages and prices to spiral upwards.

Labour supply and the wage setting relationship

In a similar way wage setters, i.e. employed insiders represented by unions, set wage demands according to the following wage setting equation (WSE):

$$w - p_e = \gamma_0 - \gamma_1 u \qquad (2)$$

where γ_o is the wage push parameter, γ_1 is the wage flexibility parameter.

Real wage rigidity

Rowthorn (1979), Nickell (1998), Layard, Nickell and Jackman (1991,1994, 2005), Bean, Layard and Nickell (1986) and Bean (1994) argue that, in a world of imperfect competition, inflationary pressures operate to reconcile the competing claims of wage-setters and price-setters. Equilibrium is reached when price and wage demands of firms and insiders are consistent and the expectations of workers and firms are satisfied simultaneously – i.e. when PSE=WSE. At this point, inflation will be stabilised and the non-accelerating inflation rate of unemployment (NAIRU) will be determined. Assuming for the moment that labour productivity is stable in the short run, from Equations (1) and (2) it follows that the NAIRU (u*) will be determined as:

$$u^* = \frac{\gamma_0 + \beta_0}{\gamma_1 + \beta_1} \qquad (3)$$

where the numerator is the sum of wage and price push factors ($\gamma_0 + \beta_0$) and the denominator is the sum of wage and price flexibility parameters ($\gamma_1 + \beta_1$), with real wage rigidity defined as:

$$RWR = \frac{1}{\beta_1 + \gamma_1} \qquad\qquad (4)$$

The sum of the price and wage flexibility parameters is capturing the real responsiveness of insiders' and firms' demands in the face of rising unemployment. This relationship shows that, with a flexible labour market, firms and workers will be elastically adjusting their prices or nominal wages in the face of rising unemployment and the NAIRU will be lowered accordingly. On the other hand, higher levels of RWR will be associated with a higher NAIRU. Some evidence in favour of this assertion is presented in Figure 2, which shows the persistent rises in unemployment rates since 1979 and the comparative trends in real earnings: real earnings remained relatively stable in the face of sustained rises in unemployment during the 1980s and 1990s, which is consistent with high levels of real wage rigidity.

Figure 2: Unemployment and real earnings in the UK, 1979-2002
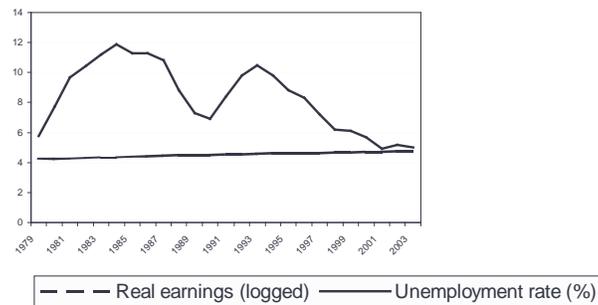
Source:OECD/ONS

According to Layard et al. this model can capture the different experiences of unemployment across the OECD and over time: in more flexible labour markets, wage and price responses will be more elastic, reducing RWR and therefore lowering the NAIRU. Real wage rigidity will be highest in countries where institutions limit the responsiveness of wage and price-setting, thus exacerbating real-wage rigidity. Layard et al (1991, 1994) argue that this approach can be used to capture the historical experience of inflation and unemployment during the 1970s and 1980s: real wage rigidity was relatively high in the EU and Australia, moderate in the USA and low in Japan and the EFTA countries. They also argue that their model can capture both supply and demand side shocks: the stagflationary period of the 1970s was driven by supply-side shocks; the persistent unemployment of the 1980s had its origins in demand-driven shocks.

III. INTRODUCING INSTITUTIONAL AND STRUCTURAL CHANGE

In developing the baseline model presented above, three sets of issues form the focus: first, the relationships between labour market institutions and real wage rigidity; second, the role of investment financing; and, third the role of technological change.

Institutions and real wage rigidity

The relationships described in Equations (1) to (4), imply that real wage rigidity is the central determinant of the equilibrium unemployment rate. It can be shown that real wage rigidity has its origins in efficiency wages and labour market institutions. Shapiro and Stiglitz (1984) show how efficiency wages operate simultaneously to boost insider productivity by encouraging effort and to price the least productive workers out of employment. To capture efficiency wages and normal cost pricing, following Hall and Hitch (1939), it is assumed here that imperfectly competitive firms set a fixed mark-up of prices relative not just to expected nominal wage demands, as described in Equation (2) but will also take into account labour productivity gains. So overall their mark-up will be determined by prices relative to expected unit labour costs ($w^e - q_l$), where q_l is labour productivity.

$$p - (w_e - q_l) = \beta_0 \qquad (5)$$

In addition, wage setters will be rewarded for their productivity increases, giving the following real efficiency wage relationship:

$$w - p_e - q_l = \gamma_0 - \gamma_1 u \qquad (6)$$

One implication is that institutions play a crucial role in determining labour market flexibility and some of these impacts will be captured within the real wage rigidity measure. Nickell, Nunziata and Ochel (2005) present evidence that real wage rigidity and high equilibrium levels of unemployment can be explained by the institutions affecting labour market policies and incentives to find work. They argue that in countries where wage flexibility is limited by a predominance of decentralised unions, where there are limited active labour market policies or where incentives to find work are curtailed by the existence of generous benefit systems, unemployment will tend to be high and persistent.

This labour market flexibility argument is also developed by Calmfors and Drifill (1988), who describe a non-linear relationship between degrees of wage flexibility and degrees of centralisation, with high degrees of flexibility seen in economies with decentralised labour markets but also in highly centralised, corporatist economies – reflecting the impacts of structural and institutional factors (see also Aidt and Tzannatos, 2003). Blanchard and Wolfers (2000) develop these ideas by focussing on the heterogeneity of individual country experiences, as determined by differences in institutional structure.

However, there are a number of shortcomings to a simplistic focus on real wage rigidity. Blanchard and Wolfers (2000) argue that interactions between shocks and institutions must be central to an understanding how and why unemployment patterns are changing. Also, it is assumed in the labour market flexibility analyses that stable equilibria exist. But what will happen if these equilibria are never reached? Karanassou and Snower (1998) and Karanassou, Sala and Snower (2004) argue that the structural and cyclical components of unemployment are dependent upon one another because of a 'chain reaction' of unemployment effects. Equilibrium concepts of unemployment may have no relevance if a new equilibrium evolves before the economy has adjusted to an old equilibrium. The interactions between shocks and

adjustment processes must be assessed in order to construct a meaningful analysis of unemployment patterns.

In addition, in the Layard et al. style of analysis it is assumed that the elasticity of factor substitution is unitary, disregarding the possibility that unemployment will rise with falling investment, i.e. when capital and labour are complements rather than substitutes (e.g., see Rowthorn, 1995, 1999; Baddeley, 2003; Alexiou and Pitelis, 2003; Arestis et al 2005a, Arestis et al 2005b, Kapadia, 2005). Similarly, the labour market flexibility story assumes that there are no impediments to the free movement of factors of production; it assumes that workers can move relatively easily between jobs in different regions, occupational groups and industrial sectors. What happens if people are not able easily to move between industrial sectors, professional groups and regions? Many impediments to the free movement of resources exist. Existing housing institutions exacerbate the constraints on geographical mobility in England and Wales; with a high degree of home ownership in the UK, the substantial property transactions costs and housing market rigidities mean that labour mobility from high unemployment regions is limited by owner occupation (Hughes and McCormick, 2000). So whilst home ownership increased throughout the 1980s with the deregulation of financial markets (enabling easier access to mortgage financing) and the introduction of MIRAS (enhancing financial incentives to own rather than rent) people could not easily move from the poorer, high unemployment regions (for example in the North of England) to the more prosperous South East. Occupational mobility was also constrained: it is not easy to shift from one sector to another or to re-train for an alternative profession and occupational immobility in the UK was associated with increasing regional specialisation, further limiting labour market flexibility (Monastiriotis, 2003).

Above, we outlined some of the institutional factors that will affect real wage rigidity. Below we explain that an alternative to the labour market flexibility models lies in the direct analysis of the independent effects on the demand side of financial and technological shocks.

Finance and financial deregulation

Whilst wage flexibility has important implications affecting the adjustment to any shock (supply-side or demand-side), in understanding the importance of demand-side factors to unemployment it is also important to understand the interactions between finance, interest rates, investment and unemployment and these are receiving greater attention in the recent literature on unemployment (e.g., see Davidson, 1998, 2001; Madsen, 1998; Sarantis, 1993).

The link between investment activity and employment / unemployment is propelled by the interactions between fixed asset investment and corporate financing decisions. In recessions, investment will slow and the capital stock will tend to shrink. If in the short term, capital and labour are complements rather than substitutes then employment will fall and unemployment will rise as the capital stock shrinks. Given the long and complex lags on investment projects, capital cannot quickly and easily accumulate in the short-term and the supply of capital resources available to meet notional demands for labour will be constrained encouraging unemployment hysteresis (Bean, 1989; Alexiou and Pitelis, 2004). In this way, capital shortages will contribute to rising and persistently high unemployment patterns.

So understanding unemployment requires an understanding of what is happening with fixed asset investment. In an uncertain world, investors will not have sufficient

information to allow them to maximise their profits; they have to take decisions that will affect their profits over a long time-horizon. Assessing these decisions using quantitative analysis is difficult under conditions of uncertainty and so other qualitative instincts become important. Keynes focuses on one such instinct, i.e. 'animal spirits', as a key determinant of real investment activity (Keynes, 1936). In uncertain economic environments, animal spirits will be fragile and investment will be volatile. Uncertainty will affect unemployment and investment by limiting not only the availability of accurate information but also the ability of either firms rationally to use that information.

Another constraint will emerge in the form of finance. Minsky (1978, 1986) argues that lending institutions respond to general economic confidence when making their decisions and it follows that the banking system, in its ability to create money, holds the key to boosting investment. The state of credit, via fixed asset investment, can have as much influence on macroeconomic outcomes as the state of confidence in moderating unemployment. Real side volatility will be exacerbated by financial instability. For example, as inflationary pressures develop, the banking system will respond to rising uncertainty by constraining the supply of finance. The increasing inelasticity in the supply of finance will be accompanied by increasingly inelastic demand for finance, reflecting the fact that some investment projects are already in process and future stages of investment and investment financing cannot easily be abandoned. This combination of inelastic demand and supply leads to rapid increases in short-term interest rates slowing investment and reducing labour demand. Furthermore, 'present value reversals' will take place as the demand price of capital falls. The ability of firms to honour debt commitments will become constrained and the stock of debt will become increasingly risky and unstable. Lenders will start to increase the risk premia that they attach to lending rates, depressing new investment projects as well as old. Investment, profits and labour demand will fall as a consequence, generating rising unemployment. In this way, Minsky argues that these financial factors generate endogenous instability, i.e. instability that feeds upon itself. It is over-optimism during the boom phases that promotes excessive reliance on debt financing and high gearing rates.

Davidson (1998, 2001) develops these arguments about the relationships between the destabilising effects of unregulated financial markets, investment uncertainty and falls in labour demand. He argues that the solution to growing unemployment problems in OECD countries is to limit financial uncertainty by promoting more stable international payments systems via fixed exchange rates and capital controls thereby moderating the effects of financial uncertainty on private investment.

In the context of UK unemployment, the impact of these financial factors has been particularly profound because of the significant moves towards financial deregulation from the 1980s onwards. By increasing the range and availability of financing instruments, financial deregulation encouraged greater reliance on gearing of investment projects, contributing to the build-up of corporate debt. This destabilised investment activity because heavily geared firms will be more sensitive to interest rate changes (Hall 2001a, p. 452). Following the 'financial accelerator model' of Bernanke, Gertler and Glichrist (1999), Hall explains how this dependence on external finance and movement away from internal financing discouraged investment by increasing the costs of investment. Hall (2001) asserts that this link between weakness of corporate investment growth and financial liberalisation is a potential explanation for the 1990s recession: whilst corporate profitability was relatively high, the corporate financial position was weak because of large dividend payments,

income gearing and dependence on externally supplied finance. And when capital and labour are more like complements than substitutes, it follows that financial instability will have knock-on effects in constraining labour demand, contributing to falling employment and rising unemployment.

The impacts of computerisation

Assessing the impacts of financial instability have been complicated by the widespread computerisation of commercial activity in the so-called 'New Economy'. Whilst it is common for the impact of technological changes to be assigned to a stochastic error term in theoretical models, we will argue here that computerisation has had wide-ranging non-random impacts on modern economies. In an endogenous growth framework, technological advance, including computerisation in the New Economy, has positive implications for productivity growth and employment. The latter has increased productivity in the financial services - for example by streamlining administrative tasks with the introduction of networked computer systems.

According to Quah (2002), the key characteristics of the current technological changes are that they are knowledge-driven and therefore a-spatial and non-rival; this means that increasing returns to human capital are possible. However, this analysis is formulated assuming a world of flexible capital stocks. In a world of heterogeneous capital and limited factor substitutability, the analysis must change for three related reasons. First, additions to the capital via fixed asset investment are constrained by what is already there; the capital stock and associated capital-labour ratios are fixed 'in clay' for each vintage of capital machinery (Leontief, 1953). Second, the capital stock is not homogenous: it includes plant and machinery of various vintages; different states of technology will be embodied within these different vintages (Wan, 1971). Third, the process of capital accumulation is constrained by lags meaning that, in the short-term at least, mismatches between old and new machinery will be exacerbated. Given the interactions between capital accumulation and labour demand outlined above, it follows that technological advance will complicate the relationships between labour demand and labour supply.

The precise impacts will vary across different segments of the labour force because labour is not homogenous. In the context of computerisation - skills useful to old Economy production may not adapt quickly to changes emerging with computerisation. For this reason the diffusion of technological innovations can have a number of destabilising impacts. Technological progress may accompany the obsolescence of skills in specific groups within the labour force, with the older, unemployed and uneducated members of the labour force at more disadvantage than the younger, employed sectors. When technological change precipitates educational change, labour productivity will differ across age groups. In the context of computerisatino, older generations will be less computer literate because they are less likely to have had access to computer education at school. Similarly, unemployed outsiders will not have the same access to productivity enhancing innovations as employed insiders (Griliches, 1969). With computerisation, insiders and outsiders face differing opportunities to acquire skills because insiders have access to 'on-the-job' training and therefore are well placed to take practical advantage of the technological progress associated with computerisation (Song, 2005). Overall, this means that a wedge will be driven between the productivity of insiders versus insiders.

In addition, instability created by technical innovation will have knock-on effects for the labour force. According to Schumpeter (1942), business cycles are generated by the 'creative destruction' that accompanies technological competition by oligopolistic firms. Schumpeter argued that the clumping of innovations leads to the dominance of 'bursts' of entrepreneurs, initially chasing high profit margins. But bandwagon effects will encourage the herding of entrepreneurs around new innovations and as more and more firms enter new markets, average profit margins are eroded. Thus technological advance does not generate sustained rises in output and employment; instead it generates cycles and volatility in employment and unemployment; the rising unemployment that is a feature of downswings is the inevitable consequence of the technological innovations that generate an upswing.

Feedback effects: financial deregulation to computerisation

The technological changes associated with computerisation have spilled over into other areas of the economy. The computerisation of business, particularly innovations in e-commerce and electronic payments, fostered growth in the already deregulated and highly liquid financial services sector. These rises are likely to be sustained as innovations in computing will allow faster and larger volumes of money to move securely via the Internet. There are also linkages in the other direction. The deregulated financial services sector has fostered growth in hi-tech industries by enabling rapid increases in the availability of finance for innovative new investments, particularly via non-traditional lenders into venture capital funds. Whilst this has relieved short-term financial constraints on innovative new businesses it has also increased gearing rates, with destabilising impacts on investment and employment.

An extended model

To gather together some of the ideas presented above, the impacts of financial deregulation and technological innovation are analysed by extending the baseline model presented in Section 2. Whilst financial deregulation and technological change do not directly affect labour market institutions, they do still affect labour market outcomes because, in a world in which capital and labour are complements, the impacts of financial deregulation and computerisation on investment activity will affect unemployment via investment. The baseline model is extended focussing on the price setting relationship again assuming normal cost pricing: firms' mark-ups of prices over unit labour costs will be a function of the price push parameter (as before). The impact of financial factors will be captured via gearing rates and the impacts of technological change will be captured as productivity from the information and communications technology (ICT) sector.

To capture financing costs within the price-setting relationship, as mentioned above, we develop Hall (2001a, 2001b) who adapts the financial accelerator model of Bernanke et al (1999) to show that the 1990s recession was associated with higher levels of gearing. Hall argues that this was because additional financing costs are incurred as the net worth (i.e. the proportion of internal financing of capital accumulation) falls. Using internal funds to finance investment is cheaper because borrower and lender risks are internalised; external financing imposes additional costs reducing overall profitability. The hypothesis tested in the empirical section below is that financial deregulation encouraged higher gearing rates, thereby increasing imperfectly competitive firms mark-ups of prices over unit labour costs. The extent of

this additional cost is captured by the gearing ratio – which measures the proportion of firm value funded via external borrowings. Incorporating this insight into the price-setting relationships, the mark-up of prices over unit labour costs will be increased to allow for the inflation of the cost of capital (c) by the ratio of external borrowing (B) to capital stock (K):

$$p - (w_e - q_l) = \beta_0 + \left(\frac{B}{K}\right)c$$

(7)

In capturing technological change and computerisation, it is assumed here that computerisation is a technological change that is not simply labour-augmenting and so output will increase in line with labour productivity gains, capital productivity gains and total factor productivity (TFP) growth. The overall output gain from technological advance is represented as ΔA. It is assumed that in a world of limited factor substitution and imperfect competition, the factor shares in these productivity gains will remain the same after the technological change as before. Similarly, the price setting relationship can be further adapted to give:

$$p - w_e + q_l - \left(\frac{B}{K}\right)c = \beta_0 + r\frac{K}{Y}\Delta A$$

(8)

where r is the real rate of return and $r\Delta q_k$ represents the value of capital productivity benefits of a technological change. Similarly, the wage-setting relationship outlined in Equation 7 can be adapted as follows:

$$w - p_e - q_l = \gamma_0 - \gamma_1 u + w\frac{L}{Y}\Delta A$$

(9)

Putting together the above relationships: in equilibrium expectations will be satisfied (as for the baseline model). In addition, capital accumulation will equilibrate at the point where the opportunity cost of capital accumulation (i.e. the user cost of capital, c) is equal to the real rate of return on capital. Furthermore, given constant returns to scale, i.e.:

$$w\frac{L}{Y} + r\frac{K}{Y} = 1 \qquad (10)$$

it follows that u* will be determined as:

$$u^* = \frac{1}{\gamma_1}\left(\beta_0 + \gamma_0 + \frac{B}{K}r + \Delta A\right)$$

(11)

So u* will rise not only as a consequence of the commonly emphasised price and wage push factors but also as capital gearing rises and with the output gains from technological change. For the UK, the impact of financial deregulation in increasing the availability of external financing for the gearing-up of corporate investment projects and the technological changes associated with computerisation will both be associated with rises in the NAIRU. The intuitive explanation for the borrowings result is relatively obvious: external financing adds to firms' costs, reduces profits and therefore reduces labour demand. The intuitive explanation for the productivity gains

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from technological change could be that firms and insiders are able to extract the gains from technological change. Consistent with insider-outsider and duration effect theories of unemployment hysteresis (Lindbeck and Snower, 1986, 2001; Hargreaves Heap, 1980; McGregor, 1978; Griliches, 1969) - insiders are able to take advantage of technological innovations as they emerge and they are better placed to learn by doing. By contrast, outsiders, particularly the long-term unemployed, do not have access to new technological skills. This would drive a productivity wedge between insiders and outsiders contributing unemployment hysteresis effects.

IV. EMPIRICAL ANALYSIS OF NEW ECONOMY UNEMPLOYMENT[1]

In this empirical analysis, the set of factors outlined above will be analysed in the context of interactions between technological and financial shocks. In this sense, this paper represents a preliminary identification of the sources of shocks to unemployment, whilst recognising the Karanassou et al. (2004) observation that single equation methods may over-estimate the impact of shocks. The empirical investigation is conducted in two stages to answer two main questions. First - is the persistence in unemployment the outcome of a stochastic trend and/or can it be explained by structural shifts?

These issues will be examined first by assessing the dynamic properties of the unemployment data. Phelps and Zoega (1998) analyse evidence relating to the existence of hysteresis in UK unemployment. They argue that unemployment can be attributed to a shift in the mean unemployment rather than high persistence. So we attempt to establish whether or not patterns in UK unemployment are characterised by structural breaks at key stages, representing shifts in the economic and political environment. The data are tested for structural shifts in unemployment patterns coinciding with the shocks of financial deregulation and computerisation respectively. The extent to which temporal patterns of unemployment in the UK are the outcome of structural breaks versus stochastic trends is assessed using standard tests for non-stationarity and also Perron's (1994) methodology.

The second question is answered by examining some raw data and by estimating the theoretical model outlined in the preceding section. If unemployment is the outcome of structural shifts, is there empirical evidence supporting the assertions above? The model is estimated to capture the interactions between the structural shifts of computerisation and financial deregulation and unemployment.

Dynamics of UK unemployment

The stationarity of the unemployment is examined series using the Dickey Fuller and Augmented Dickey Fuller (ADF) tests. Perron (1994) suggests an alternative procedure in order to test for non-stationarity and so the DF/ADF tests are supplemented with Perron tests. The results from these tests are outlined in Table 1 and suggest that the patterns in unemployment are not robust to different specifications of testing procedure. Nor are they robust over the different time periods

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[1] The data used in this paper are from the Organisation for Economic Cooperation and Development (OECD), the UK's Office of National Statistics (ONS) and Netcraft. These data are downloadable from the following websites: www.oecd.org, www.statistics.gov.uk, and www.netcraft.com. Data files are available from the author upon request.

examined – not a surprising result given the clear cyclicality in the unemployment series, as revealed in Figure 1.

One shortcoming of DF and ADF testing procedures is the increased probability of a Type II error on these tests in the presence of structural breaks. In addition, unit roots test only for the persistence of shocks and not for endogenous hysteresis of the form outlined by Rosser (1991, 2000). In this section, structural breaks were tested for using the methodology followed by Perron (1989, 1994), Greasley and Oxley (1996) and Baddeley, Martin and Tyler (1998) who adopted an extended form of Perron's innovational outlier procedure[2]:

$$u_t = \mu + \alpha u_{t-1} + \phi \Delta u_{t-1} + \beta t + \theta_f D_{ft} + \delta_f DT^*_{ft} + \gamma_f DTB_{ft} + \theta_c D_{ct} + \delta_c DT^*_{ct} + \gamma_c DTB_{ct} + \varepsilon_t$$
(12)

where t is a deterministic time trend and u is the unemployment rate and ε_t is a serially uncorrelated disturbance term. Whilst judging exactly when these events began to affect the macro-economy is problematic, it is assumed here, first - that the impacts of financial deregulation began to take hold in 1983 when Building Societies were allowed to start using the money markets; and second, that the key impacts of computerisation began to take hold in 1991 with the development of 'network-centric' computing systems, enabling the rapid transformation of business practices (Low, 2000). So the following shift and break variables were incorporated to model the structural breaks:

Financial shift variables

D_{ft} = 1 if t>1983 and 0 otherwise
DT^*_{ft} =1 if t =1984 and 0 otherwise
DTB_{ft} = t – 1983 if t > 1983 and 0 otherwise

Computerisation shift variables

D_{ct}=1 if t>1991 and 0 otherwise
DT^*_{ct} =1 if t =1992 and 0 otherwise
DTB_{ct} = t – 1991 if t > 1991 and 0 otherwise

If there are structural shifts in the series, then the parameters on D and/or DTB will be significantly different from zero; if there are trend breaks the parameter on DT* will be significantly different from zero. The results from these tests are summarised in Table 2. The Wald tests indicate that the null hypotheses of no structural shift or trend break can be rejected at significance levels of 3% and above for the financial deregulation break variables, and at 6% and above for the computerisation break variables.

Overall it seems clear that there were significant breaks at the periods tested. However, other factors were coincident and the breaks may have their origins in other

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[2]   The findings from Perron's testing procedure should be qualified by noting Perron's (1994) observations regarding the inapplicability of the model if the timing of breaks and shifts is incorrectly specified. In addition, the power of the model is reduced if significant intercept and trend terms are omitted or if insignificant intercept and trend terms are included.

sources; identifying structural breaks is not the same as proving that financial deregulation and computerisation are the explanations.

Explaining the structural breaks

Whether or not these breaks can really be attributed to financial deregulation and/or computerisation is examined more carefully - first, by examining some raw data and second, by incorporating the hypotheses outlined in the theoretical sections (that financial deregulation and computerisation have raised equilibrium unemployment rates) into an empirical model.

During the 1970s and 1980s, the UK suffered destabilising impacts from declining international competitiveness and increasing exchange rate instability. Following Corden and Neary (1982), it is possible to argue that deindustrialisation in the 1970s and 1980s was precipitated by the Dutch disease impacts of exchange rate appreciation following the discovery of North Sea oil. These impacts will have been reinforced by financial deregulation and computerisation exacerbating the disproportionate falls in manufacturing employment. In the UK, rising unemployment and falling manufacturing employment (as illustrated in Figures 1 and 3) was accompanied by key shifts in the UK's economic structure and Figure 3 illustrates shifts in jobs in manufacturing as a proportion of jobs in services; it shows that the periods of rising unemployment were accompanied by a downward shift in manufacturing jobs in favour of service sector jobs. Figure 3 shows clearly that the employment shift from manufacturing to the service sector is sustained and pronounced. The correlations between rising unemployment and deindustrialisation may be the outcome of structural mismatch: with limited occupational mobility, the labour force will take some time to adapt to structural shifts and, in the meantime, the unemployment problems will intensify. However during this time, the effective exchange rate (UK sterling) was relatively stable in spite of rising unemployment, suggesting that internal, domestic factors may be more important than external factors in capturing unemployment patterns.

Figure 3: Jobs in Manufacturing and Services, UK, 1978-2003
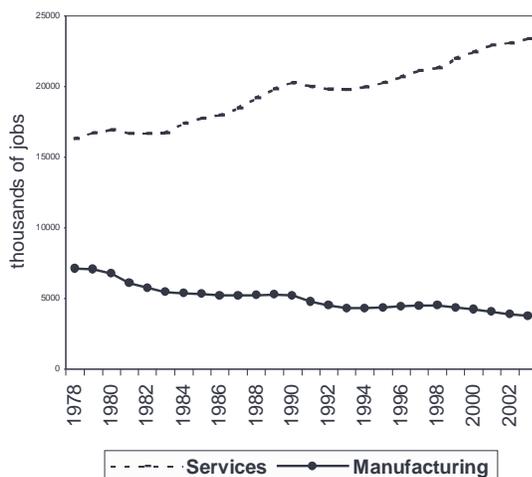
Source: ONS

Financial Deregulation and Unemployment

To provide a point of contrast with the Dutch disease explanations for rising unemployment, Figure 4 shows that the real exchange rate was fairly stable over the period of rising unemployment suggesting that it cannot provide a complete answer to the question of why unemployment rose so steadily throughout the 1980s and 1990s. Figure 4 also shows that the financial deregulation of the 1980s was accompanied by large increases in liquidity (as measured by M4 growth) and increasing financial instability (as captured by data on number of bankruptcy orders). Whilst there are clear cyclical fluctuations in these series, there is an overall upward trend sustained over the period suggesting that cyclical factors are not a complete explanation.

Figure 4: Changes in M4, Company Insolvencies and Effective Exchange Rate, 1979-2003
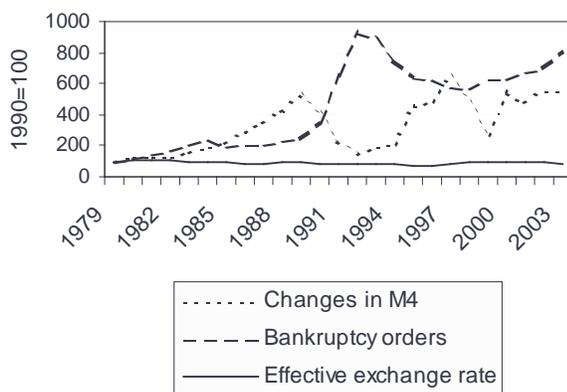
Sources: ONS and Bank of England

These increases in liquidity and bankruptcy coincided with increases in corporate borrrowing: Figure 5 shows net lending to private non-financial corporations (PNFCs) as a proportion of the capital stock, capturing the increased capital gearing during the 1980s. The gearing and bankruptcy evidence would also be consistent with theories of financial instability outlined above if excessive gearing during upswings generates unsustainable borrowing exacerbating bankruptcy rates during slump phases, both emerging as an outcome of excessively high gearing rates allowed by financial deregulation.

Figure 5: Ratio of net lending to capital stock, (%)
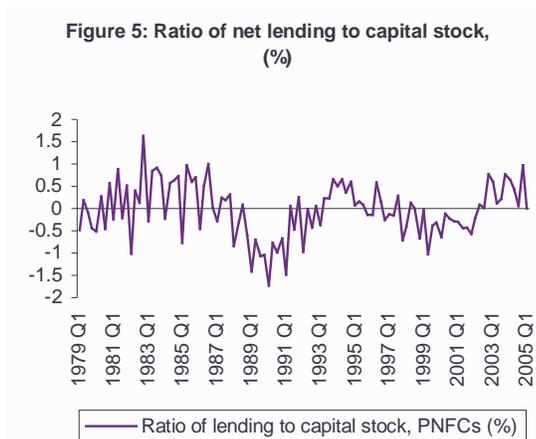
Source: ONS

Computerisation and Unemployment

Figure 6 shows that the decades of increasing unemployment were associated not only with growing financial instability but also with the widening computerisation of the economy – with exponential rises in the number of secure servers in the UK (as a measure of the penetration of computing technology into UK households). This growing computerisation within UK households mirrored trends throughout the OECD, though more recently growth in secure servers has fallen off – perhaps reflecting the fact that a computerisation saturation point has been reached.

Figure 6: Number of secure servers, UK and OECD - 1995-2002
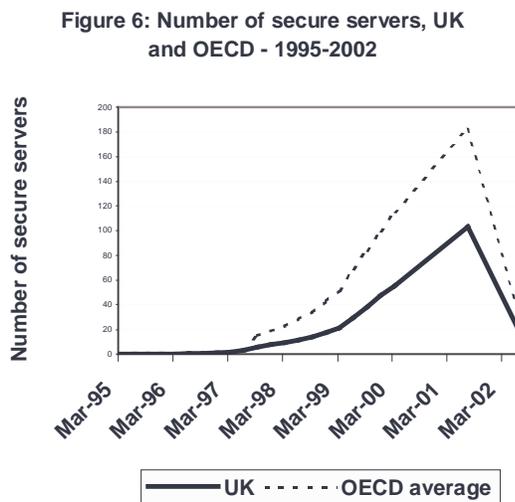
Source: OECD, www.netcraft.com

On the production side, Figure 7 illustrates the contribution of the ICT (Information and Communication Technologies) industries to total output. The proportion of ICT output to total output has grown considerably over the past decade, though it is still a small proportion of output. In disaggregating this growth, Figure 7 also shows that an increasing proportion of ICT output is coming from the service ICT rather than manufacturing ICT. This evidence is consistent with the evidence

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outlined above (in Figure 3) about the interactions between declining manufacturing jobs and rising unemployment.

Figure 7: ICT Contributions to Output, Services vs Manufacturing, 1992-2001
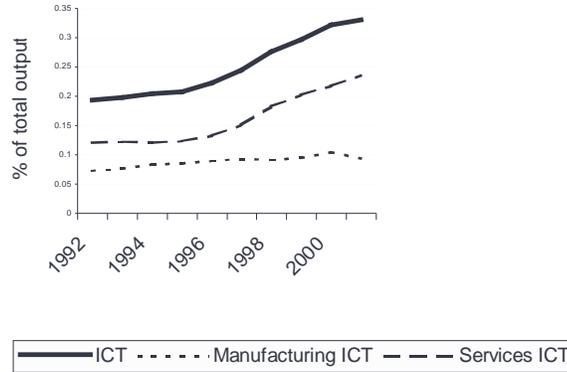
Source: ONS

The data described above only gives some indication of broad trends showing a coincidence of computerisation and financial deregulation with financial instability and rising unemployment. However, it could be that these common patterns are spurious and so in the following section an econometric model is estimated to isolate the effects of financial deregulation and computerisation.

An Econometric Model

Following from Equation (11), in disentangling the impacts of the various factors illustrated above, an econometric model was constructed to assess the impacts of each factor in testing the hypothesis that the interaction of unemployment, financial deregulation and computerisation generate rising in the NAIRU. In any given time, the reported unemployment rate will reflect cyclical factors rather than an equilibrium outcome and for this reason the unemployment series was smoothed to estimate its long-term trend using a Hodrick-Prescott (HP) filter (Hodrick and Prescott 1997). The HP filter is estimated via the constrained minimisation of the variance of smoothed unemployment around its realised value. (See Figure 8 for the smoothed unemployment series.) In the estimations described below HP smoothed unemployment (UNHP) is used as the dependent variable using the following specification to capture financial liberalisation (via the geared rate of return – BKR), financial instability (via bankruptcies) and technological advance (via ΔA):

$$UNHP = f(BKR, \Delta A, Bankruptcies) \qquad (13)$$

Figure 8: UK Unemployment – smoothed using Hodrick-Prescott Filter

Hodrick-Prescott Filter (lambda=1600)
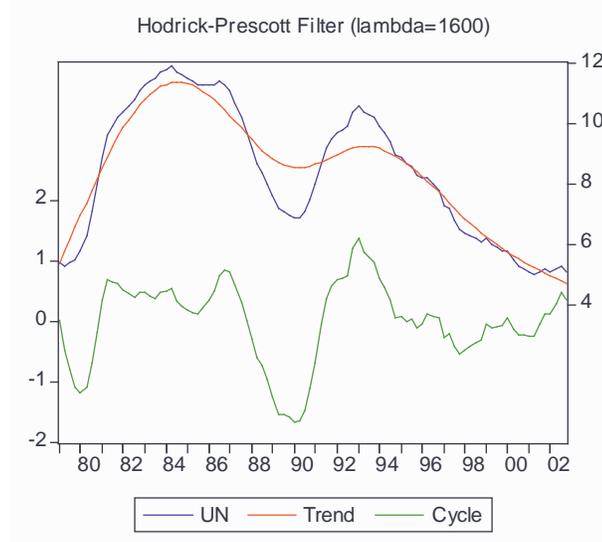
The results from a preliminary OLS estimation of this model are reported in Table 3 and the diagnostic tests reported show that a simple linear specification is inappropriate and so a vector autoregression (VAR) modelling strategy was implemented. The endogenous variables (smoothed unemployment, capital gearing bankruptcy and ICT productivity) were tested for non-stationarity and were found to be I(1). So they were incorporated into a vector error correction model. The number of cointegrating vectors was established using Johansen's cointegration tests (Trace and Eigenvalue tests, 1% significance level) which revealed evidence of at least 2 cointegrating vectors, justifying the estimation of a vector error correction (VEC) model. This VEC was estimated using an AR(2) lag structure. Structural breaks and financial instability were captured using dummy variables for policy regime switches. The results from the estimation of the VEC are reported in Table 4.

The estimate of the long-run relationship (setting the cointegrating vector to zero) reveals that there is a positive long-run relationship between unemployment and the rate of return and gearing rates, confirming the initial hypothesis that increases in liquidity and financial instability had depressing effects on the macro-economy and employment. The negative long-run relationship with computerisation runs contrary to that hypothesised above suggesting that even if the distribution of gains was uneven across different worker groups, the overall rises in productivity were nonetheless large enough to see a positive net contribution to labour productivity and employability. This empirical finding may be consistent with Rowthorn's assertion that when productivity gains to capital outweigh the productivity gains to labour, then the equilbrium unemployment rate will fall (Rowthorn, 1999, p. 422).

V. CONCLUSIONS

There are many divergent approaches to understanding the problem of unemployment. Whilst most recent literature has focused on the impact of institutions on wage flexibility and real wage rigidity in explaining unemployment, other elements affecting unemployment, particularly structural shifts and shocks, have had impacts too. The empirical evidence presented in this paper suggests that there are key shifts in the structural parameters determining the unemployment relationship and

these structural breaks coincide with the key shifts in economic structure that accompanied financial deregulation and computerisation. Amongst other things, these data show that there have been two major episodes of rising unemployment: one coinciding with financial deregulation in the 1980s and the other coinciding with computerisation in the early 1990s.

However, whilst the data confirms that financial instability had key implications for unemployment, the evidence on the impacts of computerisation is patchy. The complex patterns in the data and econometric results suggest that the Blanchard and Wolfers (2000) and Karanassou et al. (1998, 2004) insights about the dynamics of unemployment being affected by complex interactions between shocks and institutions rather than by the direct impact of specific shocks, may well be correct. Overall, however, the findings do suggest that the key to explaining unemployment patterns does not lie in assessing the role of labour market flexibility and wage flexibility. Deregulated labour markets do not necessarily dampen unemployment rises. Similarly, financial deregulation is not necessarily helpful in reducing unemployment; the evidence outlined above suggests that financial deregulation, by encouraging financial instability (e.g. emerging from excessive gearing and high bankruptcy rates) contributes to rising unemployment by encouraging financial instability /uncertainty and thereby dampening investment activity. Given the empirical evidence suggesting that the elasticity of factor substitution is low (Rowthorn 1995, 1999) it follows that subsequent falls in investment will coincide with falling employment and rising unemployment.

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Table 1: Unit root tests on UK unemployment

	Whole period	1979Q1-1992Q4	1992Q4-2002Q2
Tests on levels			
ADF	-3.326*	-3.988*	-1.734
Philips-Perron	-1.293	-1.852	-0.264
Tests on changes			
ADF	-2.013	-1.459	-2.549
Philips-Perron	-2.494	-1.876	-2.585*

* Reject H_0 at 10%

Table 2: Testing for structural shifts and trend breaks

Variable   Estimated

	Coefficient	t-Statistic	p value
Lagged unemployment	0.920	46.08	0.000
Constant	0.342	4.353	0.000
Lagged unemployment change	0.910	18.26	0.000
Deterministic trend	0.0254	2.48	0.0149
D_f	-73.48	-2.51	0.0141
DT^*_f	-0.0375	-2.508	0.014
DTB_{ft}	0.00356	0.0385	0.969
D_c	-1.502	-0.216	0.830
DT^*_c	-0.001	-0.252	0.802
DTB_c	0.0171	0.193	0.848

Adjusted R-squared 0.998   Akaike information criterion = -1.214
Durbin-Watson statistic 1.889   Schwarz criterion = -0.942
F test of explanatory power = 4404.3 (p=0.000)

Diagnostic tests (p values on H_0 that relevant GM assumption is satisfied)

LM test for 1st order serial correlation	p=0.486
LM test for 4th order serial correlation	p=0.876
White's test for heteroscedasticity	p=0.485
Ramsey's RESET square of fitted values)	p=0.540

Variable Deletion Tests p (values)

	$H_0: \delta_i = \theta_i = 0$	$H_0: \gamma_i = 0$	$H_0: \gamma_i = \delta_i = \theta_i = 0$
	no structural shift	no trend break	no shift, nobreak
Financial break	0.0409	0.9693	0.0323
Computerisation break	0.1412	0.8472	0.0615

TABLE 3: OLS ESTIMATION RESULTS
   Dependent variable: Unemployment Hodrick Prescott filtered (UNHP)
   Estimation Period: 1979Q1 2002Q4

Regressor	Coefficient	t-Statistic	p value
Constant	-13.18	-8.391	0.0000
Gearing rate	0.8455	7.196	0.0000
Rate of return	0.1834	4.071	0.0001
ICT contribution to output	-25.10	-21.71	0.0000
Bankruptcies	2.831	13.63	0.0000

Adjusted R-squared	0.8681	Akaike info criterion	2.149
Durbin-Watson stat	0.8683	Schwarz criterion	2.283
F test of explanatory power	157.3 (p = 0.000)		

Diagnostic tests (p values)

Breusch-Godfrey Serial Correlation LM Test:	p=0.000
White Heteroscedasticity test:	p=0.000
Ramsey RESET test	p=0.206
Chow Breakpoint test 1981Q3	p=0.000
Chow Breakpoint test 1991Q3	p=0.000

TABLE 4 – VECTOR ERROR CORRECTION MODEL
Estimation Period: 1979Q4 2002Q4

	ΔUNHP	ΔR	ΔBK	ΔICTY
Cointegrating vector*	-0.000712	0.049117	0.360249	0.001039
	[t=-9.30034]	[t= 2.46115]	[t= 4.48681]	[t= 0.90744]
ΔUNHP$_{-1}$	1.988225	-3.072484	0.596723	0.174402
	[t= 389.187]	[t=-2.30835]	[t= 0.11143]	[t= 2.28279]
ΔUNHP$_{-2}$	-0.999188	2.726318	-1.701889	-0.173462
	[t=-201.115]	[t= 2.10617]	[t=-0.32679]	[t=-2.33465]
ΔRate of return$_{-1}$	0.001115	0.723658	-0.024314	0.003778
	[t= 2.67956]	[t= 6.67468]	[t=-0.05574]	[t= 0.60704]
Δ Rate of return $_{-2}$	0.000730	-0.025472	0.182942	-0.005836
	[t= 1.81183]	[t=-0.24275]	[t= 0.43335]	[t=-0.96901]
ΔGearing rate$_{-1}$	-0.001153	0.040655	-0.306599	0.000912
	[t=-8.27419]	[t= 1.11991]	[t=-2.09927]	[t= 0.43779]
ΔGearing rate $_{-2}$	-0.000592	-0.001788	0.024962	0.001629
	[t=-5.56262]	[t=-0.06451]	[t= 0.22383]	[t= 1.02410]
Δ ICT output$_{-1}$	-0.015413	1.136794	-2.604116	0.180544
	[t=-2.04311]	[t= 0.57835]	[t=-0.32930]	[t= 1.60027]
Δ ICT output $_{-2}$	-0.015366	-3.370523	-1.523779	-0.044681
	[t=-2.03298]	[t=-1.71160]	[t=-0.19233]	[t=-0.39531]
Constant	0.007703	-0.005425	3.112618	-0.003215
	[t= 6.60442]	[t=-0.01785]	[t= 2.54605]	[t=-0.18432]
Exogenous variables				
Computerisation dummy	-0.001454	0.031548	0.641655	-0.000515
	[t=-7.42855]	[t= 0.61843]	[t= 3.12635]	[t=-0.17590]
Financial deregulation dummy	-0.000813	-0.165724	-0.162920	0.001720
	[t=-2.22808]	[t=-1.74266]	[t=-0.42582]	[t= 0.31513]
Bankruptcies	-0.000835	0.017127	-0.387711	0.000741
	[t=-5.23194]	[t= 0.41182]	[t=-2.31714]	[t= 0.31061]
Adjusted R-squared	0.999992	0.753140	0.494890	0.191838
F-statistic	945805.1	24.39001	8.511543	2.819885
Log likelihood	583.6799	66.34226	-63.12161	332.1123
Akaike AIC	-12.27269	-1.147145	1.637024	-6.862630
Schwarz SC	-11.91867	-0.793126	1.991043	-6.508611

*Gives long-run equilibrium of:

UNHP$_{-1}$ = 2.907 +0.651*R$_{-1}$ + 1.940*BK$_{-1}$ – 13.77*ICTY$_{-1}$
$\qquad\qquad$ **[t=-5.93]** $\qquad$ **[t=-7.00]** $\qquad$ **[t=7.20]**