Unemployment and the Productivity Slowdown: A Labour Supply Perspective*

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Abstract

Many OECD economies suffered a productivity slowdown beginning in the early 1970s. However, the increase in unemployment that followed this slowdown was more pronounced in European economies relative to the US. In this paper we present an efficiency wage model, which enables us to identify five channels through which the productivity slowdown can affect workers' effort incentives. We argue that this model can explain the different trends in unemployment across countries over this period in the face of a similar slowdown in productivity. We also demonstrate how the link between growth and unemployment depends upon labour market institutions in such a way that we can reconcile the mixed empirical results observed in the literature.

Key Words: technical progress, endogenous growth, unemployment, efficiency wages.
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1 Introduction

It is well known that unemployment has risen dramatically in many developed economies since the early 1970s, while there has been a slowdown in productivity growth over the same period. To illustrate these trends, Figures 1 and 2 show time series for labour productivity growth and unemployment, respectively, for a number of economies. One of the key things to observe in these figures is that the productivity slowdown has not obviously been more pronounced in Europe compared to the United States, while the rise in unemployment has been. This suggests that while there is a relationship between the two variables[1] it is not the same in all economies.

This basic property of the data is reflected in the findings of the empirical literature. For example, Bean and Pissarides (1993) examine cross-country correlations between unemployment and various measures of productivity growth, for OECD economies. In general, they find no relationship between productivity and unemployment, except for a mildly negative relationship between 1975 and 1985. In contrast, Caballero (1993) finds a weak positive relationship between growth and unemployment in the UK and US economies between 1966 and 1989. Aghion and Howitt (1992) examine the link between GDP growth and unemployment for 20 OECD economies and find an inverted U-shaped relationship - that is, economies with either high or low rates of growth enjoyed low unemployment relative to other economies. Additionally, Muscatelli and Tirelli (2001) find a significant negative correlation between productivity growth and unemployment for five of the G7 economies (Japan, Germany, Italy, France and Canada), while for the

[1] Manning (1992a, p.2) wrote "no story of the general rise in OECD unemployment will be complete without mentioning that the reduction in productivity growth has probably raised the long-run equilibrium rate of unemployment."

US and UK there does not appear to be any significant correlation. In general, these studies seem to imply that there is a negative relationship between productivity growth and unemployment in Europe[2], but that this relationship is positive in the US and UK.

The challenge is, therefore, to construct a coherent model which accounts for this contrasting experience across different countries. To do so, we rely on another key stylized fact that distinguishes European labour markets from their US counterparts. Empirical evidence suggests that flows into unemployment in European economies are typically lower than flows into unemployment in the US (see OECD (1997) for a survey). There is also evidence that the rate of these flows, in a number of European countries, are lower than job destruction rates, while the opposite is true in the US and UK (see Boeri (1999), for example). In other words, workers in European economies are likely to avoid a spell of unemployment, by 'directly' entering a new job when their existing job is destroyed. There are various possible reasons for these differences, but the existence of stricter employment protection legislation in Europe may account for the reluctance of firms to risk hiring workers from the pool of the unemployed[3]. This stylized fact implies that unemployed workers in Europe are more reliant than their North American counterparts, on the net creation of new jobs to enable them to exit from unemployment. As a result the European workers suffer from a greater incidence of long-term unemployment, which is a defining

[2]We characterise the 'US' and 'European' labor markets as being two polar cases in terms of our stylised facts. This is obviously a simplification as individual countries, such as the UK, lie between the 'US' and 'European' models. Throughout the paper, 'Europe' may therefore be read as consisting of those European economies which best fit our stylised facts.

[3]Boeri (op. cit.), presents a theoretical model, and some empirical evidence, that suggests that imperfect enforcement of job protection legislation may result in employment adjustment taking place through job-to-job reallocations which do not give rise to a chain of vacancies, and which, therefore, reduce the probability of the unemployed re-entering the labour market.

characteristic of the rise in European unemployment. We believe that this is key to understanding different responses of unemployment to the productivity slowdown in the US and Europe.

To capture this observation, we stress the role of technical progress in creating new jobs while, at the same time, destroying old ones. Our argument is developed in the familiar framework of the efficiency wage model of Shapiro and Stiglitz (1985). As technology advances, some workers are lucky enough to retain their jobs, but others will be allocated to new jobs or will become unemployed[4]. This whole process affects the effort incentives of workers, and hence the effective labour supply. Our approach, therefore, shifts the emphasis away from the demand-side of the labour market typically found in the literature [5]. We argue that this allows us to reconcile the different experiences of OECD economies in the face of the productivity slowdown, by allowing us to relate changes in worker effort incentives to both the productivity slowdown and differences in labour market institutions.

To highlight the incentive effects of the productivity slowdown in the labour market, we initially assume exogenous technical progress in the form of expanding variety and abstract from firms' hiring and firing decisions operating on the demand side. This allows us to identify five channels through which technical innovation affects workers' effort incentives within an efficiency wage framework. Within these five effects there are basically two

[4]Other papers which incorporate efficiency wages within a growth model include Phelps (1994), Furuya (2000), Hoon and Phelps (1997) and van Schaik and de Groot (1998). Our paper differs from these studies by stressing the important of technical progress as a mechanism of labour reallocation, which, in turn, affects workers effort incentives.

[5]Influential studies in the growth-unemployment literature are Aghion and Howitt (1994), Pissaridis (1990), Bean and Pissarides (1993), Eriksson (1997), Galor and Lach (1990), Mortensen and Pissarides (1998), Pissarides (1990) and Postel-Vinay (1998). In these models technical progress creates new jobs and destroys old jobs, affecting flows into and out of the unemployment pool. This class of models then capture the hiring and firing decisions of firms operating on the demand side of the labour market to explain the link between unemployment and growth. Although workers' job search is modelled in those studies, it only plays a secondary role in the technology-unemployment link.

competing tendencies. Firstly, a productivity slowdown reduces the growth of wage and non-wage income, cet. par., and, on balance, reduces the value of employment relative to unemployment. This therefore requires, in equilibrium, an increase in unemployment to prevent workers from shirking. This net "capitalization" effect makes unemployment negatively related to growth. At the same time, however, the slowdown in productivity growth may result in a slower rate of job turnover. We will show that this implies a higher cost of being unemployed, and hence less unemployment is required to generate the same level of worker effort. This effect implies that unemployment is positively related to growth. The paper argues that the greater incidence of job-to-job transfers in Europe means that the importance of new job creation for these workers is small and therefore the capitalization effects dominate – the slowdown in productivity growth raises European unemployment. While in the US and UK, the opposite is true.

Another important implication of our model is that public policies which alter either the demand and/or supply of labour can change the way growth affects unemployment. For example, we find that generous unemployment benefits make it more likely that a productivity slowdown will increase unemployment. This implies that the sign of the relationship between growth and unemployment depends upon institutional factors. That is, growth and labour market institutions could interact to generate the positive trend in European unemployment rather than work independently, as some studies implicitly assume[6]. This observation relates to another key result of our paper.

A widely-held view, as summarized by Manning (1992a, p.2), is that "it is very hard to

[6] A notable exception is Daveri and Tabellini (2000) who argue that higher labour taxes caused the labour productivity slowdown and a sharp increase in European unemployment.

tell a convincing story for the rise in unemployment in every OECD country based solely on these explanatory variables [union bargaining power, the generosity of the unemployment benefit system and perhaps some measure of mismatch]." This view is shared by Acemoglu (2000a, p.1). We re-examine this dominant view in our supply-side model by introducing endogenous growth. Specifically, we demonstrate that a small change in policy parameters can sometimes have a small effect on equilibrium unemployment, but can sometimes lead to dramatic and sustained increases in unemployment (and falls in productivity growth). Whether or not the effects of policy are magnified crucially depends on the degree of labour market imperfections. Generous unemployment benefits, distortionary labour taxes, and job protection measures tend to make the magnification of the effects of policy more likely. Moreover, the other side of the magnification of policy effects is a "ratchet effect" in the sense that the full reversal of policy which increased unemployment may not return it to the original level. We argue that these results accord with the sustained upward trend in Europe unemployment.

The present paper is structured as follows. Section 2 develops a basic model, and Section 3 identifies five effects of technical progress on workers' incentives to supply effort. In Section 4, we examine the effect of a slowdown in technical progress on unemployment. The impacts of public policy are considered, and the relevance of our model in explaining European unemployment is also discussed. Section 5 then extends the model by endogenising growth and we establish that a small change in a policy variable can have a magnified effect on unemployment. Section 6 concludes.

2 The Model

2.1 Technical Progress

To focus on the impact of technical progress on unemployment we develop a model in which technical progress induces labour reallocation. As a simple way of doing this, we consider technical progress in the form of expanding variety where innovations destroy jobs in old varieties, while creating jobs in new varieties. Initially, we shall assume that technical progress is exogenous, which, by definition, means that technology advances independently of economic factors, and the structure of the product market is irrelevant for the determination of economic growth. Therefore, for simplicity, we assume perfect competition in all markets other than the labour market.

There is a continuum of firms whose measure is one and time is continuous and denoted by t. A representative firm is endowed with the following production technology of final output (a numeraire).

$$y(t) = \int_0^{n(t)} Ax_j\,(t)^{\alpha}\,dj, \qquad 1 > \alpha > 0, \quad A > 0,\ i = H, L \tag{1}$$

where $x_j(t)$, is intermediate good j produced by workers on a one-to-one basis in period t. Technical progress is captured by an increase in $n\,(t)$ (expanding variety) according to[7]

$$g = \frac{\dot{n}(t)}{n(t)} \tag{2}$$

Firms maximize profits by equating the marginal product of labour to the real wage,

[7] The steady-state growth rate of y is given by $g_y = (1-\alpha)\,g$.

giving the labour demand functions:

$$\omega(t) = \frac{\alpha A}{[n(t)x(t)]^{1-\alpha}} \quad (3)$$
$$= \frac{\alpha A}{l(t)^{1-\alpha}}, \quad (4)$$

where $\omega(t) = w(t)/n(t)^{1-\alpha}$ are productivity-adjusted real wages and $l(t) = n(t)x(t)$ is the total level of employment in the economy. We define our productivity index as $T(t) = n(t)^{1-\alpha}$.

2.2 Labour Reallocation

The number of consumers-cum-workers is normalized to one, and within this population $l(t)$ workers are employed, while $u(t)$ workers are out of work. A salient feature of technical progress is that new jobs are created as old jobs are destroyed. To explain how these features work in our model, consider the labour demand function (3). $x(t)$ equals the number of workers used to produce a given variety, and it depends on the number of varieties of intermediate goods and the real wage. Log-differentiating the expression gives $-\dot{x}(t) = x(t)\left(g(t) + \frac{1}{1-\alpha}\frac{\dot{\omega}(t)}{\omega(t)}\right)$. The left-hand side is the number of jobs lost in a given variety in time interval dt. The right-hand side shows that the number of jobs lost is proportional to the number of jobs that existed with a coefficient determined by the rate of increase in real wages and technical progress. If none of the workers who are separated from firms could find jobs elsewhere, $-\dot{x}(t)$ would be equivalent to the number of workers becoming unemployed in a given variety. However, in line with the stylized facts discussed in the introduction, we assume that a fraction η of workers who are separated from firms do find new jobs elsewhere. Therefore, the number of workers joining the unemployment pool from a given variety is $-(1-\eta)\dot{x}(t)$. Therefore, the probability of a given worker becoming unemployed, $b(t)$, is given by

$$-(1-\eta)\frac{\dot{x}(t)}{x(t)} = (1-\eta)\left(g+\frac{1}{1-\alpha}\frac{\dot{\omega}(t)}{\omega(t)}\right) \tag{5}$$

$$= (1-\eta)\left(g-\frac{\dot{l}(t)}{l(t)}\right) \equiv b(t) \tag{6}$$

where (6) is obtained by using $\frac{\dot{\omega}(t)}{\omega(t)} = -(1-\alpha)\frac{\dot{l}(t)}{l(t)}$ from the labour market condition (4). When employment $l(t)$ is constant, we have $b(t) = (1-\eta)g$.

Next let us consider the flow of workers into and out of the unemployment pool. The number of workers becoming unemployed in a given variety during time interval dt is give by $x(t)b(t)$. Therefore, $n(t)b(t)x(t)$ is the total number of workers becoming unemployed in an economy as a whole. As regards unemployed workers who find jobs, their number is given by $a(t)u(t)$, where $a(t)$ is the probability of exiting unemployment at time t. Therefore, changes in employment during time interval dt are $\dot{l}(t) = a(t)u(t) - l(t)b(t)$, which gives, upon rearrangement,

$$a(t) = \frac{\eta\dot{l}(t) + (1-\eta)\,gl(t)}{u(t)}. \tag{7}$$

2.3 Workers' Effort Incentives

We now turn to consider how these flows in and out of unemployment affect workers' effort incentives. As regards preferences, all workers are identical in that they are risk-neutral and the intertemporal utility function is time-additive. This implies that the real rate of interest is given by the rate of time preference, ρ, which is common to all consumers. We assume that consumers will consume all their labour income, $w(t)$ as they receive it. They decide on whether or not to exert work effort when employed. The instantaneous utility function when employed is $w(t) - \varepsilon T(t)$. Consumers suffer disutility $\varepsilon T(t)$ if they exert effort, while shirking workers do not suffer this disutility. ($T(t)$ is the index of the level of productivity, defined above.)

Given these assumptions, the return to a worker from being employed and not shirking, denoted by $V^N(t)$, is defined by the following 'asset' equation

$$\rho V^N(t) = w(t) - \varepsilon T(t) + b(t)\left[V^U(t) - V^N(t)\right] + \dot{V}^N(t) \tag{8}$$

where $V^U(t)$ is the return from being unemployed. This equation says that the interest rate ρ times asset value $V^N(t)$ equals flow benefits ("dividends") from being an employed non-shirker. The flow benefits consist of a real wage $w(t)$, a disutility loss through not shirking $\varepsilon T(t)$, and expected capital gains/loss. The capital gains/losses arise as workers move from a state of employment to unemployment at rate $b(t)$ (defined above), and when the economy is growing due to technical progress.

The value of being an employed shirker, denoted by $V^S(t)$, follows a similar recursive equation

$$\rho V^S(t) = w(t) + [b(t) + s]\left[V^U(t) - V^S(t)\right] + \dot{V}^S(t). \tag{9}$$

Here the worker still enjoys the real wage but without suffering the disutility of effort.

The value of being unemployed is governed by the following recursive equation

$$\rho V^U(t) = zT(t) + a(t)\left[V^N(t) - V^U(t)\right] + \dot{V}^U(t). \tag{10}$$

$zT(t)$ denotes the opportunity cost of employment, including unemployment benefits. Since in equilibrium no worker shirks, the only way the worker can re-enter employment is if a technical innovation creates new jobs. The rate at which workers are selected from the pool of unemployed for employment is given by $a(t)$, defined above.

2.4 Five Incentive Effects of the Productivity Slowdown

The main objective of this section is to identify five effects of technical progress on workers' incentives to provide effort and their implications for equilibrium unemployment. Since the effort level of a shirker is zero, firms ensure that workers do not shirk, which requires $V^N(t) = V^S(t)$. Using this and equating (8) and (9) gives

$$v^N(t) - v^U(t) = \frac{\varepsilon}{s} \tag{11}$$

where $v^U(t) = V^U(t)/T(t)$ and $v^N(t) = V^N(t)/T(t)$ are productivity-adjusted values of being unemployed and employed respectively. This in turn implies

$$\dot{v}^N(t) = \dot{v}^U(t), \tag{12}$$

Equations (8) and (9) are then solved for productivity adjusted wages $\omega(t) = w(t)/n(t)^{1-\alpha}$, giving the individual's non-shirking condition (NSC):

$$\omega(t) = [\rho - (1-\alpha)\overset{\text{(i)}}{\overset{\downarrow}{g}}]\left(v^U(t) + \frac{\varepsilon}{s}\right) + \frac{\overset{\text{(ii)}}{\overset{\downarrow}{g}} - \eta\overset{\text{(iii)}}{\overset{\downarrow}{g}} + s + (1-\eta)\frac{\dot{u}(t)}{1-u(t)}}{s}\varepsilon - \dot{v}^N(t) \tag{13}$$

Taking $v^U(t)$ as given and ignoring terms involving time derivatives, there are three channels through which the productivity growth rate, g, affects $\omega(t)$. First, consider the term indicated by (i). This channel enters because the productivity slowdown results in decreased returns to employment, which workers are less reluctant to give up by being found to be shirking. Therefore through this channel the productivity slowdown tends to weaken the disciplinary effect of unemployment. We call this effect the *employment capitalization* effect of the productivity slowdown. This is analogous to what Aghion and Howitt (1994) call the capitalization effect of growth on labour demand, which makes it less profitable for firms to hire more workers as the productivity growth slows.

The second effect is indicated by (ii). This is what we call the *job destruction effect* of the productivity slowdown on workers' effort incentives. The intuition is as follows. $b(t)$ is the rate at which workers become unemployed, and its inverse $1/b(t)$ is the average duration of employment for workers. Further, equation (6) shows that $b(t)$ is increasing in g. That is, as g decreases, the employment duration rises, strengthening the disciplinary effect of unemployment. Hence firms can reduce $\omega(t)$.

The third effect, indicated by (iii) in (13), comes from the fact that an employed worker may find a new job elsewhere immediately after being separated from the firm. Through this channel, the productivity slowdown tends to shorten the duration of employment and makes it less costly to be found shirking. This weakens the disciplinary effect of unemployment, requiring firms to raise $\omega(t)$. We call this channel the *job retention effect* of the productivity slowdown. There are other effects which are realized through $v^U(t)$. (13) shows that any effects which raise (or lower) $v^U(t)$ tend to increase (or decrease) $\omega(t)$. We turn to those effects next.

Substituting (13) into (10) and using (11), we obtain

$$v^U(t) = \frac{z + \dfrac{\varepsilon}{s} \cdot \dfrac{-\eta \dot{u}(t) + (1-\eta)\ \overset{\text{(v)}}{\overset{\downarrow}{g}}\ (1-u(t))}{u(t)} + \dot{v}^U(t)}{\rho - (1-\alpha)\ \underset{\text{(iv)}}{\underset{\uparrow}{g}}}. \tag{14}$$

In (14), we can identify the fourth effect of changes in the rate of technical progress, g, on $\omega(t)$, indicated by (iv). A lower g increases the 'effective' discount rate that consumers capitalize future benefits as unemployed. That is, a slowdown in technical progress makes unemployment a less attractive option. We call this the *unemployment capitalization effect* of the productivity slowdown. This effect tends to reduce $v^U(t)$, and hence $\omega(t)$.

Note that the unemployment capitalization effect moves in the opposite direction of the employment capitalization effect identified above. Since the steady-state flow benefits to unemployment are necessarily less than the flow benefits from employment, the unemployment capitalization effect will be less than the employment capitalization effect.[8]

The fifth effect is indicated by (v) in (14). It operates through the job-acquisition rate $a(t)$ for the unemployed, which is increasing in g. Its inverse $1/a(t)$ is the average duration of unemployment. As g falls, this duration rises and, as a result, the disciplinary effect of unemployment strengthens. This is termed the *job creation effect* of the productivity slowdown. Due to this effect, v^U falls in (14), and therefore firms can reduce $\omega(t)$. Note that as *less* jobs are created, real wages fall. This prediction sharply contrasts studies of technical unemployment arising from the labour demand side, as they show that less jobs raise unemployment with a higher wage (see for example Aghion and Howitt (1994)).

2.5 Equilibrium Dynamics

Our assumption that the rate of detection of shirkers is less than infinite means that firms need to use a combination of higher wages and unemployment to provide workers with sufficient incentives not to shirk. Using (12), equations (14) and (13) can be rearranged into

$$\dot{u}(t) = -(1-u(t))\frac{(\omega(t)-z)\,\dfrac{s}{\varepsilon} + [(1-\alpha)-(1-\eta)\,\dfrac{1}{u(t)}]g - \rho - s}{\dfrac{\eta}{u(t)}+1}. \tag{15}$$

[8] If the flow benefits of employment were not greater than the flow benefits when unemployed, then there would be no disciplining effect from unemployment, and it would be impossible to prevent shirking.

This is the aggregate *NSC*. In steady state where $\dot{u}(t)=0$ this condition reduces to

$$\omega(t)=z+\varepsilon\frac{\rho-(1-\alpha)\overset{\overbrace{\text{(i),(iv)}}}{\underset{}{\downarrow}\atop g}+\overset{\overbrace{\text{(ii),(iii),(v)}}}{\downarrow\atop g}\times\dfrac{(1-\eta)}{u(t)}+s}{s}. \qquad (16)$$

Figure 3 depicts (16) and the labour demand function (4).

To examine equilibrium dynamics, suppose that initially unemployment is given by u^1.[9] Profit maximizing behaviour on the part of firms implies that the economy must be on the labour demand curve at every point in time, giving ω^1. Then, the economy moves along the labour demand function towards a long-run equilibrium. This analysis implicitly assumes that the adjustment of employment is not instantaneous. There are two possible reasons for gradual employment adjustment being a more plausible case, as suggested by Kimball (1989). First, a jump in aggregate employment requires synchronization across firms in both the timing and magnitude of hiring and firing. This seems unlikely in practice. Second, any adjustment costs would make a discontinuous change in employment extremely costly.

In fact, Georges (1994) proves that an equilibrium of gradual employment adjustment is obtained as a unique equilibrium as the adjustment costs go to zero. This result still applies to our model. In other words, if firms cannot implement a coordinated, instantaneous jump in employment levels to the long-run equilibrium then the adjustment towards equilibrium will necessarily be protracted. Intuitively, the process of adjustment affects the probabilities of entering and exiting unemployment and thereby workers' incentives to shirk. In Figure 3, as we move toward the new equilibrium real wages are lower than the new steady-state value as the rising rate of unemployment suppresses the no-shirking

[9] Note that on off-steady-state NSC intersects the demand schedule at u^1.

wage required to induce worker effort. This may explain the large degree of persistence observed in time-series data for unemployment (see, for example, the papers introduced by Henry et al (2000)).

Note that in the NSC (16), the unemployment and employment capitalization effects are combined as a single net effect, (i),(iv), as are the (ii) the *job destruction* effect; (iii) the *job retention* effect, and (v) the *job creation* effect. Also note that the last three effects (ii), (iii) and (v) are caused via the labour reallocation process. An immediate implication of this result is that any slowdown in productivity growth which does not result in worker reallocation will always increase $\omega(t)$ due to the net employment capitalization effect.[10]

3 Comparative Statics

3.1 Productivity Slowdown

We now turn to the long-run impact of a productivity slowdown on unemployment. There are two competing tendencies affecting the impact of g on the incentives to shirk. Hence the effect of a productivity slowdown on real wages is, in general, ambiguous. However, we can identify a critical level $\widehat{u}$ above and below which the growth effects on real wages differ:

$$-\frac{\partial \omega(t)}{\partial g}\begin{cases} > 0 & \text{for } u > \widehat{u} \\ = 0 & \text{for } u = \widehat{u} \\ < 0 & \text{for } u < \widehat{u} \end{cases} \qquad \text{where } \widehat{u} = \frac{1-\eta}{1-\alpha}. \tag{17}$$

[10] All effects due to labor reallocation disappear for $\eta = 1$. In (16), this means that l no longer affects ω. However, this is not true in general. For example, if we assume an exogenous rate of job separation unrelated to technical progress, ω will be a function of l, and one can easily verify that a lower g increases ω due to the net employment capitalization effect.

This shows that there exists a threshold level of unemployment $\widehat{u}$ below (above) which ω falls (rises) as the rate of productivity growth falls. This is demonstrated in Figure 4 where the solid NSC ($\dot{u} = 0$) pivots as a result of a slowdown in the rate of technical progress, to the dotted curve around a point corresponding to $\widehat{u}$. The intuition is simple. We showed that changes in the rate of technical progress create five types of effort incentive effect, the employment capitalization effect, the job destruction effect, the job retention effect, the unemployment capitalization effect and the job creation effect. However, within these effects there were basically two competing tendencies. Firstly, effects (i) and (iii) suggest that slower technical progress reduces the benefits of remaining in employment and thereby increases the need to prevent shirking through the disciplining effect of a high rate of unemployment. Second, effects (ii), (iv) and (v) imply that the lower rate of job separations induced by slower technical progress decrease the incentives to shirk, and therefore require less unemployment to discipline workers. When unemployment is sufficiently high, $u > \widehat{u}$, effects (i) and (iii) dominate effects (ii), (iv) and (v). The opposite holds for $u < \widehat{u}$.

Now it is obvious that a productivity slowdown can positively or negatively affect unemployment, depending on the position of the (initial) equilibrium unemployment rate u^* relative to the critical value $\widehat{u}$ (see Figure 4). If equilibrium unemployment is higher than $\widehat{u}$, a productivity slowdown increases unemployment. On the other hand, unemployment falls following a productivity slowdown if the equilibrium unemployment rate is lower than $\widehat{u}$. Moreover, the effect that the productivity slowdown has on unemployment tends to strengthen quantitatively as equilibrium unemployment departs in either direction from $\widehat{u}$. Clearly, the case of $u^* > \widehat{u}$ is consistent with most European countries which suffered a steep rise in unemployment coupled with the productivity slowdown. We discuss whether this case is plausible later.

3.2 Determinants of the Growth-Unemployment Link

We have shown that how productivity growth affects unemployment depends crucially on whether the initial unemployment is greater or smaller than the critical level $\widehat{u}$. In other words, the growth-unemployment link is determined by the relative positions of the $\dot{u} = 0$ and labour demand curves.

There are a number of factors, including public policy, which affect the $\dot{u} = 0$ curve. Figure 5 examines the case of increasing unemployment benefits (a higher z).[11] The policy shifts the $\dot{u} = 0$ curve leftward, and raises the real wage required to prevent shirking, increasing unemployment.[12] An intuition is that the policy makes unemployment relatively more attractive, creating increased incentives to shirk. Now suppose that the economy initially has an unemployment rate below the critical value $\widehat{u}$, as depicted in Figure 5, so that growth and unemployment are positively related in the long-run. After the policy is in place, unemployment may increase beyond the critical level $\widehat{u}$, and the economy goes into the region where growth increases unemployment. That is, the growth-unemployment link changes qualitatively due to more generous unemployment benefits.

Next let us consider the effect of labour income tax. Assume that labour income is taxed at a rate of τ. It can be easily verified that a higher τ shifts the $\dot{u} = 0$ curve leftward,

[11] For simplicity, we ignore the budget constraint facing the government.

[12] The movement towards the new equilibrium will be gradual as firms use the rising rate of unemployment during transition to lower the wages paid to workers below the new steady-state level without compromising the supply of effort.

as depicted in Figure 5.[13] Again, it should be clear that the policy may alter the nature of the growth-unemployment link from the positive relation to the negative one.

The preceding analysis concerns factors which affect the long-run NSC. The qualitative nature of how growth affects unemployment also depends on factors operating on the labour demand side. For example, consider payroll taxes paid by employers. An increase in the tax rate will reduce the labour demand. Then, starting from the situation of $u < \widehat{u}$, increased payroll taxes may move an economy into the region of $u > \widehat{u}$. One can easily verify this using Figure 5, moving the D curve leftward with the $\dot{u} = 0$ curve holding constant. Any factors that affect the position of the labour demand can change the nature of the growth-unemployment link.[14]

3.3 Discussion

An important implication of the preceding section is that public policy is an important determinant of how growth and unemployment are related. In particular, our analysis suggests that growth and unemployment are more likely to be negatively correlated in countries where unemployment subsidies are generous, labour income tax is high and job protection reduces the rate of entry into unemployment. This seems to accord with the experience of continental European economies. As Figure 1 shows, the productivity slowdown beginning in the early 1970s took place in both Europe and the US. However, the

[13] When labour income taxation is introduced, w in the value functions (8) and (9) is multiplied by $1-\tau$ where τ is a tax rate. Therefore, the right hand side of the aggregate NSC (16) is divided by $1-\tau$, and consequently the NSC in the figure shifts upward when τ is raised.

[14] There are many other factors that may affect the position of the labor demand curve. For example, increasing wage inequality between skilled and unskilled labor as is observed in the UK and the US is often attributed to increasing globalization and skill-biased technical progress (see, for example, Acemoglu (2000b)). Both globalization and skill-biased technical progress basically decrease labor demand for unskilled workers. This issue is formally examined in Leith and Li (2001).

European labour market witnessed a far stronger increase in the rate of unemployment, which cannot be explained by differences in the degree of productivity slowdown.

This observation is strengthened by a stylized fact distinguishing European labour markets from their US counterparts – the incidence of job-to-job reallocation. As discussed in the Introduction, a key stylized fact is that European workers are more likely to avoid a spell of unemployment by 'directly' entering a new job when their existing job is destroyed. This suggests that η, the fraction of workers finding a job following job separation, is greater in Europe than in the US. In turn, this implies that the European threshold level of unemployment $\widehat{u}$ is relatively smaller than that of the US, *cet. par.* This means, together with relatively generous welfare state provisions and high labour taxes, that an equilibrium unemployment rates in European countries are likely to be larger than the critical level $\widehat{u}$. This generates to the negative correlation between growth and unemployment, as plotted in Figures 1 and 2 . On the other hand, the US (and the UK to a lesser extent) may be characterized by an equilibrium unemployment closer or even to the right of the critical level $\widehat{u}$. These differences may explain contrasting growth-unemployment links in the two continents, as shown in Figures 1 and 2.[15]This reasoning seems consistent with what happened in the both continents.

Another aspect of this result which deserves emphasis lies in the fact that the growth-unemployment link arises due to interactions between growth and labour market institutions. In contrast, many studies on European unemployment seem to implicitly assume

[15]More intuitively, in both the US and Europe the productivity slowdown may have reduced the rate of growth of real wages, and thereby reduced the benefits of employment relative to unemployment cet. par. However, the increase in unemployment required to induce labour effort in the US as a result of this slowdown is partially offset by the reduction in labour turnover due to the productivity slowdown. While in Europe where workers enter a new job fairly quickly anyway, the reduction in technology-induced job separation is less significant and unemployment has to rise by more in Europe to maintain worker effort.

that institutional arrangements affect unemployment independently of growth or technical progress and have, instead, attempted to relate these changes in the natural or equilibrium rate of unemployment to labour market imperfections such as unemployment benefits and trade union activities (see, for example, Layard et al. (1991)). However, these studies led Manning (1992) to conclude that while these models can explain short-run movements in unemployment and some of the cross-country differences in rates of unemployment, they cannot fully explain the significant rise in European unemployment observed in the past decades.[16]

We argue that this failure may be due to the lack of explicit considerations regarding the interactions between growth and institutional factors which operate on the supply side of the labour market.[17]The analysis of such interactions may also provide a key to an understanding of persistence of high European unemployment in the past decades. In fact, our model can demonstrate that a "small" change in policy variables, e.g. unemployment subsidies, can lead to a significant rise in unemployment and can explain "ratchet effect" whereby when a policy that raises unemployment is reversed unemployment remains high. This is the topic of the next section.

4 Explaining the Persistence of Unemployment

An important feature of European unemployment is the persistence of a relatively high unemployment rate over decades. Frequently cited explanations of this feature include hiring and firing costs, capital shortages, insider union membership dynamics, and outsider

[16]For a discussion of this point, see references in Manning (1992a) and the papers introduced by Henry *et. al* (2000).

[17]Manning (1992) also makes a similar point.

disenfranchisement (see CEPR (1995)). In the context of the model developed above, persistent unemployment cannot be explained unless public policy instruments such as unemployment benefits remain high throughout the period. However, a widely-held view is that changes in public policy cannot fully explain sustained high unemployment in Europe. For example, state welfare provisions have become less generous in the UK since the 1980s, while, until more recently, its unemployment rate remained high.

This section re-visits the issue of policy effects on persistence of unemployment. More specifically, we are interested in whether a "small" policy change generates a kind of "ratchet effect" in the sense that the reversal of the policy shift does not reduce unemployment to an original level. For this purpose, we introduce endogenous growth into the model developed above.

4.1 Endogenous Growth

First, we derive the labour market equilibrium condition, using the aggregate *NSC* (15) and the labour demand function (3):

$$\dot{u} = \frac{1-u}{1+\eta/u}\left[\rho + \frac{s}{\varepsilon}\left(z + \varepsilon - \frac{\alpha}{(1-u)^{1-\alpha}}\right) + \left(\frac{1-\eta}{u} - (1-\alpha)\right)g\right]. \tag{18}$$

This equation defines equilibrium unemployment rate as a function of productivity growth g. In this sense, this condition captures the link running from growth to unemployment. The curve representing $\dot{u} = 0$ is depicted in Figures 6(a) and 6(b). It is monotonically increasing for $u < \widehat{u}$, and falling for $u > \widehat{u}$ with g going off to infinity at $\widehat{u}$.

Second, to endogenise productivity growth, we require another condition which defines the link running from unemployment to growth. Since we are not interested in the source of endogeneity of long-run growth (but its consequence), we make an assumption as simple as possible. Technical progress is assumed to be driven by learning-by-doing in a serendipitous way according to

$$g = g(1-u), \qquad g' > 0, \qquad g(1) < \infty, \qquad g(0) = 0. \tag{19}$$

This means that production activities generate new insights of how goods are produced, leading to productivity improvement.[18]

The equilibrium values of u and g are determined by two conditions (18) and (19), as shown in Figures 6(a) and 6(b). Note that the growth equation (19) must hold at each point in time, so that the economy moves along the $g(1-u)$ line before it reaches steady state. It can also be easily verified that the unemployment rate tends to move away from steady state in the directions indicated by arrows. Figure 6(a) shows the case where the long run equilibrium unemployment rate u^* is smaller than the critical value $\widehat{u}$. Note that the shaded area is irrelevant, since starting from this area is infeasible [19]. A similar interpretation holds for Figure 6(b).[20]It should be clear that a long-run equilibrium is unique for the case of $u^* < \widehat{u}$, as the $\dot{u} = 0$ and $g(1-u)$ curves have slopes with different signs. In contrast, both curves are monotonically falling in the case of $u^* > \widehat{u}$. Therefore,

[18]Note that (19) assumes that unemployment negatively affects growth, i.e. recessions are bad for long-run growth. This plausible relation is first mentioned by King and Rebelo (1988) and stressed by Stadler (1990) in his business cycles model. There are a number of models where learning-by-doing leads to the negative unemployment-growth link as an endogenous outcome, including Van Ewijk (1997) and Martin and Rogers (1997). However, one does not need to literally take the learning-by-doing interpretation of (19). It can be regarded as a reduced-form equation derived from more sophisticated assumptions. In fact, the basic results detailed below do not significantly change even if technical progress is driven by deliberate profit-seeking R&D (in which case the NSC should be modified to take into account R&D workers).

[19]Starting from $u > \widehat{u}$ would require a vertical or inverted NSC (see Figure 3), which is impossible given the assumptions made.

[20]The long-run unemployment rate can coincide with the critical value $\widehat{u}$. Figure 6 does not apply to this case. However, it can be verified that the long-run equilibrium is unique and stable. Since this is an uninteresting case, it will not be discussed further.

in general an odd number of equilibria exist in this case.[21]This property is exploited to explain a steep rise in unemployment in the coupled with the productivity slowdown of the recent past.

4.2 Policy Effects Can Be Magnified

There are several explanations for a dramatic rise in European unemployment, including generous unemployment benefits and high taxes. However, it is generally accepted that, on their own, these factors can explain only a relatively small part of the rise in unemployment. In contrast, we will show that a "small" policy shift (or alternatively exogenous shocks) can generate a dramatic impact on unemployment through the channels detailed in this paper.

We first examine the conventional case where a policy shift creates only a "small" increase in unemployment. Consider the case of $u^* < \widehat{u}$, depicted in Figure 6(a). Let us examine, as an example, the effect of a higher level of unemployment benefits. The policy shifts the $\dot{u} = 0$ curve downward, reducing growth and increasing unemployment. This qualitative result is commonly found in labour market models. What is worth stressing, however, is that the impact of the policy on unemployment (and growth) is "small" in the sense that a long-run equilibrium unemployment rate changes "continuously" as the policy changes.

However, this result is reversed in the case of $u^* > \widehat{u}$, which we argued above is more relevant to the European experience. In this case, there can be multiple equilibria. To

[21] This is because the $\dot{u} = 0$ curve goes to infinity as $u \rightarrow \widehat{u}$ from above and cuts the horizontal axis at a point less than one.

explore the implications of multiple equilibria, consider Figure 7 where the $\dot{u} = 0$ curve initially intersects the $g(1-u)$ curve at three points, E_1, E_1' and E_1''. To highlight our argument, suppose that the economy is initially at a point E_1 where growth is relatively high and unemployment is low. To fix our idea, one may wish to consider E_1 as corresponding to the European situation in the early 1970s. Starting from this point, let us examine the effect of higher unemployment subsidies. The policy shifts the curve upward, as illustrated by two dotted curves. Initially, the policy merges points E_1 and E_1' into E_2. Thus the economy moves to E_2, resulting in lower growth and higher unemployment. Qualitatively, the impact of the policy shift is still "small" in the afore-mentioned sense since the long-run equilibrium changes "continuously." This may represent the period of the early 1970s where an upward pressure on unemployment rate built up gradually. Now let us further increase unemployment benefits. Then, the low unemployment growth equilibrium E_2 disappears, and there is a unique long-run equilibrium with a higher unemployment rate. That is, changes in the long-run equilibrium involve discontinuity. In this sense, the impact of the policy is "large" due to the feedback effects of endogenous growth. A movement from E_2 to E_3 may represent the period of late 70s and 80s when the unemployment rate rose sharply. Although the above analysis focused on unemployment subsidies in highlighting the key mechanism, other policies, such as a higher labour income tax, qualitatively generate the same result.

Conventional wisdom suggests that the combination of several different factors generated a steep increase in unemployment. Indeed, an upward shift of the $\dot{u} = 0$ curve as depicted in Figure 7 can be caused by a higher interest rate ρ and a negative productivity (level) shock (a downward shift of labour demand). Moreover, the low unemployment equilibrium E_1 can also disappear in Figure 7 due to a downward shift of the $g(1-u)$ curve for a given $\dot{u}=0$ curve. Such a downward shift could be caused by a fall in the average skill-level of the labour force (see OECD (1994, Ch.7)), which reduces the effect of learning-by-doing (or lower R&D productivity). These are all cited as contributing factors to rising unemployment. A key message of this analysis is that the combination of "small" changes in policy or other exogenous factors makes it even more likely that unemployment rises very sharply due to discontinuous changes in the long-run equilibrium when $u^* > \widehat{u}$. This, as we argued above, is relevant to the Europe experience.

4.3 Persistent Unemployment Due to Ratchet Effects

Europe's welfare state provisions did not become significantly more generous between the 1960s and the 1980s. Despite this, European unemployment witnessed a dramatic rise and remained persistently high. This observation generally contributed to a view that the generosity of welfare state can account for only a part of persistent European unemployment. We re-examine this issue. In particular, we demonstrate that our model exhibits ratchet effects which leave unemployment high even after the policy is reversed. In fact, the ratchet effects are the other side of the policy effect magnification discussed in the preceding section.

Consider unemployment benefits for illustrative purposes. An equilibrium E_3 in Figure 7 was achieved after the policy moved a long-run equilibrium from E_1 to E_3. Now suppose that the policy is removed. Initially equilibrium moves to E_2' after a partial reversal of the policy. If the policy is fully reversed, the $\dot{u}=0$ curve moves back to the solid curve, and a long-run equilibrium E_1'' is achieved. Note that the economy does not revert back to the starting equilibrium E_1. As aggregate employment changes only gradually, so does unemployment, and the economy is "trapped" in a high unemployment equilibrium even after the policy is fully withdrawn.

The only way to attain the starting equilibrium E_1 is to reduce unemployment benefits further sufficiently below the initial level. In Figure 7, it means that the $\dot{u} = 0$ curve shifts leftward to the extent that a long-run equilibrium become unique, so that a high unemployment equilibrium is eliminated. This explains why reducing unemployment is so costly.

A crucial element of the ratchet effects and the policy effect magnification discussed above is the existence of multiple equilibria. In turn, it depends on the degree of non-linearity of the $\dot{u} = 0$ and $g(1-u)$ curves. How plausible are the requirements of such non-linearity for long-run multiple equilibria? At the current degree of abstraction, it is difficult to answer this question. However, the existence of high and low unemployment equilibria is one plausible line of research which can explain the persistence of high unemployment.[22]In fact, Manning (1992b) provides evidence that the rise in unemployment in Britain in the 1980s can be plausibly viewed as a move from a low- to a high-equilibrium unemployment rate.

It is also worth mentioning that the ratchet effect as an unemployment persistence mechanism is different from Saint-Paul (1995b) who also developed a dynamic efficiency wage model. In his model, intertemporally profit-maximizing firms take efficiency wages as costs of adjusting employment before a long-run equilibrium is reached. In our model, this aspect is not relevant to the ratchet effects, and in contrast to Saint-Paul, our model

[22]For example, see Diamond (1982) and Saint-Paul (1995a).

explains persistent unemployment as a long-run equilibrium.

5 Conclusion

Many authors have sought to explain the rise in European unemployment by examining the concurrent productivity slowdown. However, empirical studies that present cross-country evidence on this link tend to find very mixed results. This paper provides a theoretical explanation of the link between growth and unemployment that focuses on the supply-side of the labour market. This focus is in contrast to the usual emphasis in theoretical work on the demand side. We find that key characteristics of the European labour market -and in particular the high rates of job-to-job labour reallocation observed in Europe - mean that we are far more likely to find a negative relationship between growth and unemployment in Europe than in the UK or US.

Specifically, we identify five different effects of technical progress on workers' incentives to supply effort. These effects work in opposite directions and offset each other, depending upon the structure of the labour market. In both the US and Europe the productivity slowdown could be expected to have reduced the rate of growth of real wages, and thereby reduced incentives to provide effort due to the reduced benefits of employment relative to unemployment cet. par. However, the increase in unemployment required to induce labour effort in the US following this slowdown is partially offset by the reduction in labour turnover that the slower rate of technical progress also implies. While in Europe, where workers can often expect to by-pass a significant spell of unemployment, the reduction in technology induced job separation is less important to workers currently in employment and unemployment has to rise by more in Europe to maintain worker effort. Moreover, we demonstrate that once endogenous growth is taken into account, our model can account for both the sharp rise in European unemployment and its persistence. We argue that these findings confirm our view that the demand side of the labour market can only give a partial picture of the link between technical progress and unemployment, and a deeper understanding of the issues involved requires an analysis of the supply-side.

References

[1] Acemoglu, D. (2000a). "Credit Market Imperfections and Persistent Unemployment." MIT Department of Economics Working Paper No. 00-20.

[2] Acemoglu, Daron (2000b). "Technical Change, Inequality, and the Labour Market." NBER Working Paper No.7800.

[3] Aghion, P. and Howitt, P. (1992). "Growth and Unemployment", *mimeo*, University of Western Ontario.

[4] Aghion, P. and Howitt, P. (1994). "Growth and Unemployment." *Review of Economic Studies*, 61, 477-94.

[5] Bean, C. and Pissarides, C. (1993). "Unemployment, Consumption and Growth." *European Economic Review,* 37 , 837-859

[6] Boeri, T. (1999), "Enforcement of Employment Security Regulations, on-the-job search and unemployment duration", *European Economic Review*, No. 43, pp65-89.

[7] Cabellero, R. (1993), "Comment on Bean and Pissarides", *European Economic Review,* 37 , 855-859.

[8] CEPR (1995). *Unemployment: Choices for Europe*, Center for Economic Policy Research.

[9] Daveri, F, and Tabellini, G. (2000). "Unemployment, Growth and Taxation in Industrial Countries." *Economic Policy*, 30, 49-88.

[10] Diamond, P. (1982). "Aggregate Demand Management in Search Equilibrium." *Journal of Political Economy*, vol. XC, pp. 881-94.

[11] Eriksson, C. (1997). "Is There a Trade-off between Employment and Growth?" *Oxford Economic Papers*, 49, 77-88.

[12] Furuya, K. (2000). "Capital, Savings and Unemployment."Mimeo, University of California, Irvine.

[13] Galor, O. and S. Lach (1990). "Search Unemployment in an Overlapping Generations Setting", *International Economic Review,* 31, 409-419.

[14] Georges, Christopher (1994). "Adjustment Costs and Indeterminacy in Perfect Foresight Models." *Journal of Economic Dynamics and Control*, vol.19, pp.39-50.

[15] Henry, B., S. Nickell and D. J. Snower (2000), "Unemployment Dynamics and the Natural Rate: An Introduction", *Oxford Economic Papers*, No. 52 pp1-2.

[16] Hoon, H. Teck and Edmund, S. Phelps (1997). "Growth, Wealth and the Natural Rate: Is Europe's Jobs Crisis a Growth Crisis?" *European Economic Review*, 41, 549-57.

[17] Kimball, M. S. (1989). "Labor-Market Dynamics When Unemployment is a Worker Discipline Device", NBER Working Paper No.2967.

[18] King, R.G. and Rebelo, S. (1988). "Production, Growth and Business Cycles: II. New Directions." *Journal of Monetary Economics*, vol.21, pp.309-41

[19] Layard, R., S. Nickell and R. Jackman (1991), *Unemployment,* Oxford University Press.

[20] Leith, Campbell, and Li, Chol-Won. (2001). "Wage Inequality and the Effort Incentive Effects of Technical Progress." Manuscript, University of Glasgow.

[21] Manning, Alan (1992a). "Productivity Growth, Wage Setting and the Equilibrium Rate of Unemployment." London School of Economics, Centre for Economic Performance Discussion Paper No. 63.

[22] Manning, Alan (1992b). "Multiple Equilibria in the British labor Market: Some Empirical Evidence." *European Economic Review*, vol.XXXVI, pp.1333-66.

[23] Martin, P. and Rogers, C.A. (1997). "Stabilization Policy, Learning-by-doing, and Economic Growth." *Oxford Economic Papers*, vol.49, pp.152-66.

[24] Muscatelli, V. A. and P. Tirelli (2001), "Unemployment and Growth: Some Empirical Evidence from Structural Time Series Models", *Journal of Applied Economics, forthcoming*

[25] OECD (1997a). "Employment Adjustment, Workers and Unemployment", *Employment Outlook*, pp161-184. Organization for Economic Co-operation and Development.

[26] OECD (1997b). *The OECD Jobs Study: Evidence and Implications*, Organization for Economic Co-operation and Development.

[27] Phelps, E.S. (1994). *Structural Slumps*. Cambridge, MA: Harvard University Press.

[28] Pissarides, C. (1990). *Equilibrium Unemployment Theory*, Blackwell.

[29] Pissarides, C. and D. Mortensen (1998). "Technological Progress, Job Creation, and Job Destruction." *Review of Economic Dynamics*, 1, 733-53.

[30] Postel-Vinay, F. (1998). "Transitional Dynamics of the Search Model with Endogenous Growth." *Journal of Economic Dynamics and Control*, 22, 1091-1115.

[31] Saint-Paul, G. (1995a). "The High Unemployment Trap." Quarterly Journal of Economics, vol., pp.527-50.

[32] Saint-Paul, G. (1995b). "Efficiency Wages as a Persistence Mechanism." In H. Dixon and N. Rankin, eds., *The New Macroeconomics.* Cambridge: Cambridge University Press.

[33] Shapiro, C. and Stiglitz, J.E. (1985). "Equilibrium Unemployment as a Worker Discipline Device." *American Economic Review*, 74, 433-44.

[34] Stadler, G.W. (1990). "Business Cycles with Endogenous Technology." *American Economic Review*, vol.80, pp.764-78.

[35] Van Ewijk, C. (1997). "Entry and Exit, Cycles, and Productivity Growth." *Oxford Economic Papers*, vol.49, pp.167-87.

[36] van Schaik and Anton de Groot (1998). "Unemployment and Endogenous Growth." *labor,* 12, 189-219.

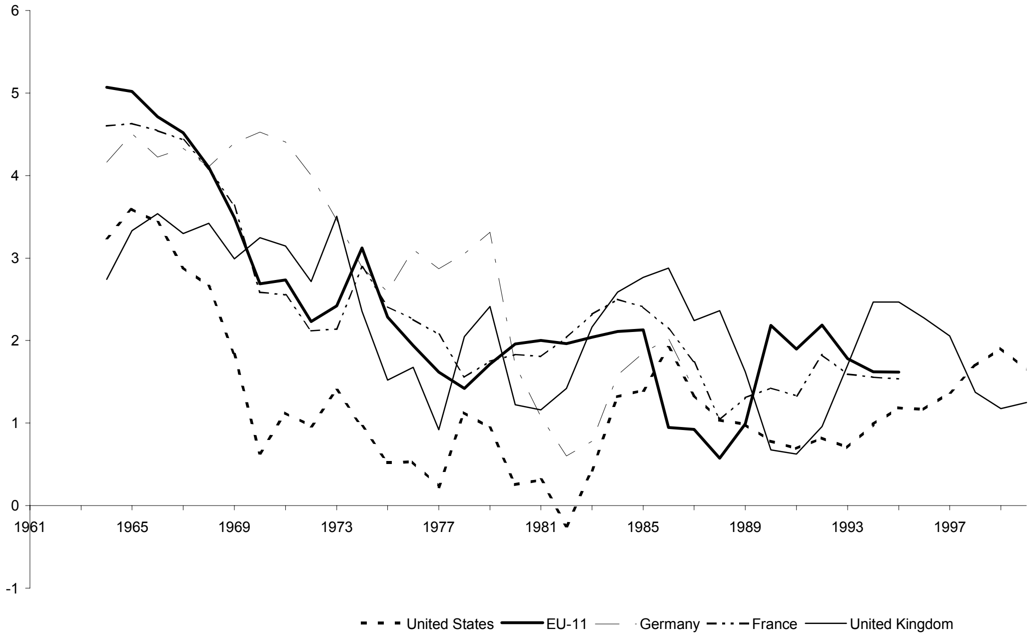

Figure 1: Productivity Growth Rates (%) in various OECD economies. The data has been smoothed using four year moving averages adn data for Germany post reunification as been omitted. Source Economic Outlook in the OECD Statistical Compendium 2001

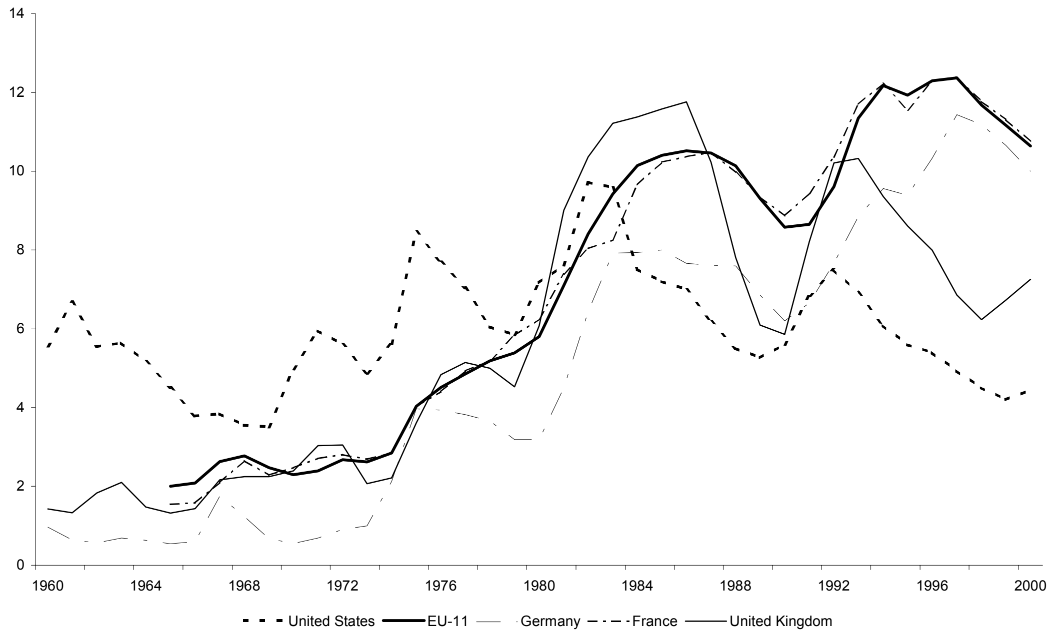

Figure 2: Unemployment rates in various OECD economies. Source: OECD Economic Outlook on the OECD Database CD-Rom, 2000.

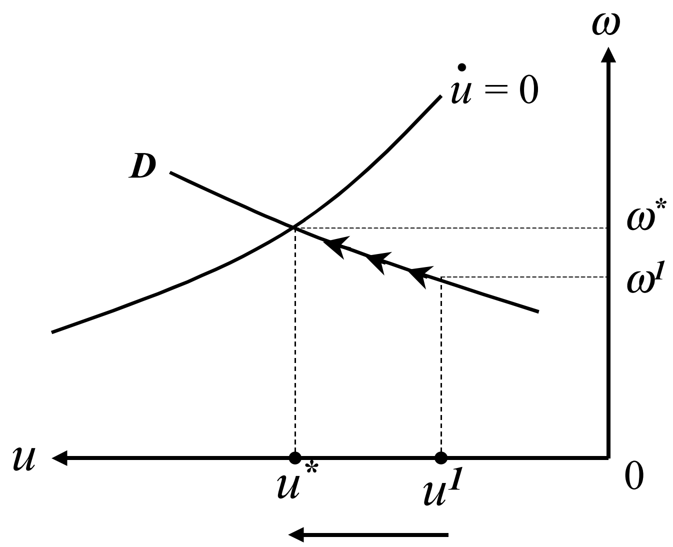

Figure 3: Equilibrium Dynamics

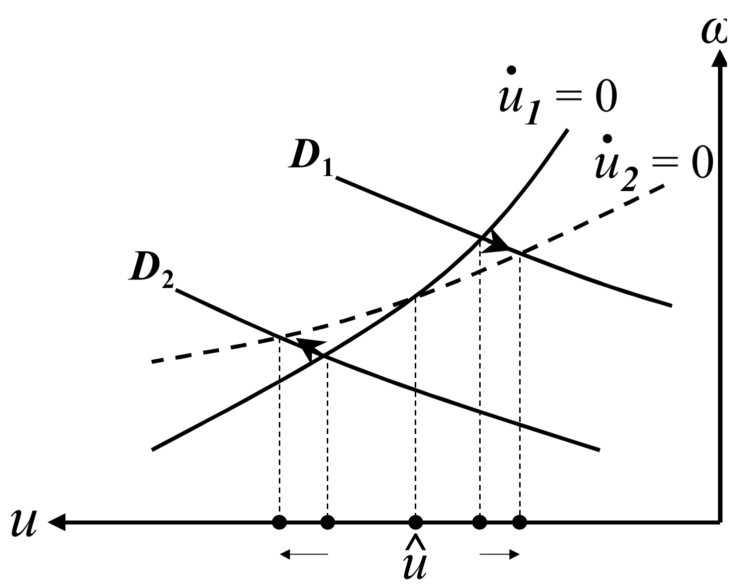

Figure 4: The Productivity Slowdown and the Equilibrium Rate of Unemployment.

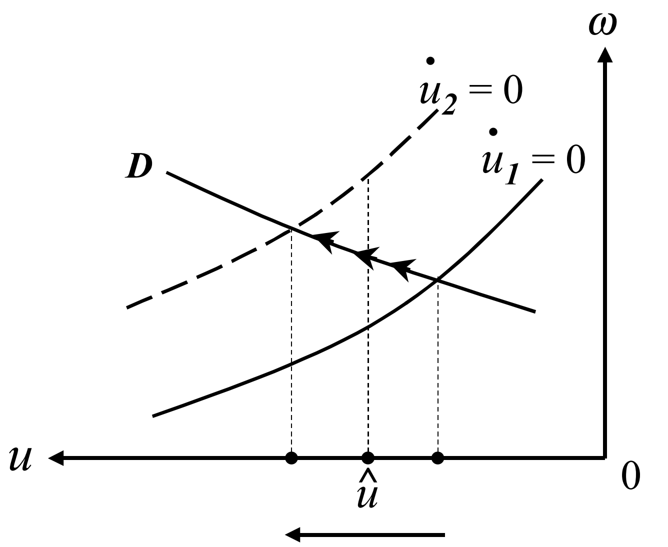

Figure 5: The Effects of Unemployment Benefits and Labour Income Tax

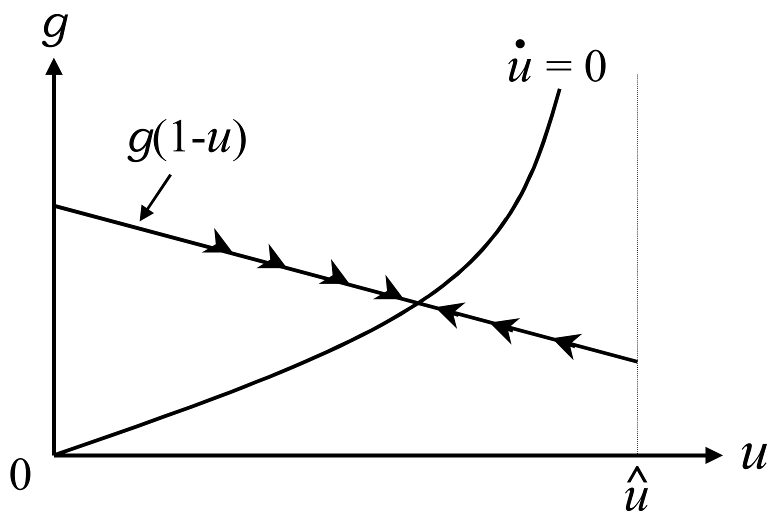

Figure 6(a): Endogenous Growth when $u < \widehat{u}$

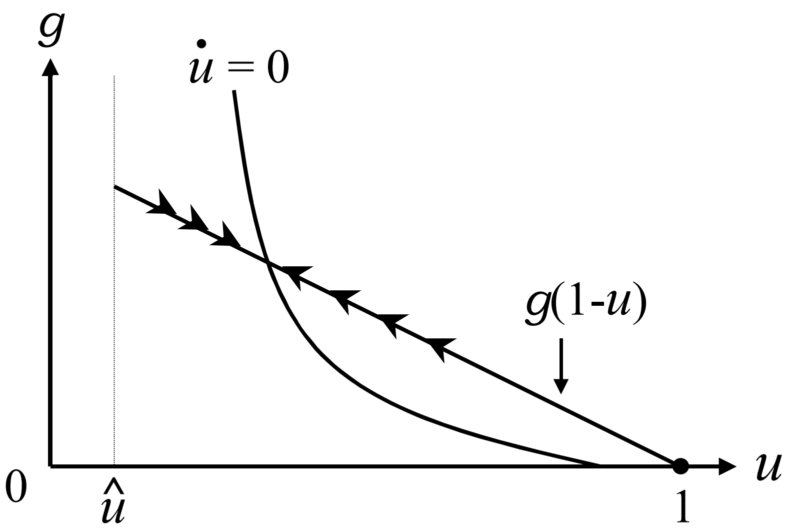

Figure 6(b): Endogenous Growth for $u > \widehat{u}$

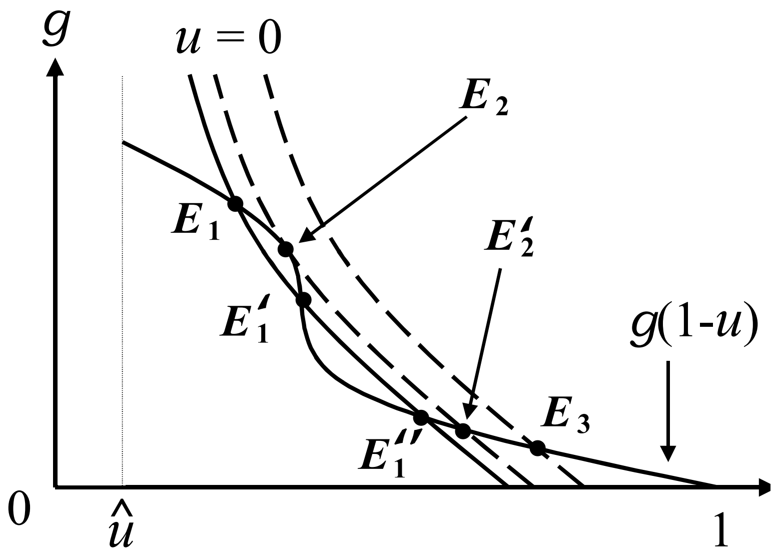

Figure 7: The Magnification and 'Ratcheting' of Policy Effects.