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INTRODUCTION

There has been an enormous amount of research, both theoretical and empirical, on the behaviour of unemployment in the OECD countries in the post-war period. In recent years, models based on imperfect competition in product and labour markets have been increasingly popular, and there is a widespread perception that these models are quite successful in explaining changes in unemployment both over time and across countries.

These models have generally been successful in explaining relatively short-run movements in unemployment (e.g. Layard and Nickell, 1985) and the cross-sectional variations in unemployment e.g. why some countries have had lower rises in unemployment than others (e.g. Calmfors and Driffill, 1988, Layard and Nickell, 1991). But it is much less clear that the models currently in use can explain the long-run rise in unemployment which occurred in *all* OECD countries after 1973, even the economies that are regarded as relatively successful. Almost two decades later, there is little sign of a return of unemployment rates to the levels experienced in the early 1960s and so it seems reasonable to conclude that the long-run equilibrium rate of unemployment has risen.

But most of the factors that are generally used to explain the short-run movements in unemployment, like aggregate demand shocks, taxes, competitiveness, oil price shocks etc., are predicted by the models currently in use to have only temporary effects on unemployment and to leave the long-run equilibrium unemployment rates unchanged (see below for a fuller discussion of the reasons for this). Only a limited set of factors like union bargaining power, the generosity of the unemployment benefit system and perhaps some measure of mismatch would be predicted to affect the long-run equilibrium unemployment rate. Although these variables can be used to explain the behaviour of unemployment in some countries for some periods, it is very hard to tell a convincing story for the rise in unemployment in every OECD country based solely on these explanatory variables.

One common line of escape from this problem is to argue that there is a large amount of persistence in the economy so that the short-run lasts a very long time. The popularity of insider-outsider and hysteresis models (Blanchard and Summers, 1986; Lindbeck and Snower, 1989) is, in large part, because of the potential that these models have for explaining the long-run rise in unemployment as a result of a series of long-lasting short-run shocks when we have no convincing equilibrium explanations for the long-run behaviour of unemployment.

The aim of this paper is to suggest one additional factor that might account for a rise in equilibrium unemployment rates. It argues that the reduction in productivity growth as reflected in a fall in the rate of growth of real consumer wages which occurred in most OECD countries in the mid 1970s, could be an important explanation of the long-run rise in unemployment in OECD countries. The claim is not that the reduction in productivity growth can fully explain the behaviour of unemployment: the factors identified by existing models and persistence are important. But it is claimed that 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.

Of course, an emphasis on the productivity slowdown in the discussion of unemployment is not new. Bruno and Sachs (1985) and Grubb, Jackman and Layard (1982), among many others, discuss the effects of the productivity slowdown on unemployment. But, it is probably fair to say that these authors see the slowdown as having only temporary effects on unemployment while workers' wage aspirations adjust downwards (which might take a very long time). The arguments presented below suggest that there is no reason to believe that the effects will only be temporary and that we cannot expect to see unemployment falling towards the levels of the 1960s unless sustainable real wage growth can be raised to the levels experienced then.

The plan of the paper is as follows. In the next section the reasons why existing models rule out any link between productivity growth and equilibrium unemployment is examined. The second section presents a union bargaining model in the spirit of Layard and Nickell (1985), but with one small modification, to show how easy it is to generate equilibrium links between unemployment and productivity growth. Long-run steady-state equilibrium and short-run adjustment is discussed. The model used here generates an Euler equation for real wages which is essentially an expectations-augmented Phillips Curve. In section 5 this Phillips Curve is estimated for 19 OECD countries to derive the magnitude of the effect of productivity growth on unemployment. For most countries the effect is important and substantial. Finally, section 6 suggests that other non-competitive labour market models would have similar links between growth and unemployment.

1. PRODUCTIVITY AND THE LONG-RUN EQUILIBRIUM UNEMPLOYMENT RATE

Why have the most popular imperfectly competitive macro models ignored a potential long-run equilibrium link between unemployment and productivity growth/capital accumulation? The reason is that most authors have followed the argument clearly stated by Layard and Nickell (1985, p.74) who wrote that "we might expect ... capital to have no long-run effects. If this were not the case then ... a steady rise in the capital stock would lead to either a continuing rise or a continuing fall in unemployment. Given that this does not appear to have been the consequence of capital accumulation ... in Britain over the last 150 years, we feel justified in our expectation". Another way of putting this point is to argue that productivity/capital accumulation is probably unbounded, while the unemployment rate is, at the very least, bounded between zero and one so that the two cannot be related in the very long-run.

It is hard to disagree with this argument. One might summarise it as "a one-off change in productivity should have no effect on long-run equilibrium unemployment" or "in an economy experiencing steady-state growth, the unemployment rate should be constant". However, the models that have tended to be used to analyse unemployment actually assume something much stronger than this neutrality proposition about the effects of productivity growth and capital accumulation on equilibrium unemployment. The "typical" model of the long-run equilibrium rate of unemployment is represented in Fig. 1. Equilibrium is at the intersection of a price-setting or labour demand schedule, PP, (whose slope will depend on returns to scale but is drawn here as upward-sloping implying decreasing returns) and a wage-setting schedule, WW, which replaces the labour supply schedule which one would use in a competitive model. The important point is that the WW schedule is vertical, its position depending on a limited range of variables like union power, the replacement ratio etc. (which have been discussed in the introduction) but not including any variables related to productivity growth and capital accumulation[1]. With productivity growth the PP schedule will move up but, because the WW schedule is vertical, unemployment is unchanged and only the real wage changes. Now what this long-run equilibrium version of the theory implies is that the unemployment rate is independent of the entire time path of a capital accumulation and productivity growth whatever that may look like[2].

This kind of super-neutrality property of the equilibrium unemployment rate with respect to productivity is much stronger than the original neutrality proposition that in an economy experiencing steady-state growth, the unemployment rate should be constant. There is nothing theoretically absurd a priori about claiming a link between the equilibrium unemployment rate and the rate of productivity growth as both these variables are probably bounded. And the model presented below shows how easy it is to generate such an effect in a standard theoretical framework.

2. THE MODEL

The aim of this section is to show how easy it is to generate equilibrium links between productivity growth and unemployment in a standard theoretical framework. It is worth noting that if we want a model that satisfies the neutrality of unemployment with respect to productivity but not superneutrality, a necessary condition is that the model be dynamic. So, in this section we present a dynamic version of a bargaining model used by Layard and Nickell (1985). However, in a later section, we show how an efficiency wage model predicts essentially the same result. So, not too much emphasis should be placed on the particular model presented here.

(a) The Firm

We assume that firm i has a production function of the form:

$$Y_{it} = F(A_{it} \cdot N_{it}, K_{it}) \qquad (1)$$

where Y_{it} is output, N_{it} employment, K_{it} the capital stock, and A_{it} a measure of labour-augmenting technical progress. We assume that the firm faces a downward-sloping demand curve of the form:

$$Y_{it} = (P_{it}/P_t)^{-\frac{1}{\theta}} G(P_t, \underline{X}_t) \qquad (2)$$

where P_{it} is the firm's price, P_t some aggregate price level and G() a measure of real aggregate demand which depends on P_t (e.g. through real money balances) and some other exogenous variables $\underline{X}_t$.

Combining (1) and (2), we can write real profits as

$$\Pi_{it} = G(P_t, \underline{X}_t)^{\theta} . F(A_{it} \cdot N_{it}, K_{it})^{1-\theta} - \left(\frac{W_{it}}{P_t}\right)(1+\tau_t)N_{it} - C_t K_{it} \qquad (3)$$

where W_t is the wage that is received by workers and hence τ_t represents the tax wedge between consumer and producer real wages, and C_t represents the real user cost of capital.

We are going to assume that wage-setting takes place after K_t has been set but before N_{it} is determined so, by maximising (3) with respect to N_{it} we can derive a labour demand curve

$$N_{it} = N\left(\frac{W_{it}}{P_t}(1+\tau_t), A_{it}, K_{it}, G_t\right) \tag{4}$$

and a maximised profit function:

$$\Pi_{it} = \Pi\left(\frac{W_{it}}{P_t}(1+\tau_t), A_{it}, K_{it}, G_t\right) \tag{5}$$

(b) The Union

The question of the appropriate form of a union utility function is an open one (particularly in a dynamic model) but we will adopt a functional form which is reasonably flexible and has been popular in recent work (e.g. Layard and Nickell, 1990; Hoel, 1991). We will assume that union utility, U_{it} is given by:

$$U_{it} = N_{it}^{\psi}[V_{it} - V_t^a] \tag{6}$$

where V_{it} is the value of employment in this firm and V_t^a is some measure of the value of alternatives available elsewhere in the economy to workers who lose their jobs. These are specified in more detail below. ψ represents the union's preferences for employment relative to wages.

The value functions will be defined in the following way:

$$V_{it} = \left(\frac{W_{it}}{P_t}\right) + \delta_t E_t\left[q_{t+1}.V^u_{t+1} + (1-q_{t+1})V_{t+1}\right] \tag{7}$$

where δ is the discount factor and q_{t+1} is the probability of a worker employed this period being unemployed next period. Depending on one's view of capital markets, one could either interpret δ as being the rate of time preference in workers' utility functions or as a market discount rate. In the empirical work below, we do experiment with including real interest rates but given that many workers faced severe capital market constraints over much of the period, it is perhaps not surprising that the results are mixed. $V_{t+1}{}^u$ is the value of being unemployed next period and V_{t+1} is the value of being employed at (t+1). This is written as being independent of i as we assume that wage-setting is only for one period.[3] We will denote by V_t the value of being employed in other firms at date t; this will be of the same form as (7) but with W_{it} replaced by W_t, the wage elsewhere in the economy. The value of being unemployed at date t, V^u_t, will be given by:

$$V^u_t = \left(\frac{B_t}{P_t}\right) + \delta_t.E_t\left[s_{t+1}.V^u_{t+1} + (1-s_{t+1}).V_{t+1}\right] \tag{8}$$

where B_t is the level of nominal unemployment benefits and s_{t+1} is the probability of a worker who is unemployed this period remaining unemployed next period.

Finally let us assume that workers made redundant from firm i at date t do have some employment possibility elsewhere at date t so we can write V^a_t in (6) as[4]:

$$V^a_t = \eta_t V_t + (1-\eta_t)V^u_t \tag{9}$$

(c) Wage-Setting

We assume that W_{it} is set to maximise a Nash Bargain where the fall-back position of both union and firm is zero, i.e.

$$W_{it} = argmax\ U_{it}^{\chi_t}\ \Pi_{it}^{1-\chi_t} \tag{10}$$

where χ_t is the bargaining power of the union[5]. The first-order condition for the maximisation of (10) with respect to W_{it} can be written as:

$$\chi_t \psi . \frac{\partial \log N_{it}}{\partial W_{it}} + \frac{\chi_t}{V_{it}-V_t^a} + (1-\chi_t). \frac{\partial \log \Pi_{it}}{\partial W_{it}} \tag{11}$$

After some re-arrangement this can be written as:

$$\left(\frac{W_{it}}{P_t}\right) = \mu_t(V_{it} - V_t^a)$$

$$where\ \ \mu_t = \psi . \epsilon_N + \frac{(1-\chi_t)}{\chi_t} \epsilon_\pi \tag{12}$$

where ε_N, ε_Π are the elasticity of employment and profits respectively with respect to the wage. In what follows, we will regard these elasticities as constants although this will only be exact if the revenue function is Cobb-Douglas (Manning, 1991b, describes one empirical strategy if this is not the case). Now, using (9) and the fact that $V_{it} = V_t + (W/P)_{it} - (W/P)_t$, we can write (12) as

$$\left(\frac{W_{it}}{P_t}\right) = \frac{\mu_t}{\mu_t-1}\left[\left(\frac{W_t}{P_t}\right) - (1-\eta_t)(V_t-V_t^u)\right] \tag{14}$$

where for existence of equilibrium we require $\mu_t > 1$, which we assume to be satisfied. This type of condition is usual in union models and ensures that it is not optimal to forever raise wages. Essentially it will be violated if the labour demand curve is sufficiently inelastic, unions have a lot of bargaining power and do not care much about employment.

Now let us impose the symmetry condition that $W_{it} = W_t$. (13) then becomes

$$\left(\frac{W_t}{P_t}\right) = \mu_t(1-\eta_t)(V_t - V_t^u) \qquad (15)$$

To get a wage equation in terms of observables we need to eliminate $(V_t\text{-}V_t^u)$. Using (7) and (8) we have:

$$\left(V_t - V_t^u\right) = (1-\rho_t)\left(\frac{W_t}{P_t}\right) + \delta_t E_t\left[(s_{t+1}-q_{t+1})(V_{t+1}-V_{t+1}^u)\right] \qquad (16)$$

where $\rho_t = (B_t/W_t)$ is the replacement ratio at date t. So far the model has been entirely conventional (see Layard and Nickell, 1990; Hoel, 1991; Manning, 1991a). But the conventional approach now proceeds by assuming that, in equilibrium $(V_t\text{-}V_t^u) = (V_{t+1}\text{-}V_{t+1}^u)$, using (16) to solve for $(V_t\text{-}V_t^u)$ and then substituting the result in (15) to derive a static wage equation which, it is simple to check, is vertical as drawn in Fig. 1. However, if there is economic growth in the economy, we would not expect $(V_t\text{-}V_t^u)$ to ever equal $(V_{t+1}\text{-}V_{t+1}^u)$. The novelty of this paper simply lies in not imposing this restriction. Using (15) to eliminate $(V_t\text{-}V_t^u)$ from (16) and (15) put forward one period to eliminate $(V_{t+1}\text{-}V_{t+1}^u)$ we arrive at the following Euler equation for wages which forms the basis for the subsequent analysis:

$$[1-\mu_t(1-\eta_t)(1-\rho_t)]\left(\frac{W_t}{P_t}\right) = \delta_t\mu_t(1-\eta_t)E_t\left[\frac{s_{t+1}-q_{t+1}}{\mu_{t+1}(1-\eta_{t+1})}\cdot\frac{W_{t+1}}{P_{t+1}}\right] \qquad (17)$$

(17) is not quite a convenient form for analysing the dynamics of wages and unemployment, as the unemployment rate enters (17) only indirectly through (s_t, q_t, η_t) which represent the probabilities of various labour market transitions. There are many assumptions that we might make about these probabilities but, for the illustrative theoretical analysis below, we consider only one.

First assume that with probability q employed workers at date t-1 quit their existing job. However they do have a chance of immediately finding employment elsewhere and we will assume that their probability of staying unemployed is $\gamma . s_t$ where s_t, it should be recalled, is the probability of workers unemployed at date t-1 remaining unemployed at date t. If employers discriminate against the long-term unemployed then we would expect that $\gamma < 1$. Consequently the probability of a worker employed at (t-1) not being employed at t, which we have denoted by q_t, is given by:

$$q_t = q \cdot \gamma s_t \tag{18}$$

Now s_t is determined by the number of job openings relative to the number of job-seekers and must satisfy:

$$(1-u_t) - (1-q)(1-u_{t-1}) = (1-s_t)u_{t-1} + q(1-\gamma s_t)(1-u_{t-1}) \tag{19}$$

where u_t is the unemployment rate.

The left-hand side of (19) is employment at date t minus the number of date (t-1) employees who have not quit. The right-hand side is the number of previously unemployed workers times the probability of their leaving unemployment, ($1-s_t$) plus the number of quitters $q(1-u_{t-1})$, times the probability of their leaving unemployment ($1-\gamma s_t$). Rearranging (18) we can derive:

$$s_t = \frac{u_t}{q\gamma + (1-q\gamma)u_{t-1}} \tag{20}$$

(20) says that the probability of unemployed workers remaining unemployed is increasing in current unemployment, decreasing in lagged unemployment (as there are then fewer job-seekers today) and increases as γ, the amount of discrimination in hiring, falls. This is all very sensible.

Finally we need a model of η_t, the probability that workers made redundant will find a job. The simplest assumption is that they face the same re-employment probability as job quitters so that:

$$\eta_t = 1 - \gamma s_t \tag{21}$$

Combining (18), (19), (20) and (21) we can write the wage equation (17) as:

$$\left(\frac{W_t}{P_t}\right) = \frac{\delta_t \mu_t u_t (1-q\gamma)}{q\gamma + (1-q\gamma)u_{t-1} - \mu_t \gamma (1-\rho_t) u_t} \cdot E_t\left[\frac{1}{\mu_{t+1}} \cdot \frac{W_{t+1}}{P_{t+1}}\right] \tag{22}$$

In what follows, we will analyse the long-run steady-state equilibrium, the dynamics of short-run adjustment, and the empirical estimation of (22).

One feature worthy of note in (22) is that it is not just current unemployment but also lagged unemployment that affects wage-setting. The significance of lagged unemployment in empirical wage equations has often been interpreted as evidence in favour of insider-outsider theories. The model presented here, which is a quite standard union model with no membership dynamics, should warn us that such a conclusion may not be justified. The intuition for the presence of lagged unemployment in (22) is simple. In union models the probability of leaving unemployment ((1-s) in the current model) is an important determinant of wage pressure. The current level of unemployment determines the number of job-seekers but the change in unemployment (which is the negative of the change in employment) tells us about the number of job-openings for the job-seekers. So, knowing the current level of unemployment is not sufficient to know the current probability of leaving unemployment; one also needs to know how unemployment is changing; hence the presence of lagged unemployment in (22).

3. STEADY-STATE EQUILIBRIUM

First let us consider the long-run equilibrium rate of unemployment implied by (22) when all variables are constant, except real wages which we assume to grow at a rate g. We will treat g as exogenously given, independent of the level of unemployment but, if one believes in endogenous growth models one might want to also have a relationship between g and u. We will assume that the government alters the level of real unemployment benefits to keep the replacement ratio constant. If the government does not do this, e.g. because the level of real benefits is constant, the replacement ratio will be asymptotically zero and we can then apply the equation below. In steady-state (22) can be written as:

$$u = \frac{q\gamma}{\delta(1-q\gamma)}\left[1 + g - \frac{1}{\delta} + \frac{\gamma\mu(1-\rho)}{\delta(1-q\gamma)}\right]^{-1} \tag{23}$$

From this it is easy to work out the following, not very surprising comparative statics:

(i) an increase in the replacement ratio ρ increases the unemployment rate,

(ii) an increase in union power, which decreases μ (see (12)) increase the unemployment rate,

(iii) an increase in the rate of growth, g, reduces the unemployment rate,

(iv) if one interprets δ as a market discount factor, an increase in the interest rate increases the unemployment rate.

The first two predictions are unsurprising; the third one is the main focus of interest here as it demonstrates the claim in the introduction that the rate of productivity growth which will affect the rate of growth of real wages, should be expected to have an effect on unemployment. What is the intuition for this result? One of the features of the model presented here is that the more valuable a job is relative to unemployment in the future, the lower the level at which current wages will be set as workers would like to raise the probability of enjoying those future rents. The only way they can do this is to raise their current employment chances by reducing wages. Economic growth raises the future rents relative to current wages and hence encourages current wage moderation which, in turn, is reflected in a lower equilibrium rate of unemployment. Some weak empirical evidence consistent with this mechanism is Lawrence and Lawrence (1985) who argue that in declining industries (where the probability of future employment is low) current wages seem to rise (although they provide a different explanation for this finding).

However, although there is undoubtedly some effect from productivity growth to unemployment, a natural question to ask is how large it is. Differentiating (23) with respect to g, we can derive:

$$\frac{du}{dg} = -u^2 \cdot \frac{\delta(1-q\gamma)}{q\gamma} \qquad (24)$$

Because of the presence of u^2 on the right-hand side we would expect (24) to be very low unless q or γ are close to zero. So, in the model examined here, unless labour turnover is very low, or employers discriminate very strongly against the unemployed in hiring, we would expect the rate-of-growth effects to be small. However, the current model is a simple one in many respects, and this should ultimately be an empirical question. As we shall see, the empirical evidence suggests that in many countries rate-of-growth effects might be quite large. The theoretical models do not predict this, probably because in the interests of analytical convenience, they assume too much homogeneity on the part of the unemployed and this leads to an overstatement of the sensitivity of real wages to unemployment (a similar argument has been made by Blanchard and Diamond, 1991, in the context of a matching model).

Of course, the precise form of some of these results depends on the somewhat arbitrary assumptions made about the labour market transitions. One might wonder how general they are. Using (17), a sufficient condition for a rise in g to reduce equilibrium unemployment is that a rise in unemployment increases (s-q) i.e. increases the difference in the probability of being unemployed this period between workers unemployed and employed last period. This is a condition normally required in models of this type to obtain conventional comparative statics results like (i) and (ii) above. In reality, we would expect this condition to be satisfied as the outflow rate from unemployment seems to be more cyclical than the inflow rate to unemployment.

Finally, it is worth discussing the effect of the rate of interest on the equilibrium unemployment rate if one interprets the discount factor in the workers' value functions as 1/(1+r). An increase in the rate of interest raises the equilibrium unemployment rate as it reduces the present value of the future rents from a job and hence reduces current wage moderation.

One other point that emerges from (23) is that the equilibrium unemployment rate can be written as a function of (g-r), the difference between the growth rate and the interest rate. If one believed that the economy always satisfied the 'golden rule' in which r=g, rate-of-growth effects would be eliminated. However, this is probably not a good empirical assumption particularly as the access of workers to capital markets is often very poor, and the empirical evidence presented below suggests that it is hard, in any case, to find empirical evidence for the view that the workers' discount factor should be equated with real interest rates.

4. SHORT-RUN DYNAMICS

Now let us briefly consider the short-run adjustment process implied by the model presented above. It is important to bear in mind that the short-run dynamics are very sensitive to the assumptions made about labour market transitions so that this should be thought of as an illustration only.

To analyse the dynamics of the economy we need to introduce a labour demand curve. First, let us consider the demand side of the economy. Let us assume that the production function in (1) is Cobb-Douglas

$$Y_{it} = (A_{it}N_{it})^{\alpha}K_{it}^{\beta}$$

Using this in (3), maximising with respect to N_{it} and K_{it} and using the equilibrium condition that $G_t = Y_t$ we can derive the following marginal revenue product conditions:

$$\alpha(1-\theta)A_t^{\alpha}N_t^{\alpha-1}K_t^{\beta} = \frac{W_t}{P_t}(1+\tau_t) \tag{25}$$

$$\beta(1-\theta)A_t^{\alpha}N_t^{\alpha}K_t^{\beta-1} = C_t$$

Eliminating K_t and log-linearising, using lower-case letters to denote logs we can derive the following aggregate labour demand curve:

$$(w-p)_t = -\tau_t + \log \alpha(1-\theta) + \frac{\beta}{1-\beta} \log \beta(1-\theta) + \frac{\alpha}{1-\beta} a_t$$

$$- \frac{1-\alpha-\beta}{1-\beta} l_t + \frac{(1-\alpha-\beta)}{1-\beta} u_t \tag{26}$$

where we have used the approximate $n_t = l_t - u_t$ where l_t is the log of the labour force.

For future use, let us define x_{1t} to be the right-hand side of (26) ignoring the unemployment term so we have:

$$(w-p)_t = x_{1t} + \frac{1-\alpha-\beta}{1-\beta} u_t \tag{27}$$

Of course this aggregate labour demand curve ignores sluggish adjustment of factor demands which are, in reality, very important. However the focus of interest here is on the dynamics induced by the wage equation so we stick to (27).

Turning now to the wage equation, we will use a log-linearised version of (22). Of course, this log-linearisation cannot be exact and there are well-known problems with treating the expectations terms in (22) in this way. However, for the case of constant returns to scale all that follows can be said in an exact equivalent way using (22) directly so the errors are probably not too great. Log-linearising (22) we get something like:

$$E_t\Delta(w-p)_{t+1} = \lambda_0 - \lambda_{11}u_t + \lambda_{12}u_{t-1}$$

$$+\lambda_{21}E_t\Delta \log \mu_{t+1} - \lambda_{22} \log \mu_t \tag{28}$$

$$= x_{2t} - \lambda_{11}u_t + \lambda_{12}u_{t-1}$$

where x_{2t} is all the terms on the right-hand side of (28) apart from the unemployment terms. Using (27) to eliminate the real wage terms from (28) we can derive the following difference equation for unemployment:

$$E_t\left[\Delta x_{1t+1} + \frac{1-\alpha-\beta}{1-\beta}\,\Delta u_{t+1}\right] = x_{2t} - \lambda_{11}u_t + \lambda_{12}u_{t-1} \tag{29}$$

The solution to this can be written as:

$$u_t = \gamma_1 u_{t-1} + \gamma_2 E_t \sum_{i=0}^{\infty} \gamma_3^i (x_{2t+1} - \Delta x_{1t+1}) \tag{30}$$

where (γ_1, γ_2, γ_3) can be shown to be given by:

$$\gamma_3 = \frac{1-\alpha-\beta}{1-\beta} \cdot \frac{1}{\lambda_{12}} \cdot \gamma_1$$

$$\gamma_2 = \frac{1}{\lambda_{12}} \cdot \gamma_1 \tag{31}$$

$$\lambda_{12} - \frac{1-\alpha-\beta}{1-\beta}\,\gamma_1(1-\gamma_1) - \gamma_1\lambda_{11} = 0$$

It is straightforward to check that for the case of long-run non-decreasing returns to scale i.e. $\alpha+\beta \geq 1$, there is a unique (positive) value of γ_1 between -1 and 1 so that there is a unique stable adjustment path. It is also easy to check that $|\gamma_3| < 1$ as well.

To solve for the actual time path of unemployment one does need to make some assumptions about the dynamic processes driving x_1 and x_2. However, the simplest case to focus on is probably constant returns to scale when (29) can be written as:

$$u_t = \frac{\lambda_{12}}{\lambda_{11}} u_{t-1} + \frac{1}{\lambda_{11}} (x_{2t} - E_t \Delta x_{1+t})$$

$$u_t = \frac{\lambda_{12}}{\lambda_{11}} u_{t-1} + \frac{\lambda_{21}}{\lambda_{11}} E_t \Delta \log \mu_{t+1} - \frac{\lambda_{22}}{\lambda_{11}} \log \mu_t \qquad (32)$$

$$+ \frac{1}{\lambda_{11}} E_t \Delta \tau_{t+1} - \frac{1}{\lambda_{11}} E_t \Delta a_{t+1}$$

There are several things worth noting about (32). First, it confirms that high expected productivity growth leads to lower unemployment. Second, variables like the tax wedge only have an effect on unemployment to the extent that changes in taxes are perceived to be temporary. Unanticipated changes in taxes that are expected to be permanent will have no effect on unemployment. Temporary changes in taxes will also have effects on unemployment that persist through time because of the autoregressive process that unemployment follows[6]. However the effect of tax changes is somewhat perverse. Unexpected temporary cuts in taxes which lead to expectations of future tax rises act to raise unemployment. This is because expected future tax rises reduce the expected growth of real wages and this tends to increase unemployment.

The effect of temporary changes in taxes is the opposite of what one might expect. One way of thinking about this result is to think of the wage equation (27) as "intertemporal substitution for unions"[7]. In contrast to the competitive model of intertemporal substitution where higher current (future) wages is associated with higher (lower) employment, here higher current (future) wages is associated with lower (higher) employment. As mentioned at the beginning of this section, one should be cautious about thinking of this a general result as it may be a product of the particular assumptions made about the labour market transitions. However, it should always be remembered that our conclusions about the dynamics of the wage effects in the wage equation and the equilibrium effects of productivity growth are not sensitive to different assumptions about labour market transitions (see (22)).

5. EMPIRICAL IMPLEMENTATION

(a) Specification

Now let us consider how we might try to implement the theory described above to provide quantitative estimates of the effects of productivity growth on equilibrium unemployment. One could estimate something like the non-linear Euler equation for real consumer wages in (22). However, it is probably simpler (and makes comparisons with other studies easier) to estimate a log-linear Euler equation of the form:

$$E_{t-1}\Delta(w-p)_t = \lambda_0 - \lambda_1(L).E_{t-1}u_t + E_{t-1}\lambda_2 x_t \qquad (33)$$

where λ_1 is some distributed lag on unemployment (which will depend on the transition probabilities, and x_t is a vector of other explanatory variables which the theory would predict should include the replacement ratio, a measure of union bargaining power and perhaps interest rates. The approximations in moving from (22) to (33) have been discussed above.

(33) is essentially an expectations-augmented Phillips Curve so that the model presented here can be interpreted as a theoretical foundation for the Phillips Curve. Given the enormous empirical literature on the estimation of Phillips Curves, we

know that something like (33) fits the data. However, Phillips Curves have fallen out of fashion as aggregate wage equations in recent years and one might wonder how (33) relates to specifications of the aggregate wage equation that have become more popular. Manning (1991b) looks in more detail at the comparison between (33) and other popular wage equations and argues that (33) is more suitable as a foundation for empirical analysis.

(b) Data and Estimation

(33) was estimated for 19 OECD countries using annual data for the period 1956-85. I am very grateful to George Alogoskoufis for making his data available. The dependent variable was the rate of growth of real consumer wages which were computed by deflating weekly earnings in manufacturing by consumer prices and a measure of the direct tax rate[8]. For three countries, Italy, New Zealand and Spain, direct tax rates were not available for the whole period so real consumer wages were computed by omitting the tax variable. The rate of growth of consumer wages for each country is presented in Figure 2. As expected most countries show a marked decline in real consumer wage growth in the late 1970s although there are exceptions; for example Finland and the United Kingdom show no obvious decline.

For the unemployment rate we used the OECD standardised unemployment rate which is plotted for each country in Figure 3. We assumed that the unemployment term in (33) was linear, although for some countries a non-linear term did work better (and is predicted by the theory). As discussed above, the theory provides little guidance about the appropriate form of the distributed lag on unemployment in (33). After some experimentation, we settled on including current and lagged unemployment which seemed to work best for virtually all countries.

One of the problems with cross-country econometric modelling is that relatively few structural variables are generally available. In this case, for example, we have no time series on replacement ratios or measures of union power for most countries and the effects of these variables is confined to the equation error. However, we do have data on real interest rates and experimentation with both short- and long-term interest rates was carried out for every country. The theory predicts that high real interest rates raise real wage growth. We also experimented with including the change in inflation as a regressor to capture errors in forecasting inflation (c.f. Layard and Nickell, 1985, *inter alia*) but with no success. For some countries, dummy variables were included for particular episodes in those countries' history; these are reported in the notes to Table 1.

Turning to the estimation (33) was estimated using instrumental variables replacing expectations by their realised values. The earliest instruments used were dated (t-2) because of potential time aggregation problems and they are listed at the bottom of Table 1. From the conceptual point of view, the instruments should include variables that affect the labour demand curve and this influences our choice of instruments.

(c) Results

Table 1 reports the results. Equation (i) for each country includes both current and lagged unemployment parameterised as the level and the change. From the theory presented above, we would expect a negative coefficient on both variables (as would the insider-outsider theory). Equation (ii) omits lagged unemployment as it is insignificant for most countries. Equation (iii), presented only for some countries, shows the "best" results obtained when trying to find effects of the real rate of interest. For some countries, the short-term interest rate worked best; for others it was the long-term one. This is marked with an S or an L respectively.

The estimated coefficients on the level of unemployment are, as expected, significantly negative in most countries in most specifications. In common with other studies (e.g. Bean, Layard and Nickell, 1986; Newell and Symons, 1987; Alogoskoufis and Manning, 1988) the estimated coefficients differ widely across countries from, for example, -0.38 in Canada and the Netherlands to -4.05 in Switzerland and -5.14 in Japan. These differences will be important in explaining the different unemployment response of different countries to the productivity slowdown. For many countries the estimated coefficient on unemployment is not very sensitive to specification but for others it is. For example, the coefficient on unemployment in the Irish wage equation is only significantly negative if one excludes the change in unemployment (which is very significant) or includes long-term real interest rates. And achieving a significantly negative coefficient on unemployment in the US wage equation seems to require the inclusion of real interest rates. Generally, the inclusion of real interest rates in those countries where they are significant does seem to increase the estimated sensitivity of wage growth to unemployment. There are three countries for which it proved impossible to obtain a sensible negative level effect of unemployment on wage growth. For both Finland and the United Kingdom, only the change in unemployment seems to be important, while for Norway no unemployment terms seem to matter at all. This last finding is inconsistent with many previous studies that have found a high sensitivity of real wages to unemployment in Norway, but is consistent with the detailed study of Rodseth and Holden (1989). It may be that the model presented above, which is a model of decentralised wage bargaining, is not appropriate for countries with more centralised bargaining arrangements like Norway and Finland. In this context, it should perhaps be noted that the estimated effect of unemployment in Sweden, while large in absolute terms, is very poorly determined. However, this could not explain the poor showing of the UK wage equation[9].

The coefficient on the change in unemployment is significantly negative in only a few countries; Finland, Germany, Ireland, Netherlands and the UK. In many countries the estimated coefficient is positive although insignificant. Thus we find that hysteresis effects are much less important in wage-setting than other studies have suggested (although the interpretation given to the effects of lagged unemployment here is different in any case). As the change in unemployment is insignificant in most countries we omit it in equation (ii) for each country.

Finally, let us consider the effect of interest rates. The countries for which interest rates were found to be significant are presented in Table 1. Sometimes short-term interest rates worked best; sometimes long-term ones. Only in Belgium were interest rates found to have a significantly negative effect on wage growth. These mixed results are not very surprising as it is quite likely that the workers concerned faced substantial capital market constraints in many of these countries.

Finally, it is worth commenting on the overall fit and performance of the wage equations presented here. For each equation we present a goodness-of-fit measure, a test of residual autocorrelation and a test of the over-identifying restrictions. Two points stand out. First, the overall fit of the equations is often quite low, and there is evidence of a certain amount of serial correlation in the residuals. Neither of these findings should surprise us very much. As discussed above, we have omitted many important structural variables from our wage equation (because we do not have the data) and these variables are likely to be important in explaining the variation in wage growth and to persist over time causing some serial correlation in the residuals of our estimated equations. However, we have found, as our theory would predict, that there is for most countries a significantly negative relationship between real wage growth and unemployment. This implies that if we have a productivity slowdown, which will be reflected in a slowdown in the rate of growth of real wages, we would expect a permanent rise in unemployment. The size of this effect is the subject of the next section.

(d) The Productivity Slowdown and the Rise in Unemployment

Although the results presented in Table 1 do show that there is a negative correlation between real wage growth and unemployment, they do not make very clear how the model can explain the difference in unemployment experience across countries. For example, a higher rise in unemployment in one country might be because the slowdown in productivity growth was larger or because unemployment was more sensitive to a given fall in productivity growth. This section compares experiences across countries. To do this in a complete way, one would want to measure the productivity slowdown directly, and then use a labour demand curve to work out the implications for the rate of growth of real consumer wages. We do not do this here; instead we treat the observed time path of real consumer wages as exogenously given by the labour demand curve (which will be exact if there is constant returns to scale) and work out what the predicted response of unemployment is using the wage equations of Table 1. Implicitly, we assume that we have something like the picture drawn in Fig.4 where the fall in real wage growth from Δa_1 to Δa_2 associated with an identical fall in productivity growth causes a rise in unemployment from u_1 to u_2.

There is a problem in choosing the time period for the comparison. From Figures 2 and 3 we can see that different countries experienced a slowdown in real wage growth and high unemployment at different times. The choice of time period can affect one's interpretation of the cross-country experience. However, we pick two sub-periods which work for most countries; 1957-65 for a period representative of the good times of the early post-war period, and 1977-85 for a period representative of the bad times experienced later on.

The first column of Table 2 presents the slowdown in the average consumer wage growth comparing 1977-85 with 1957-65.[10] The variation in the experience of different countries is quite marked. The second column presents the long-run elasticity of unemployment with respect to real wage growth as estimated from various equations in Table 1. In contrast to the predictions of the theoretical model, some of these elasticities are very large. For example, for many of the EEC countries a one percentage point fall in the rate of real wage growth is predicted to raise the long-run equilibrium unemployment rate by between 1 and 2 percentage points. However, for a country like Japan the estimated elasticity is only about 0.2.

The third column of Table 2 multiplies the first two columns to derive a measure of the predicted rise in unemployment as a result of the slowdown in real wage growth. It is useful to compare this with the actual rise as presented in column

4. The changes in unemployment in columns 3 and 4 are not identical because of the other factors affecting unemployment (which are consigned to the equation error in our model) and because the economies are not in a true steady state. But there is a positive correlation between the predicted and actual changes in unemployment.

The cross-country experience is very varied. Some countries e.g. Canada which had a small reduction in consumer real wage growth are predicted to have suffered a large increase in unemployment because wage-setting is not sensitive to unemployment. But a country like Japan where wage growth is very sensitive to unemployment managed to absorb a large reduction in real wage growth without much of an increase in unemployment.

This means that, as other authors have suggested, a high sensitivity of real wage growth to unemployment in wage-setting will enable a country to adjust to the productivity slowdown without suffering large increases in unemployment. One might try to explain, as others have done, the sensitivity of real wages to unemployment in wage-setting in terms of corporatism etc. (e.g. see Layard and Nickell, 1991, Alogoskoufis and Manning, 1988, *inter alia*). This interesting speculation is left to others.

But one should not conclude that differences in the unemployment sensitivity of wage-setting are the only important factor in explaining the different rises in unemployment across countries: differences in the slowdown in real wage growth seem equally important. The correlation between the actual rise in unemployment and the slowdown in real wage growth is 0.61 while the correlation between the rise in unemployment and $(1/\lambda_1)$ is 0.80. It should be noted that the correlation between the slowdown in real wage growth and $(1/\lambda_1)$ is -0.24.

6. ALTERNATIVE THEORETICAL MODELS

We have examined the equilibrium relationship between unemployment and growth in the context of a union bargaining model. The purpose of this section is to suggest that other labour market models would be expected to have similar predictions so that even if one does not like the particular theoretical story that has been told here, one should not be surprised by the existence of an equilibrium link between unemployment and growth.

There are some existing models with such a link. For example Pissarides (1990, ch.2) presents a search model in which a higher rate of growth reduces equilibrium unemployment. In his model, the effects come through the demand for labour in a model with employment adjustment costs, whereas I have emphasised the effect on wage-setting.

An efficiency wage model can generate a similar prediction. For example, Malcomson (1984) presents a model in which the promise of future wage growth (through promotion) enables employers to deter shirking while paying a lower wage. If there is general wage growth, a similar effect will be at work; workers will be keen not to lose their job and the high future wages associated with it so they do not need to be paid such a high wage today to stop them shirking. This raises the demand for labour today and reduces unemployment. This argument is demonstrated more formally in the Appendix using a Shapiro-Stiglitz (1984) shirking model.

One should not regard an equilibrium link between growth and unemployment as a curiosity, a prediction only of very strange theoretical models; its is likely to be a robust prediction of a variety of labour market models.

7. CONCLUSIONS

In this paper, we have argued that one cannot tell a convincing story of the rise in OECD unemployment without mentioning the slowdown in productivity and real wage growth in the 1970s. It was argued that whereas most authors have regarded any effects of the slowdown on unemployment as temporary while "real wage resistance" is overcome, there is no theoretical reason to believe that this is the case. This point was illustrated using a dynamic union bargaining model. This model also suggested that a Phillips Curve was appropriate as an empirical wage equation. For most OECD countries such a wage equation works well, and the slowdown in real wage growth does appear to have been important in explaining the rise in unemployment.

In this paper we have implicitly treated the rate of productivity growth as exogenously given, independent of the rate of unemployment. This is reflected in Fig.4 where the dynamic labour demand curve is drawn as horizontal. This analysis suggests that unless sustainable real wage growth can be restored to the levels experienced in the 1960s, it is going to be very difficult to reduce unemployment. In the days when growth was thought of as an exogenous process, this observation might not have been very helpful. But now that growth is commonly seen as endogenous and possibly subject to influence by government policy, it may well be the case that governments can reduce unemployment through policies to promote growth.

A natural extension of the model presented here would be to endogenise the rate of growth and allow it to vary with unemployment. If, for example, a high level of unemployment depresses growth, it would be fairly simple to construct a model with multiple equilibrium growth rates and unemployment rates. Then, a fall in the rate of growth need not be caused by an exogenous change; it could simply be a move from one equilibrium to another. We leave the explanation of the fall in the rate of productivity growth to another paper.

FOOTNOTES

* London School of Economics and Centre for Economic Performance. I would like to thank the discussants at the Conference on Unemployment and Wage Determination held at the National Bureau for Economic Research in October 1991, Mark Bils and Bill Dickens, for their comments. I would also like to thank Asbjorn Rodseth and seminar participants in Oslo, Oxford, the University of East Anglia, the London School of Economics, Warwick and the European Economic Association Conference at Cambridge for comments on an earlier version of this paper. I am grateful to the Leverhulme Trust for financial assistance with this project. The Centre for Economic Performance is financed by the Economic and Social Research Council.

1. Note that this is not the way in which these models are normally presented, but Manning (1991b) argues that it is more helpful to think of these models in this way.

2. Note also, that this implies that other variables that shift the labour demand curve like taxes, competitiveness and other input prices will also have no effect on the long-run equilibrium unemployment rate.

3. Manning (1991a) looks at the situation where this is not the case and it is important to model direct moves from one firm to another.

4. Problems of existence of equilibrium can arise if we assume that redundant workers have no current re-employment possibility as the duration of unemployment for such workers is then bounded below at one period no matter what the unemployment rate in the rate of the economy.

5. For a fuller discussion of the foundations of (10) see Manning (1991a). The general results presented in this paper are robust to some changes in the bargaining solution used e.g. a different treatment of outside options.

6. The importance of the change in the wedge rather than the level has been emphasized by Newell and Symons (1987). One could interpret something like (32) as providing a theoretical justification for this.

7. This is quite a good way of looking at the model presented here. In competitive labour supply models, intertemporal substitution is used as a way to get an elastic short-run supply schedule but an inelastic long-run one. In exactly the same way, here we have an elastic short-run wage-setting schedule but a vertical long-run one as drawn in Fig. 1.

8. Manufacturing rather than aggregate wages were used as this is the only wage series available in the OECD data set.

9. However, the more detailed study of the UK aggregate wage equation contained in Manning (1991b) that includes variables like the replacement ratio and measure of union power does find a significantly negative effect of the level of unemployment on real wage growth.

10. Finland, Norway and the UK are omitted from Table 2 as they have no significant unemployment effects in Table 1.

APPENDIX

A Dynamic Shirking Model

The purpose of this appendix is to show how a dynamic shirking model of the Shapiro and Stiglitz (1984) form can generate an Euler equation for wages very similar to the bargaining model presented in the main text. The model is deliberately kept very simple but the qualitative conclusions are likely to be the same in more complicated models.

First consider the value functions for an employed worker who does not shirk and an unemployed worker:

$$V_t = \left(\frac{W}{P}\right)_t (1-e) + \delta F_t\left[q_{t+1}V^u_{t+1} + (1-q_{t+1})V_{t+1}\right] \tag{a1}$$

$$V^u_t = \rho\left(\frac{W}{P}\right)_t + \delta E_t\left[S_{t+1}V^u_{t+1} + (1-S_{t+1})V_{t+1}\right] \tag{a2}$$

(a1) and (a2) are the same as (7) and (8) except that we assume that workers who work have to put in effort e (assumed constant) and that their current utility is given by the first-term on the right-hand side of (a1).

Taking (a2) from (a1) we obtain

$$(V_t - V^u_t) = \left(\frac{W}{P}\right)_t (1-e-\rho) + \delta E_t\left[(S_{t+1} - w_{t+1})(V_{t+1} - V^u_{t+1})\right] \tag{a3}$$

where, for a meaningful equilibrium we require $\rho < 1-e$ so that employed workers are better-off than unemployed workers.

Now, consider the no-shirking condition. Assume that a worker who shirks puts in zero effort, and that there is a probability ξ of being caught and fired. If not fired, the pay-off will be $[V_t + e(W/P)_t]$. If fired, we assume that there is some probability of getting employment elsewhere immediately (one should think of this as an approximation to a continuous time model) and that the expected utility is given by (9). Using this information, the value function for a shirking worker will be:

$$V_t^s = (1-\xi)\left[V_t + e\left(\frac{W}{P}\right)_t\right] + \xi\left[\eta_t V_t + (1-\eta_t)V_t^u\right] \qquad \text{(a4)}$$

In equilibrium it must be the case that employers set wages so that workers are indifferent between shirking and working, i.e. so that $V_t = V_t^s$. Replacing V_t^s in (a4) and re-arranging yields:

$$(V_t - V_t^u) = \frac{(1-\xi)e}{\xi(1-\eta_t)}\left(\frac{W}{P}\right)_t \qquad \text{(a5)}$$

Using (a4) and (a5) put forward one period in (a3) yields the following Euler equation for real wages:

$$\left[(1-\xi)e - \xi(1-\eta_t)(1-e-\rho)\right]\left(\frac{W}{P}\right)_t$$

$$= \delta(1-\xi)(1-\eta_t)E_t\left[\frac{s_{t+1}-q_{t+1}}{1-\eta_{t+1}}\left(\frac{W_{t+1}}{P_{t+1}}\right)\right] \qquad \text{(a6)}$$

which is of the same qualitative form as (17).

TABLE 1

Estimated Real Wage Equations, 1956-85

Dependent Variable $\Delta (w-p)_t$

Method of Estimation: Instrument Variables

	c	u_t	Δu_t	r_{t-1}	R^2	DW	BAS
AL(i)	0.023	-0.44	-1.17		0.40	1.92	0.42
	(2.06)	(1.42)	(1.23)				
(ii)	0.020	-0.36			0.54	1.52	0.83
	(2.13)	(1.38)					
AU(i)	0.074	-1.64	-1.46		0.19	1.81	1.42
	(4.86)	(2.56)	(0.82)				
(ii)	0.076	-1.75			0.19	1.68	1.50
	(5.14)	(2.81)					
(iii)S	0.088	-2.46		0.80	0.29	1.65	1.10
	(5.84)	(3.61)		(1.97)			
BE(i)	0.060	-0.66	0.58		0.61	1.19	1.89
	(10.45)	(6.65)	(1.18)				
(ii)	0.060	-0.62			0.60	1.10	1.98
	(10.18)	(6.52)					
(iii)L	0.066	-0.51		-0.38	0.63	1.47	1.12
	(10.58)	(3.96)		(2.28)			
CA(i)	0.039	-0.38	0.64		0.18	1.15	0.98
	(4.24)	(2.73)	(1.48)				
(ii)	0.036	-0.32			0.17	1.14	1.29
	(4.02)	(2.39)					
DK(i)	0.061	-0.69	0.90		0.47	1.99	0.70
	(9.13)	(5.50)	(1.68)				
(ii)	0.060	-0.64			0.50	1.79	1.17
	(9.32)	(5.40)					
(iii)L	0.059	-1.03	1.29	0.42	0.56	2.01	0.40
	(9.55)	(4.99)	(2.52)	(1.97)			
FN(i)	0.025	-0.09	-1.98		0.16	1.59	1.27
	(2.35)	(0.29)	(2.82)				
(ii)	0.026	-0.22			0.00	1.39	2.43
	(2.25)	(0.67)					
(iii)S	0.025	-0.20		0.25	0.10	1.36	2.15
	(2.23)	(0.64)		(1.58)			
FR(i)	0.053	-0.65	1.38		0.40	1.27	1.15
	(7.08)	(2.71)	(0.82)				
(ii)	0.051	-0.49			0.44	1.28	1.36
	(7.60)	(3.51)					

TABLE 1 (cont.)

	c	u_t	Δu_t	r_{t-1}	R^2	DW	BAS
GE(i)	0.046	-0.40	-2.72		0.27	2.05	1.06
	(6.18)	(1.41)	(2.67)				
(ii)	0.052	-0.79			0.25	1.41	2.96
	(7.14)	(3.21)					
(iii)S	0.042	-0.63	-2.12	0.96	0.37	1.92	0.86
	(5.56)	(2.13)	(2.10)	(1.62)			
IR(i)	0.014	0.32	-3.10		0.25	2.10	0.66
	(0.86)	(1.20)	(3.18)				
(ii)	0.048	-0.34			0.08	1.65	2.15
	(3.41)	(1.84)					
(iii)L	0.058	-0.58		0.42	0.16	1.75	1.88
	(4.07)	(2.67)		(1.66)			
IT(i)	0.100	-0.85	0.74		0.14	1.19	1.85
	(4.47)	(2.69)	(0.77)				
(ii)	0.096	-0.78			0.19	1.11	2.15
	(4.57)	(2.66)					
JA(i)	0.134	-5.14	-0.27		0.46	1.12	1.74
	(7.28)	(5.15)	(0.84)				
(ii)	0.134	-5.15			0.48	1.11	1.75
	(7.47)	(5.28)					
(iii)L	0.166	-6.87		0.36	0.51	1.02	1.07
	(7.21)	(5.49)		(2.05)			
NL(i)	0.056	-0.38	-1.72		0.25	1.48	2.37
	(6.30)	(2.10)	(2.11)				
(ii)	0.055	-0.50			0.23	1.23	4.25
	(6.21)	(2.93)					
(iii)L	0.051	-1.07		1.26	0.22	1.21	1.59
	(5.42)	(3.48)		(2.27)			
NW(i)	0.032	-0.42	-1.29		0.00	1.07	2.29
	(1.24)	(0.35)	(0.79)				
(ii)	0.040	-0.85			0.00	1.07	2.12
	(1.73)	(0.79)					
NZ(i)	0.019	-0.87	1.43		0.12	1.72	1.03
	(2.79)	(2.17)	(0.68)				
(ii)	0.019	-0.78			0.09	1.72	0.99
	(2.89)	(2.03)					
SP(i)	0.076	-0.42	1.12		0.06	1.91	1.39
	(6.39)	(1.42)	(0.56)				
(ii)	0.074	-0.27			0.09	1.89	1.43
	(6.50)	(1.94)					

TABLE 1 (cont.)

	c	u_t	Δu_t	r_{t-1}	R^2	DW	BAS
SW(i)	0.046	-1.26	-0.83		0.06	1.76	1.05
	(2.03)	(1.17)	(0.53)				
(ii)	0.050	-1.45			0.05	1.74	1.01
	(2.30)	(1.42)					
SZ(i)	0.030	-4.05	2.09		0.22	1.62	0.77
	(7.04)	(3.04)	(0.72)				
(ii)	0.030	-3.68			0.25	1.60	0.86
	(7.17)	(3.07)					
(iii)S	0.034	-4.26		0.47	0.24	1.49	0.57
	(6.52)	(3.29)		(1.59)			
UK(i)	0.026	0.03	-1.26		0.10	2.11	0.68
	(3.42)	(0.20)	(1.97)				
(ii)	0.026	-0.09			0.00	1.94	1.00
	(3.36)	(0.61)					
US(i)	0.017	-0.17	-1.01		0.03	1.34	2.54
	(1.18)	(0.70)	(1.90)				
(ii)	0.018	-0.20			0.00	1.23	5.44
	(1.30)	(0.86)					
(iii)L	0.028	-0.49		0.33	0.27	1.14	4.28
	(2.34)	(2.30)		(3.13)			

Notes:

1. The country codes used in this and subsequent tables are AL: Australia, AU: Austria, BE: Belgium, CA: Canada, DK: Denmark, FN: Finland, FR: France, GE: Germany, IR: Ireland, IT: Italy, JA: Japan, NE: Netherlands, NW: Norway, NZ: New Zealand, SP: Spain, SW: Sweden, SZ: Switzerland, UK: United Kingdom, US: United States.

2. t-statistics are given in parentheses below estimated coefficients.

3. The instruments used in all cases were the second lags of real consumer wages, output, employment, capital, interest rates, unemployment, the wedge, the third lag of real consumer wages and a linear and quadratic time trend.

4. For France the estimated equations include a dummy variable for the years 1958 and 1959. For Australia the estimated equations include a dummy variable for the wage explosions of 1974 and 1982.

5. For Italy, Spain and New Zealand the consumer wage was constructed excluding income taxes for which no data was available.

TABLE 2

Comparison of Rise in Unemployment with Prediction from Slowdown in Rate of Growth of Real Wages

	Slowdown in rate of growth of real wages	$(1/\lambda_1)$	Predicted rise in unemployment	Actual rise in unemployment
AL(ii)	0.2	2.78	0.6	4.8
AU(ii)	3.1	0.57	1.8	0.4
(iii)		0.41	1.3	0.4
BE(ii)	3.6	1.61	5.8	7.5
CA(ii)	1.7	2.63	4.5	4.0
DK(ii)	4.8	1.45	7.0	6.8
(iii)		0.97	4.7	
FR(ii)	0.7	2.04	1.4	5.8
GE(i)	5.0	2.50	12.5	3.5
(ii)		1.26	6.3	
(iii)		1.59	7.9	
IR(ii)	4.8	2.94	14.1	7.9
(iii)		1.72	8.3	
IT(ii)	1.0	1.28	1.3	2.3
JA(ii)	3.2	0.19	0.6	0.7
(iii)		0.14	0.5	
NL(ii)	4.1	2.00	8.2	7.3
(iii)		0.93	3.8	
NZ(ii)	1.5	1.28	1.9	2.0
SP(ii)	1.2	3.70	4.4	11.1
SW(ii)	2.8	0.69	1.9	0.8
SZ(ii)	2.2	0.27	0.6	0.5
(iii)		0.23	0.5	
US(iii)	2.0	2.04	4.1	2.1

FIGURE 1

Long-Run Equilibrium

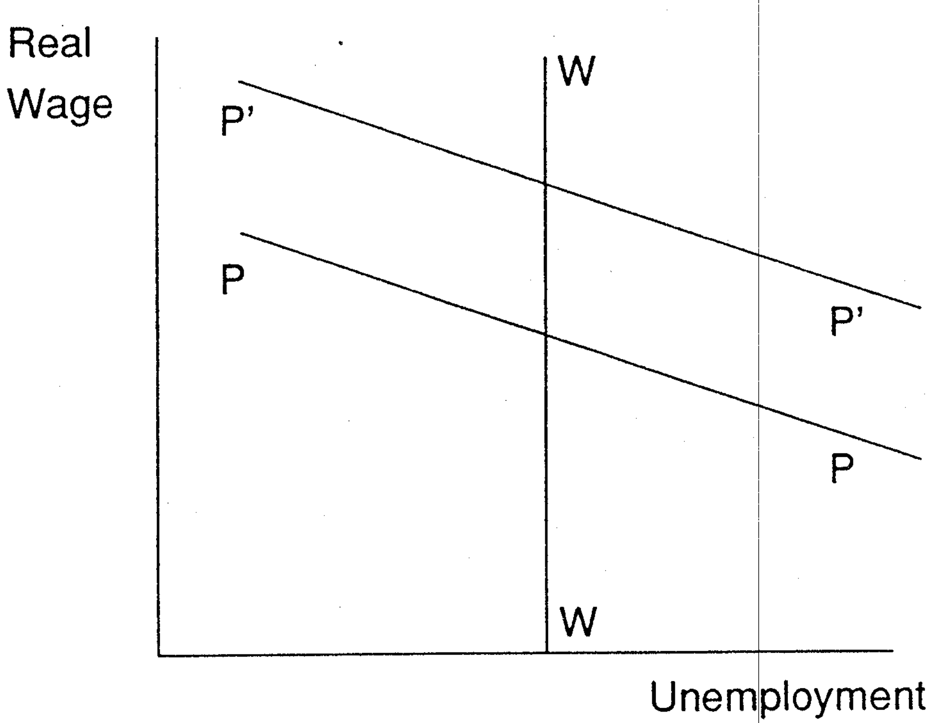


FIGURE 2

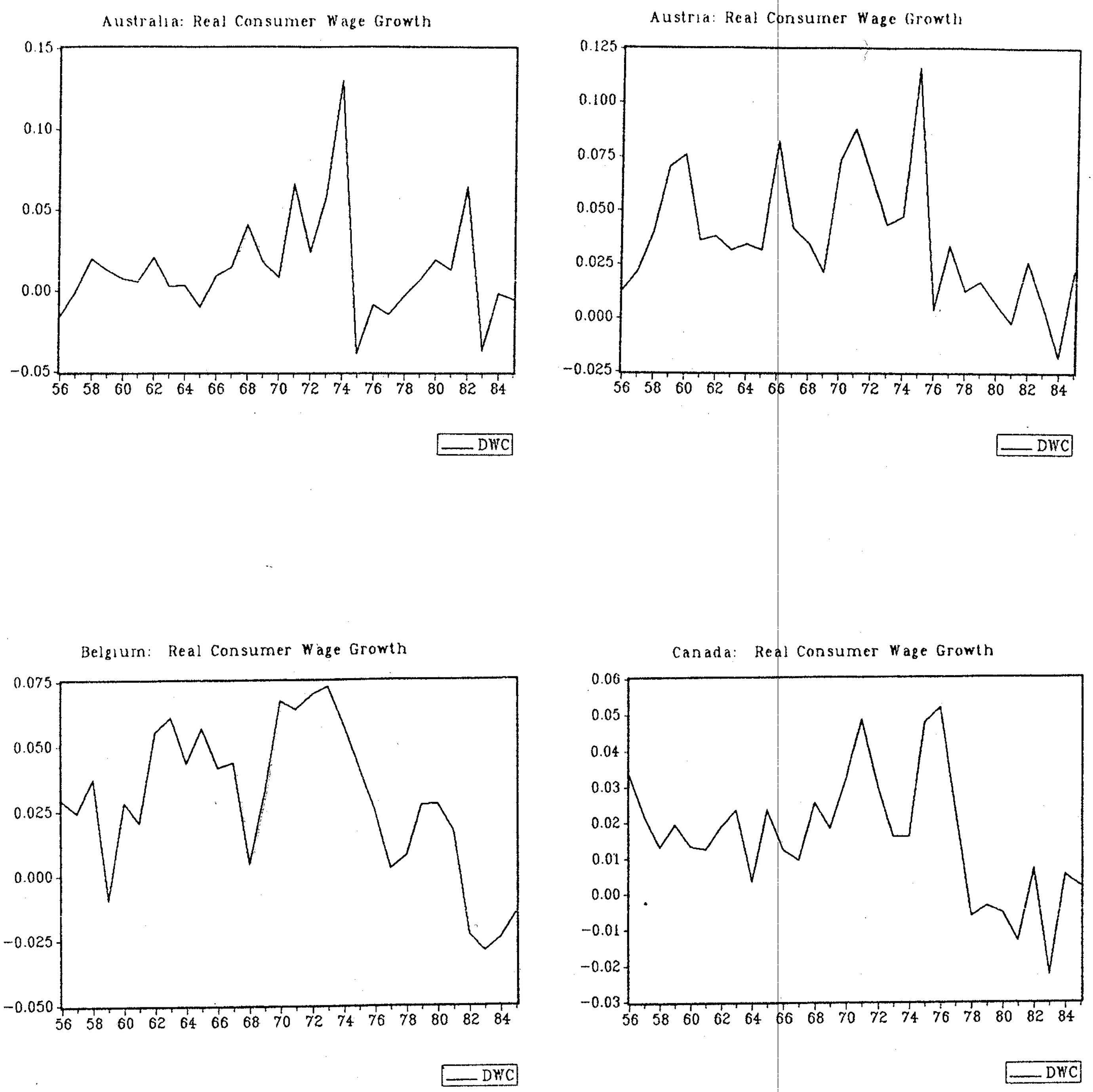
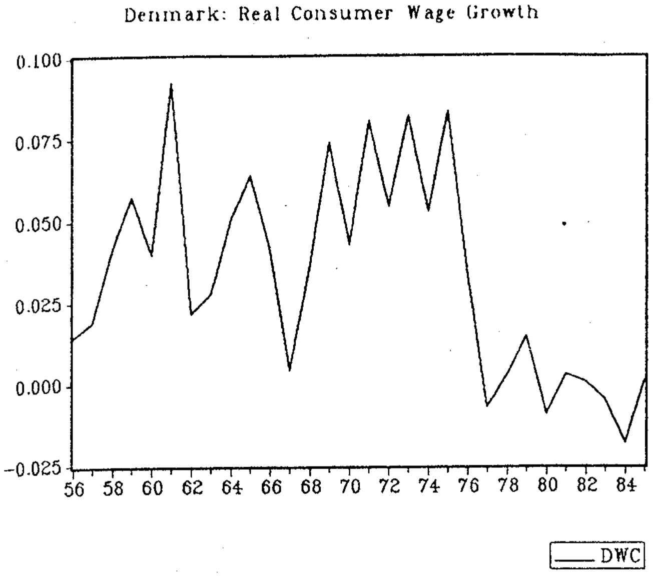
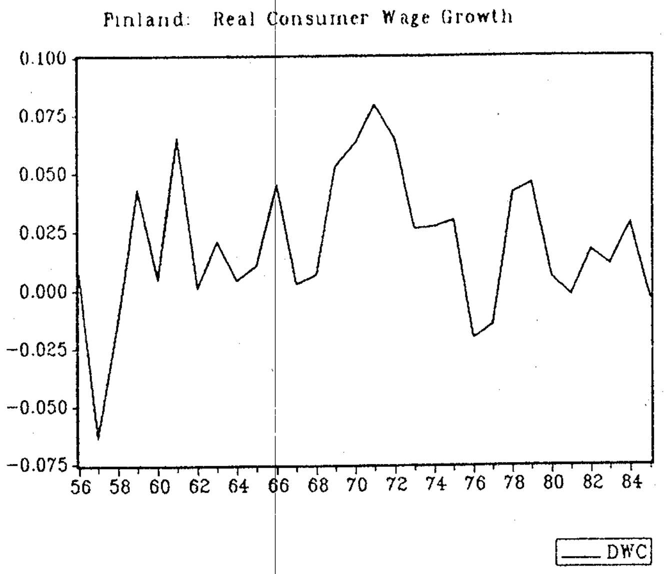
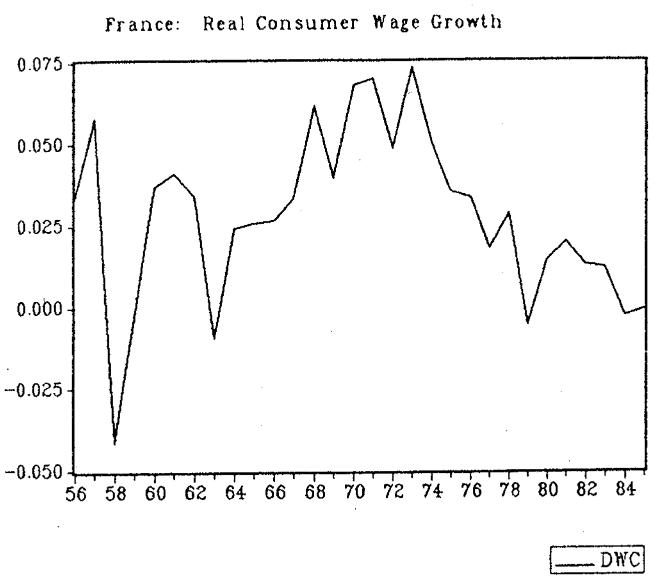

Australia: Real Consumer Wage Growth
0.15
0.10
0.05
0.00
−0.05
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
DWC
Austria: Real Consumer Wage Growth
0.125
0.100
0.075
0.050
0.025
0.000
−0.025
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
DWC
Belgium: Real Consumer Wage Growth
0.075
0.050
0.025
0.000
−0.025
−0.050
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
DWC
Canada: Real Consumer Wage Growth
0.06
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
DWC

FIGURE 2 (cont.)







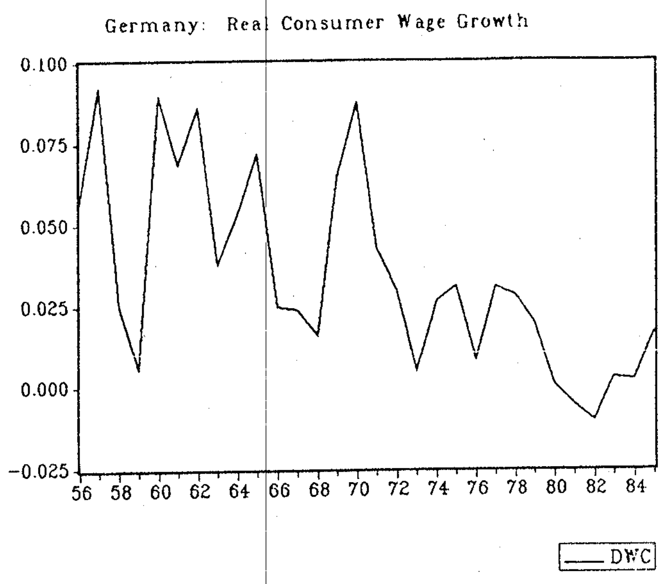


FIGURE 2 (cont.)

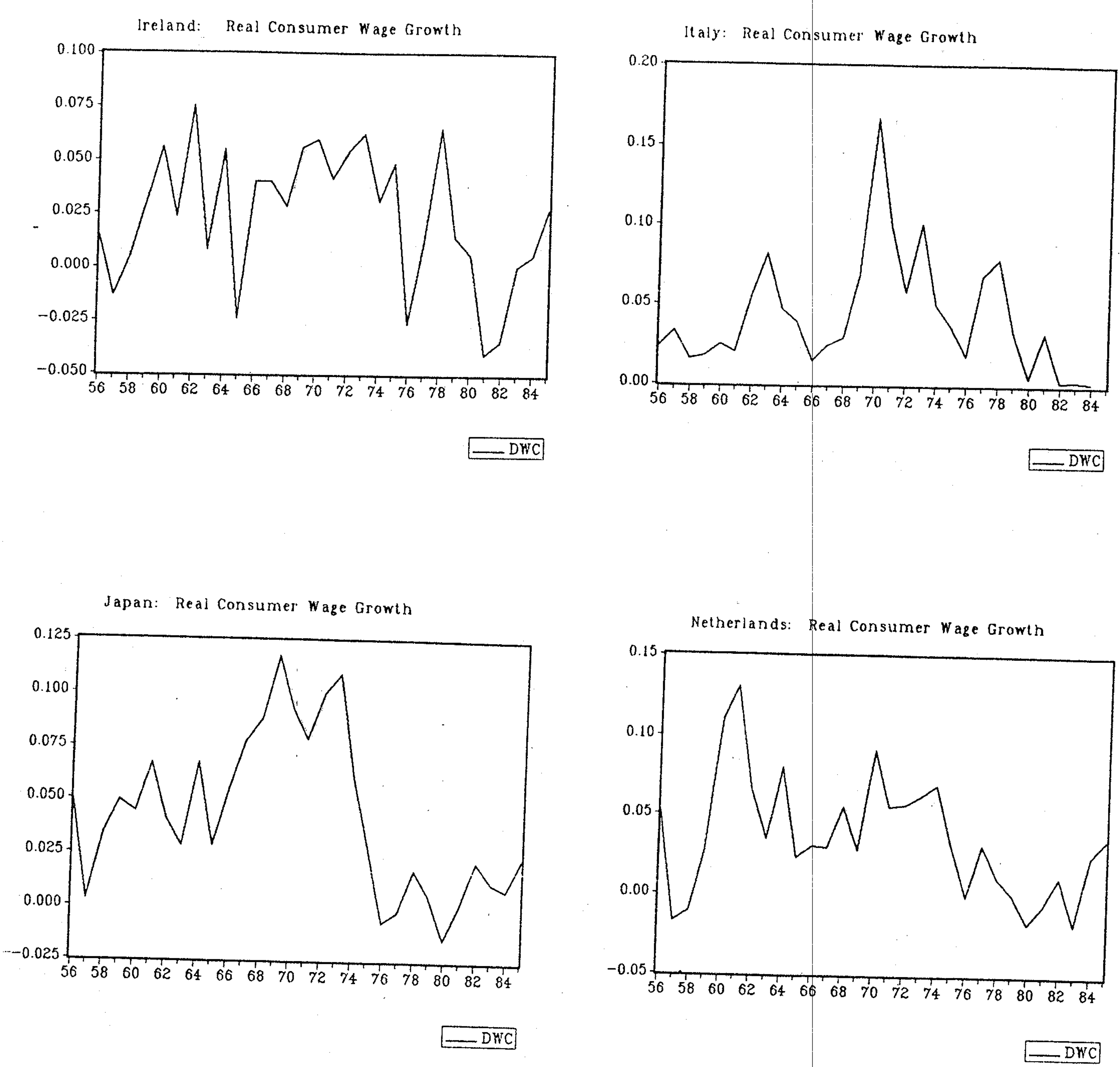


FIGURE 2 (cont.)

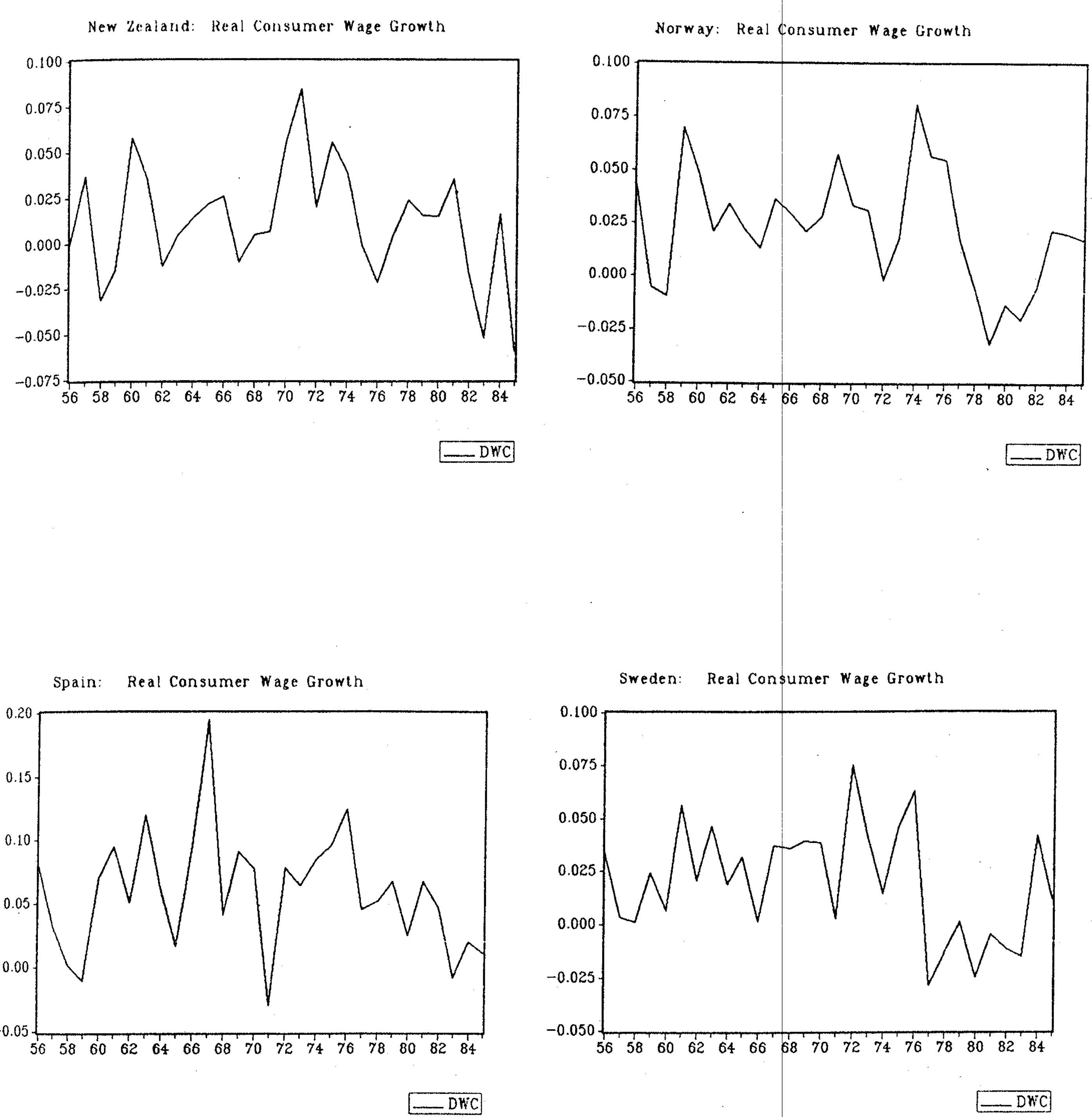
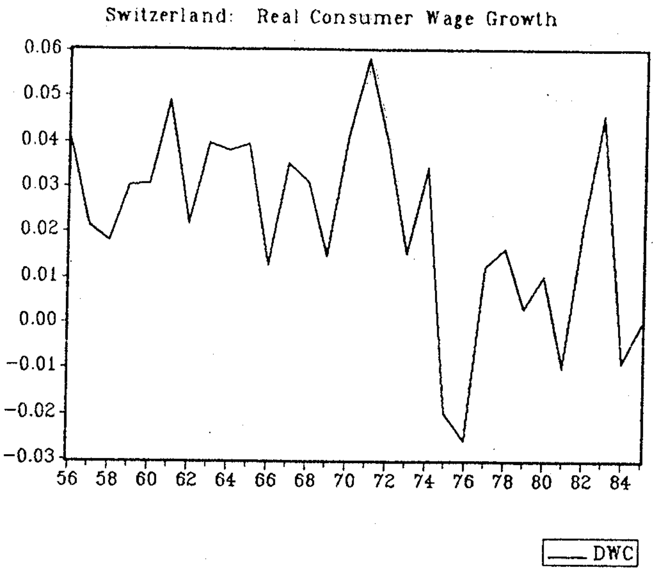
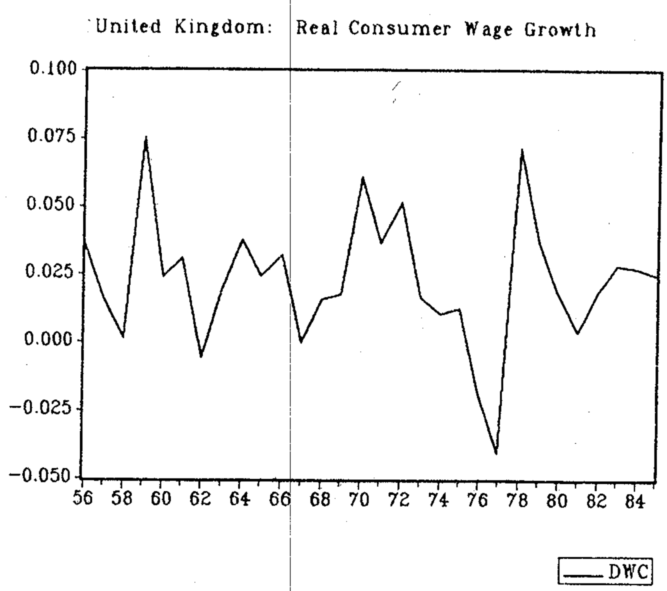


FIGURE 2 (cont.)





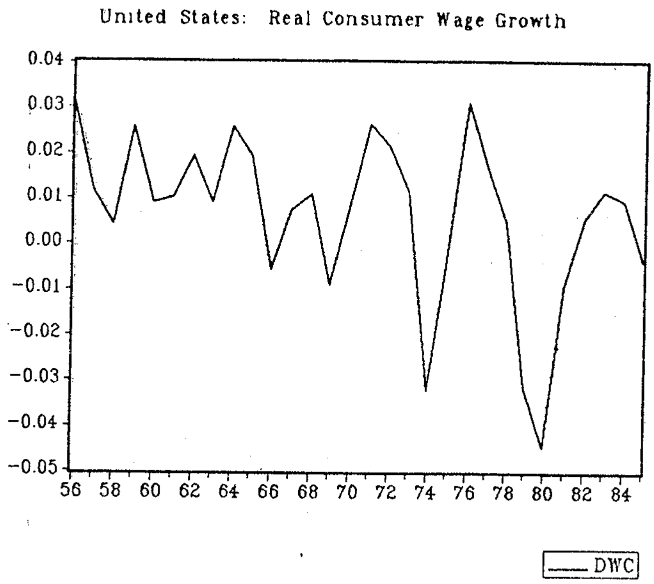


FIGURE 3

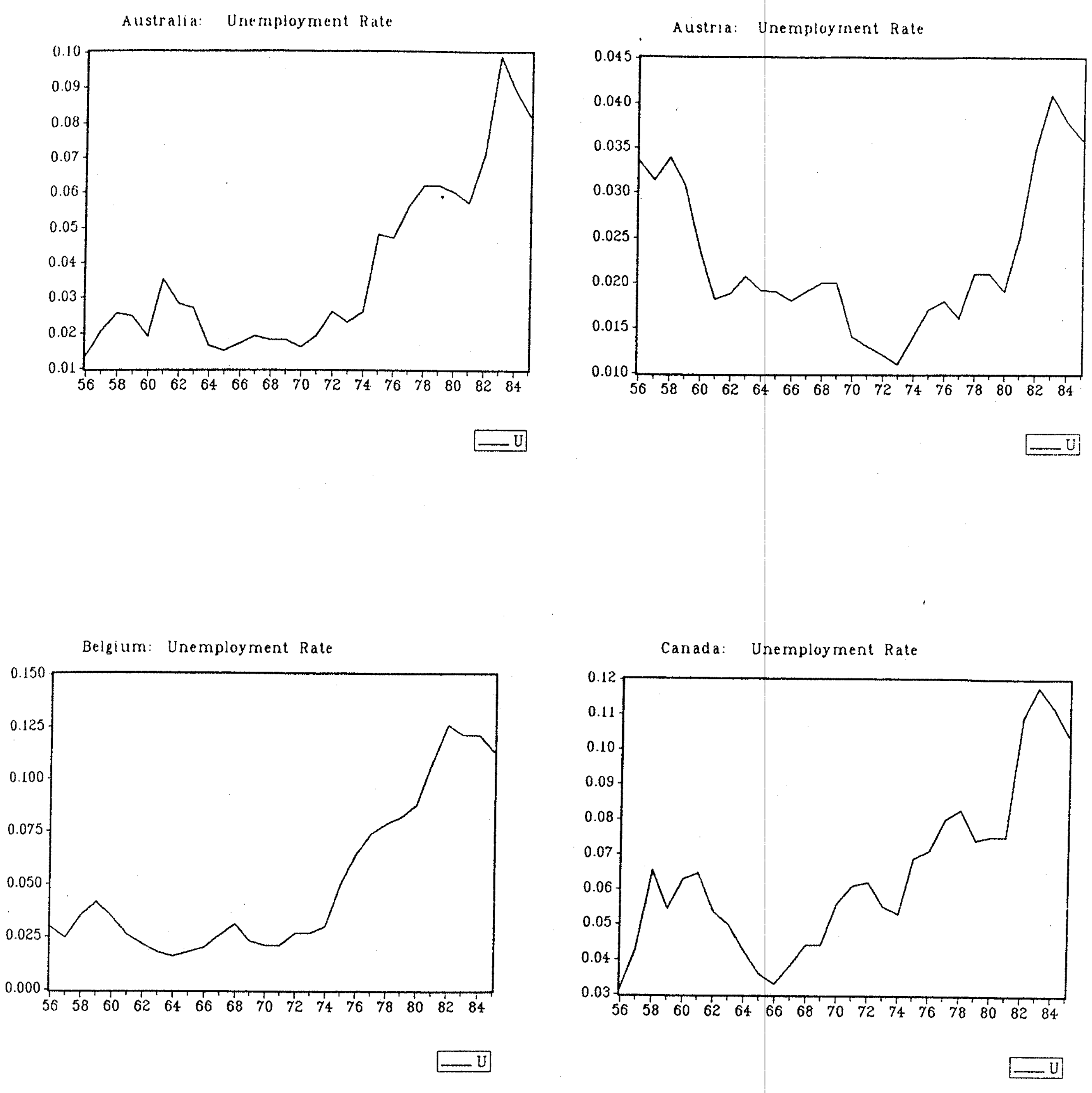
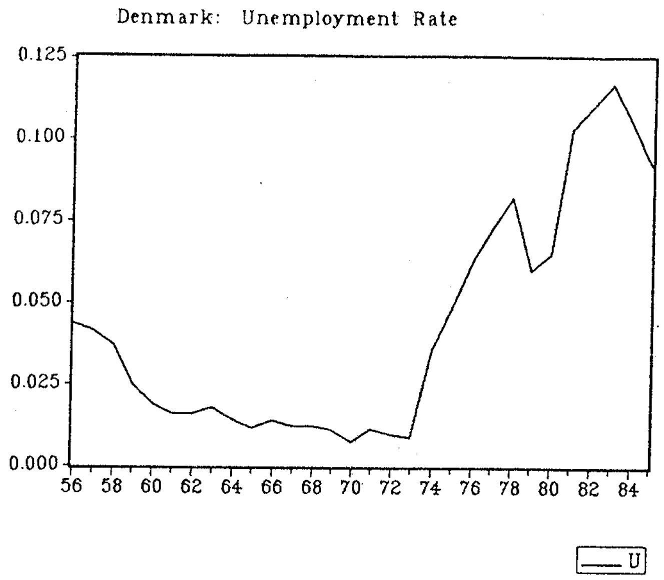
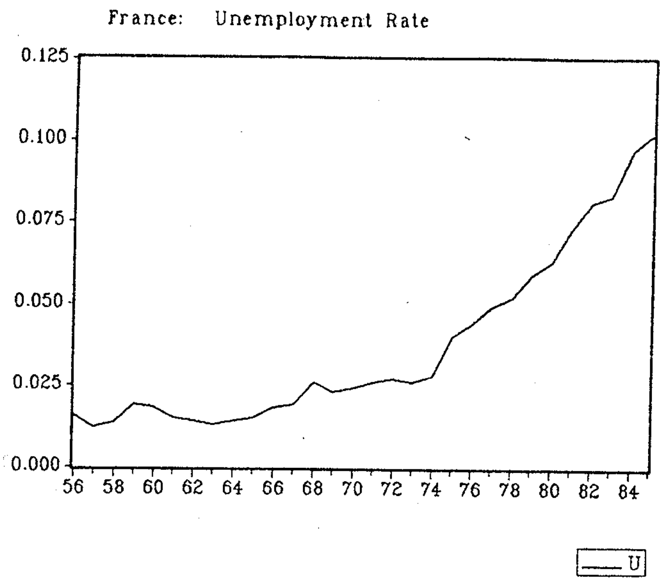

Australia: Unemployment Rate
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
U
Austria: Unemployment Rate
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
U
Belgium: Unemployment Rate
0.150
0.125
0.100
0.075
0.050
0.025
0.000
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
U
Canada: Unemployment Rate
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
U

FIGURE 3 (cont.)





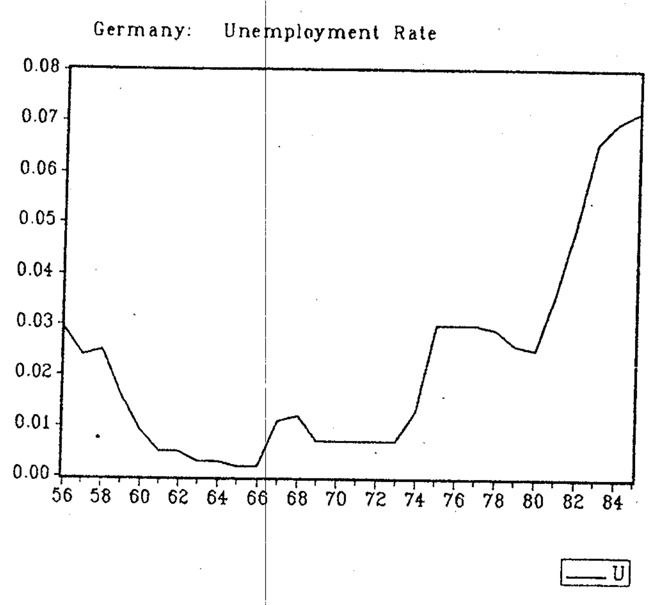


FIGURE 3 (cont.)

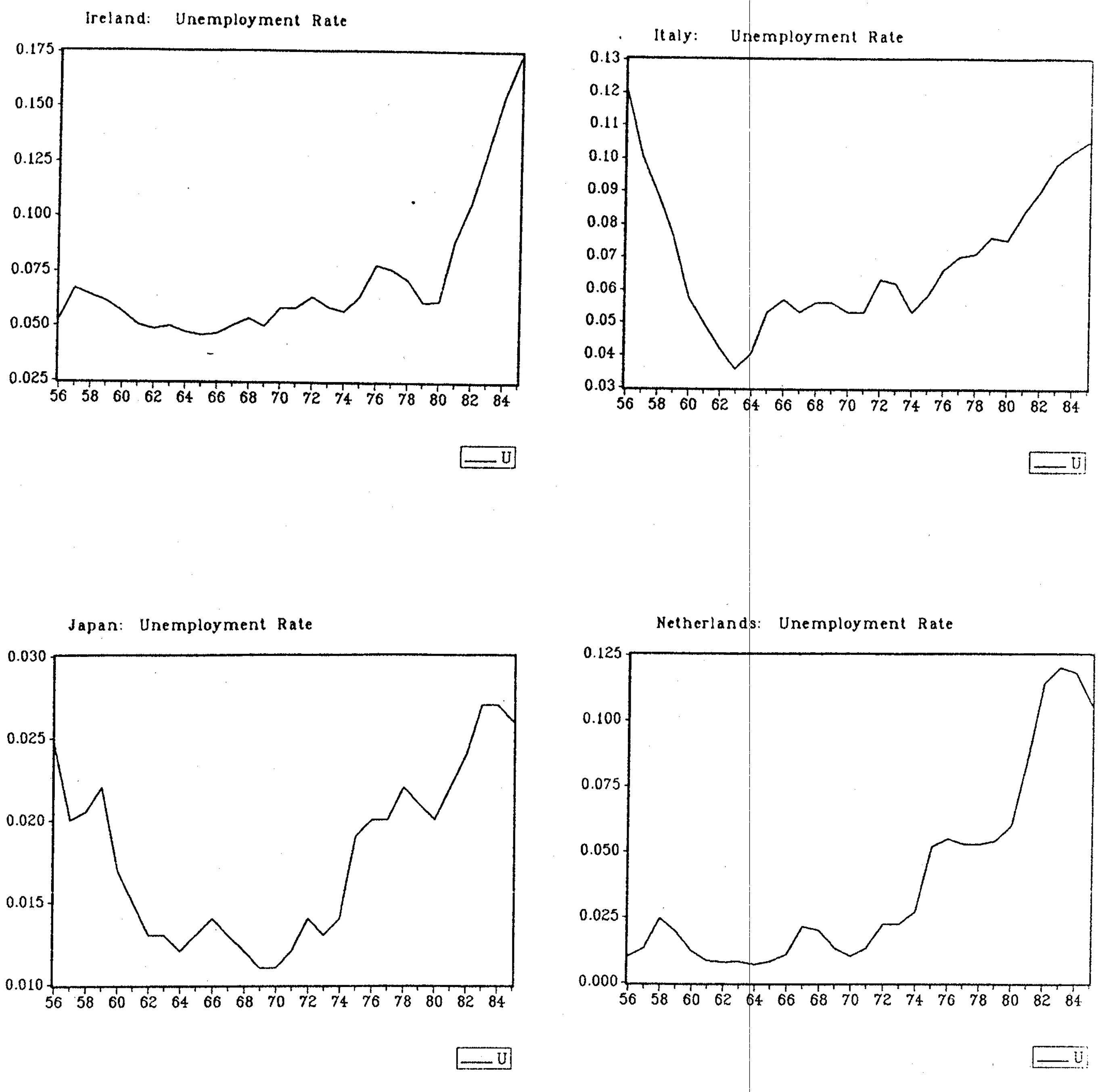


FIGURE 3 (cont.)

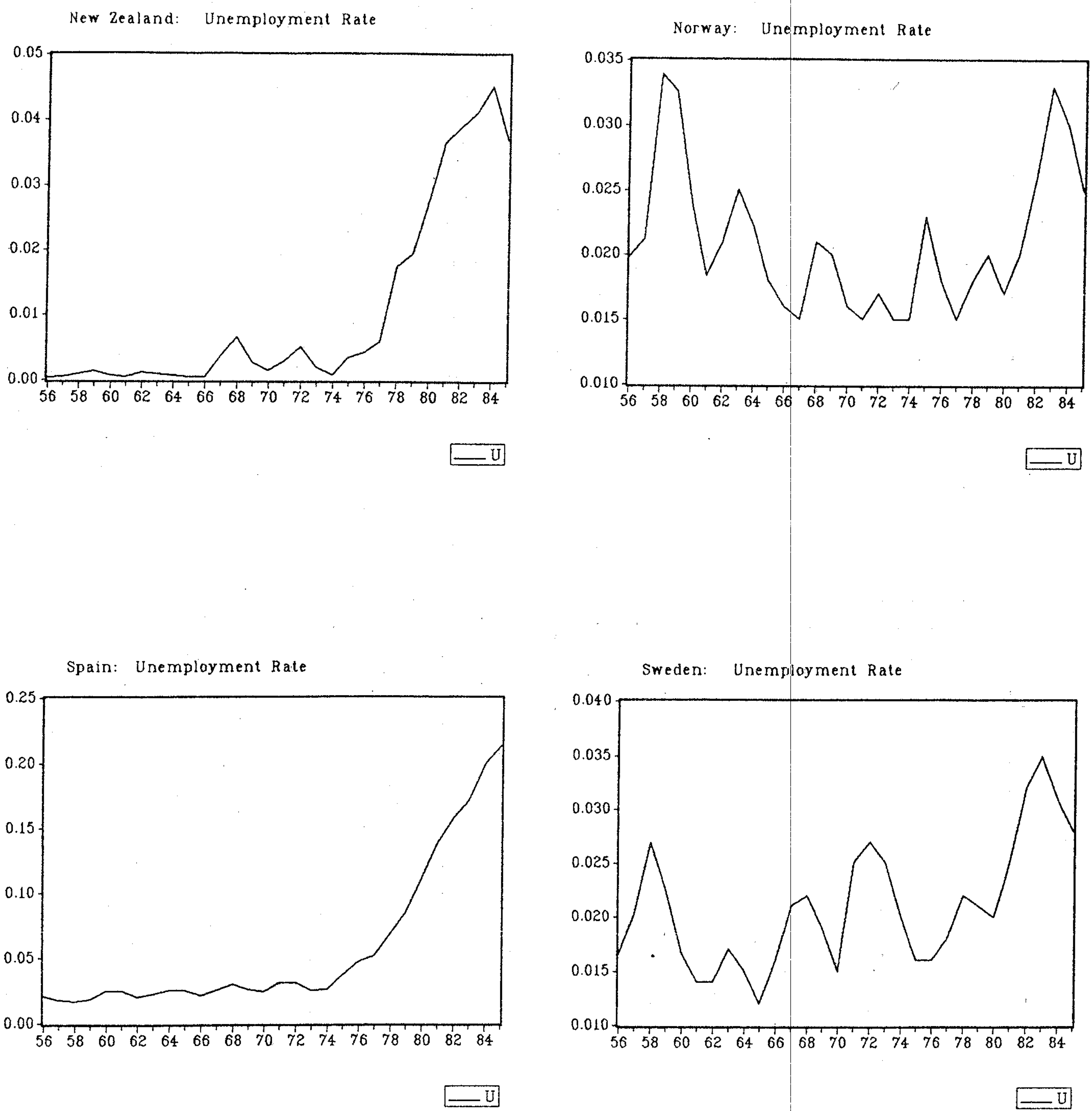
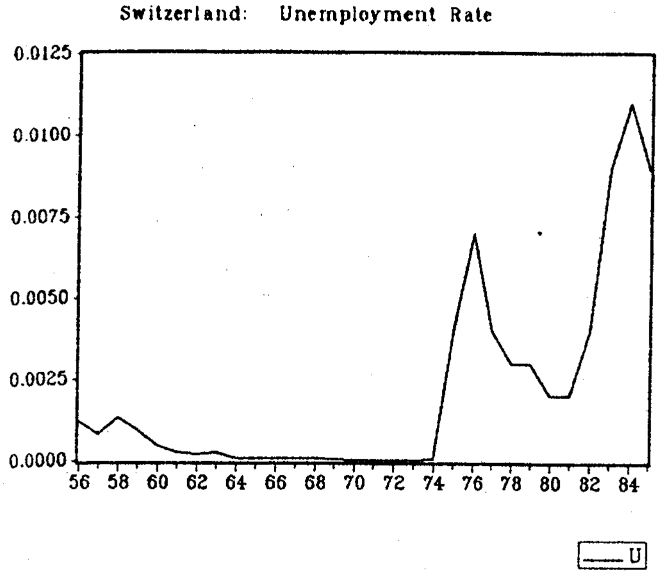


FIGURE 3 (cont.)



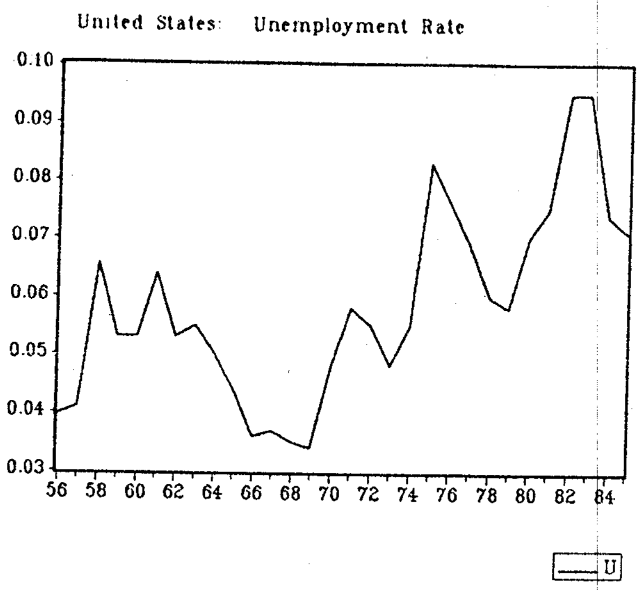
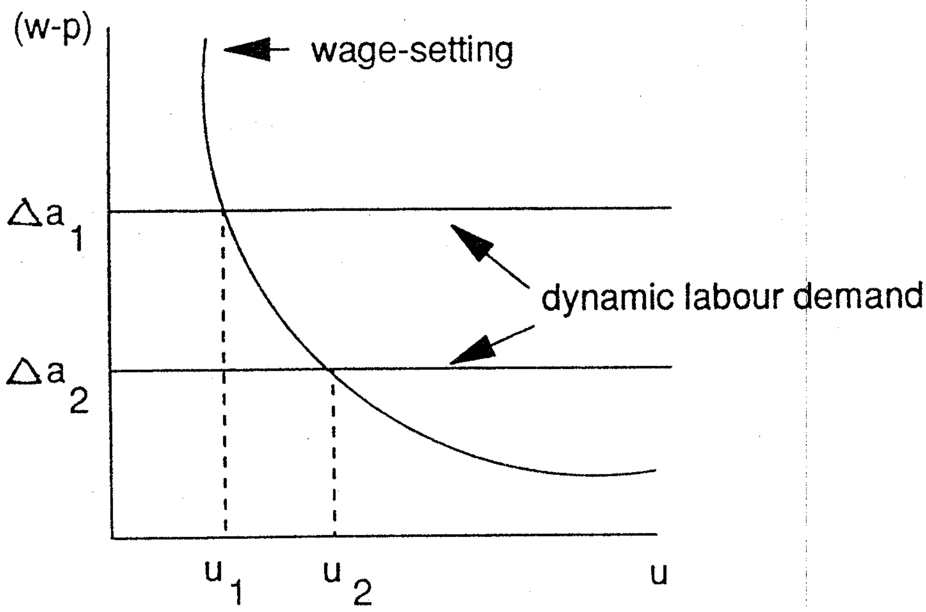


FIGURE 4

The Relationship between Productivity Growth, Real Wage Growth and Unemployment



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