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WAGE FORMATION AND THE PERSISTENCY
OF UNEMPLOYMENT

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Abstract: This paper suggests a reason why in an economy with nominal wage contracts, the effects of monetary shocks persist after labor contracts have been renegotiated. The basic idea is that employed and unemployed workers have diverging interests. Since employed workers form a majority of union membership, union decisions are likely to favor the interest of those employed. A monetary shock affects employment within the contract period, when nominal wages are given. Since employment, in turn, affects the risk that employed workers will lose their jobs, a change in employment will have consequences for future wages and employment levels.

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1. Introduction

One of the most pressing economic problems in Europe today is unemployment. Not only is the unemployment rate high, what is even more alarming, at least from a social point of view, is the fact that the rate of turn-over among the unemployed is very low. As a consequence, employed and unemployed workers differ not only with respect to their current situation, but also by their different future employment prospects. In contrast to the employed, the unemployed have a very limited chance of employment in the foreseeable future.

The source of the European unemployment problem is a matter of controversy. Two main lines of reasoning are contrasted. The unemployment is sometimes claimed to be of a "Keynesian" nature, being due to deficient aggregate demand. The other main argument suggests that the unemployment is essentially of a "classical" kind. Excessive real wages are then often said to result from trade unions' influence on wage setting. The increase in unemployment that started in the 1970's is, according to the latter view, the consequence of the combination of downward stickiness of the real wage, the increases in the real prices of energy and raw materials, and the sudden appearance of competition from the Newly Industrialized Countries.

The model to be presented here suggests that both these two arguments may contribute to the understanding of the present situation. The main idea is that, inherent in the wage formation process, there is a tendency for

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1 For instance, Main (1981) reports that for British males the average completed duration of all unemployment spells rose from 2.3 months 1970, to 5.5 months 1980, and to 9.4 months 1983. Furthermore, according to Albert and Ball (1983), the length of the periods of unemployment in the European Community exceed those in the U.S. by a factor of six.

2 See, for instance, Bruno (1981), Bruno and Sachs (1985), and Sachs (1979, 1982).
unemployment, once created, to persist. The present unemployment may originally have arisen for Keynesian reasons, but once unemployment is created it will change the conditions under which wages are formed, thus persisting in a classical form. More specifically, we want to show how unemployment, caused by a combination of wage stickiness and a temporary contractionary demand shock, may persist after wage contracts have been renegotiated.

The formulation of the model is inspired by three, in our view characteristic features of many European economies. First, trade unions play decisive roles in wage formation, both directly through participation in wage negotiations with employers, and indirectly, through the standards set by these negotiations for wages in non-unionized sectors. Second, labor contracts specify more or less state-independent nominal wages, leaving employment decisions to the discretion of employers. Third, employed workers are very rarely exchanged for unemployed workers. This may be the consequence of negotiated or legislated seniority systems. It may also be due to the fact that firms find it profitable to minimize the rate of turn-over of its work-force. Whatever the reason is, the result is that unemployed workers are only offered jobs to the extent that employed workers voluntarily resign or labor demand increases.

It follows from the last observation, that employed and unemployed workers have diverging interests. It seems likely that union decisions reflect primarily the interests of employed rather than unemployed workers. One reason for this is that the employed workers constitute a majority of union membership. Also, contacts between union officials and workers largely occur at the workplaces, where the unemployed are underrepresented.

Oswald (1984a) provides some empirical evidence.
or absent.

In the model to be presented here, there are many separate trade unions, each one organizing all workers in a firm or a sector. Each trade union maximizes the expected utility of its representative employed worker. Nominal wages are set in each period before an uncertain monetary shock is realized. After the realization of the uncertainty, firms decide on how many workers to employ. Those who were employed in the preceding period then have a first shot at the resulting jobs.

The mechanism behind the persistency of unemployment is the following. The probability that an employed worker will lose his job in a particular period depends on the level of employment in the preceding period. Employment is therefore a state variable that affects wage demands and employment in coming periods. Since a monetary shock affects employment within the contract period, it will have effects that persist after contracts have been renegotiated. More specifically, suppose that there was a contractionary shock in the previous period. Then, since there are fewer workers employed, it may be possible to raise wages to a higher level without any substantial increase in the likelihood that an employed worker loses his job. Since higher wages imply that fewer unemployed workers will be hired, a contractionary shock have a persistent negative effect on employment.

In section 2 we present the basic trade union model. Some of its features are new and some it shares with models developed by e.g. McDonald and Solow (1981), Oswald (1982, 1984a), and Grossman (1983). The model is in spirit related to the recent papers by Lindbeck and Snower (1986) and Solow (1985), which emphasize the distinction between insiders and
outsiders in the labor market. In section 3 we show how the results are changed when the wage is set through bargaining rather than by the union unilaterally. The partial equilibrium model developed in section 2 is put into a simple macroeconomic framework in section 4. The demand side is simply represented by a quantity theory of money equation. We show that the wage formation process may cause monetary shocks to have persistent real effects, something which accords well with empirical evidence (c.f. Barro (1977, 1981)).

The trade unions are in sections 2, 3 and 4 portrayed as facing one-period-decision problems, since this allows us to convey the basic point in as simple a fashion as possible. In a multi-period model, the optimization problem of a forward-looking union becomes very complicated and we are unable to characterise the solution in the general case. In order to examine additional considerations that a union has to make when facing a multi-period decision problem, we analyze the two-period case in section 5. Finally some concluding remarks are made in section 6.

2. The Monopoly Union

Consider a union which organises all employees in a firm or an industry. Let the firm's (industry's) demand for labor be

\[ x_t = D(w_t) \gamma_t : D_w(w_t) < 0. \]

\[ 4 \text{Lindbeck and Snower (1986) summarize a sequence of papers on how productivity differentials, hiring and firing costs, threats of harassments, etc. make it possible for those employed by the firm to bid up wages above the reservation wage of other workers, without making displacement of workers profitable for the firm. Solow (1985) shows how insiders may choose an intertemporal wage structure so as to prevent entry of outsiders.} \]
where $x_t$ is employment, $w_t$ is the wage and $\gamma_t$ is an i.i.d. random variable with distribution function $F$. Thus, all demand shocks are expected to be temporary. (Subscripts attached to function operators are used to denote partial derivatives.)

We assume that the union has to set the nominal wage before it knows the realization of $\gamma_t$. The realization of this demand shock, together with the wage, then determine whether employment in a period increases or decreases as compared to the previous period. The assumptions about how jobs are allocated in these two situations are crucial to the analysis.

A first assumption is that those who were employed in the previous period are offered jobs before those who were unemployed. Put differently, rather than laying off someone who currently has been working and hiring someone else who has been unemployed, the firm minimizes the turn-over, given total employment. An important (and reasonable) consequence of this assumption is that when labor demand expands, all currently employed workers retain their jobs. This seems to be broadly consistent with the way actual firms behave and within the model this behavior could be motivated by (small) hiring costs.\(^5\)

As to the situation of reduced employment, real world decisions about which workers to lay off are usually governed by several factors. Seniority rankings within production units are important.\(^6\) The model developed by Grossman (1983) focuses on this. Grossman assumes that there is a complete ranking of all workers within the firm with respect to the order in which

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\(^5\)Such costs must be small enough to have a negligible effect on the employment decision.

\(^6\)Oswald (1984a) reports some empirical evidence.
lay-offs occur. However, direct profit considerations, such as the relative profitability of different production units also influence the choice of which workers to lay off. If the relative profitability of the different production units is unknown to the workers, the order in which possible layoffs occur becomes uncertain. The models analyzed by McDonald and Solow (1981) and Oswald (1982) can be seen as representing the latter type of consideration. In these models it is assumed that the workers to be laid off are chosen by random draw. This assumption is also maintained here.

There are thus two kinds of uncertainty in the model. First, given the wage, the realization of \( \gamma_t \) determines the period's total employment. Second, if lay-offs are to occur, the identity of those to be laid off is determined by random draw. The two kinds of uncertainty can be seen formally in the following expression, yielding the probability \( \Pi(w_t, x_{t-1}) \) that a worker who was employed in period \( t-1 \) retains his job in period \( t \):

\[
(2) \quad \Pi(w_t, x_{t-1}) = \int_0^\infty \min(D(w_t) \gamma_t / x_{t-1}, 1) \, dF(\gamma_t).
\]

If a low value of \( \gamma_t \) occurs, the probability of employment is \( D(w_t) \gamma_t / x_t \). If a value of \( \gamma_t \) greater than \( x_{t-1} / D(w_t) \) occurs, the corresponding probability is unity.

The assumptions made above imply that there are two, internally homogeneous groups of workers at the outset of any period \( t \): the \( x_{t-1} \) who were employed in the previous period, and the unemployed. As in Grossman's model, the union is assumed to act so as to maximize the (single-peaked) expected utility of the median worker. Assuming that the group of workers who were previously employed constitutes more than 50 percent of the union
membership, the median worker belongs to this group.

Let the instantaneous utility of an employed worker be \( V(w_t) \), and let the worker get utility \( v^u \) if he is unemployed. The instantaneous expected utility at the beginning of period \( t \) of a worker who was employed in period \( t-1 \) is

\[
U(w_t, x_{t-1}) = \Pi(w_t, x_{t-1}) V(w_t) + [1 - \Pi(w_t, x_{t-1})] v^u
\]

As it turns out, the general multi-period decision problem of the union is difficult-to-characterize. It is possible, however, to derive interesting analytical results in a two-period framework. In this and the following two sections we analyze wage determination in the last period (period 2), while the intertemporal decision problem in period 1 is analyzed in section 5.

In the last period the maximand of the union is simply (3) for \( t=2 \). The first-order condition is then

\[
\frac{U_w(w_2, x_1)}{x_1} = \Pi(w_2, x_1) V(w_2) + \Pi_w(w_2, x_1) [V(w_2) - v^u]
\]

\[
= \int_0^\infty \min(D(w_2), \gamma_2/x_1, 1) dF(\gamma_2) V(w_2)
\]

\[
+ \frac{D_w(w_2)}{x_1} \int_0^\infty \gamma_2 F(\gamma_2) (V(w_2) - v^u) = 0
\]

As usual, the monopoly union increases the wage until the cost in terms of increased risk of unemployment outweighs the expected benefit of a higher wage. The first term is the expected return from a marginal increase in the
wage: the probability of employment times the marginal utility of a higher wage for someone who gets a job. The second term is the expected cost of the wage increase. It is the negative effect of an increased wage on the probability of employment multiplied by the loss from becoming unemployed. To understand this term, recall that if a sufficiently low level of demand is realized \( \gamma_2 < x_1/D(w_2) \), a number of workers will lose their jobs and this number will depend on the predetermined wage, but for higher levels of demand all previously employed workers not only keep their jobs at the going wage, but would also do so for (at least) a marginally higher wage.\(^7\) It is thus only for sufficiently low values of \( \gamma_2 \) that the wage turns out to affect employment of previously employed workers.

Our first conclusion follows directly from an inspection of this formula. Since the previous level of employment appears in the first-order condition, it will typically affect the wage demanded by the union and therefore employment in the current period. To examine the direction of this effect, differentiate the first-order condition to get

\[
\frac{dw_2^*}{dx_1} = - \frac{U_{wx}}{U_{ww}}.
\]

Assuming that the second-order condition \( U_{ww} < 0 \) is fulfilled the sign of \( \frac{dw_2^*}{dx_1} \) is the same as the sign of \( U_{wx} \). The sign of the latter is ambiguous in the general case and so is therefore the sign of \( \frac{dw_2^*}{dx_1} \). To understand the effect of an increase of the previous period's employment on the wage demanded by the union, it is useful to examine how \( x_1 \) enters the

\(^7\)The discontinuity in the probability of employment as a function of the wage after the state of demand is known is also studied by Oswald (1984b) in a context without uncertainty about demand.
first-order condition (4). Let us consider the implications of a marginally smaller stock of previously employed workers.

A lower $x_1$ has a direct positive effect on the probability of obtaining a job, as captured by the implied change in the first term in (4). This signifies the fact that with fewer people employed in the previous period, the probability of employment is higher, and so is therefore the expected utility from an increased wage. This increases the return from a wage increase.

A reduction in $x_1$ affects the cost of a wage increase — the last term in (4) — in two opposing ways. First, $x_1$ appears in the denominator of this term. A higher wage reduces employment and the chance that this will affect some particular worker increases as the number of previously employed workers falls. This tends to increase the cost of a wage increase.

The two effects considered so far are hence of opposite sign. They are also present in the type of model developed by McDonald and Solow (1981) and Oswald (1982). In their models these effects just cancel in equilibrium, and hence the previous employment, or the size of the membership, does not affect the optimal wage.

The second channel through which $x_1$ affects the cost of a wage increase is through the presence of $x_1$ in the upper bound of the integral in the last term in (4). A lower $x_1$ implies that there are fewer states in which a marginal wage increase will reduce employment of previously employed workers. This tends to reduce the cost of a wage increase. Because of this effect, if employment in the previous period is lower, the employed workers tend to push up the wage, since a higher wage is not likely to affect their employment prospects. It is this feature that is novel to our trade union model.
We cannot determine the sign of \( \frac{d\omega_2}{dx_1} \) without more specific assumptions about the distribution of \( \gamma_2 \), labor demand and the utility function of workers. In the appendix we show that, in the case of isoelastic functions, at least if workers have a high degree of risk aversion, the first and third effect dominate the second. In this case, a lower level of employment in period one leads to a higher wage and a lower level of employment in the subsequent period, too.

One way of understanding this result is as follows. Suppose that the distribution function \( F \) has a lower support at \( \gamma_{\text{min}} \). Then, if workers are very-risk averse, they will set a wage so that \( x_1/D(w_2) = \gamma_{\text{min}} \), i.e., so that they are sure to keep their jobs. In this case we see immediately that a reduction in \( x_1 \) implies a higher wage. If workers are somewhat less risk averse they will accept some probability that lay offs occur. Then a reduction in \( x_1 \) will lead to both a higher wage and a higher probability of future employment, but the wage will still rise as a result of a reduction in \( x_1 \).

3. The Bargaining Union

In the previous section we studied the case when the union was powerful enough to set the wage unilaterally. The purpose of this section is to show that features similar to the ones pointed to above may also exist when the bargaining power is more equally distributed between the union and the firm (or an agent representing a group of firms). We will hence assume that the wage is determined through bargaining. But following e.g. Nickell and Andrews (1983) and Solow (1985) we maintain the empirically reasonable assumption that employment decisions are left at the
discretion of the firm, and are made after the wage is settled.

There is unfortunately no universally accepted solution concept for bargaining. It has, however, been shown that the Nash bargaining solution is a limiting result of a sequential bargaining procedure of the type developed by Rubinstein (1982). The Nash solution could hence be supported by both the axiomatic as well as the strategic approach to bargaining, and since it is also computationally simple, it is adopted here.

An important element of Nash' bargaining theory is the proper identification of the status-quo point. Binmore, Rubinstein and Wolinsky (1985) show that if impatience is what prevents the completely informed bargaining parties from bargaining indefinitely, then the status-quo point should be identified with the utilities of the parties during the bargaining (i.e. before an agreement is reached). We assume that during a wage dispute the firm's profit is zero, and workers obtain the utility $v^u$. Letting $R(w_2)$ denote the firm's expected profit ($R_w < 0$), the bargained wage is

$$(6) \quad w_2 = \arg \max_{w_2} (U(w_2, x_1) - v^u) \, R(w_2)$$

and the first-order condition is

$$(7) \quad U_w(w_2, x_1)R(w_2) + [U(w_2, x_1) - v^u]R_w(w_2) = 0.$$

Then, how does the previous period's employment level affect the bargained wage? Differentiating (7) with respect to $x_1$ we get

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8See Rubinstein (1985) for a comprehensive survey of the sequential strategic approach to bargaining.
\[
\frac{dw_2}{dx_1} = \frac{U_{wx} R + U_{xw} R}{U_{ww} R + 2U_{w} R + (U-u^1)R_{ww}}.
\]

The second order condition again requires the denominator to be negative. In the numerator we have one term containing \( U_{wx} \), the sign of which was analyzed in the previous section. What is new in the Nash bargaining case is the positive term \( U_{xw} R \), which tends to make lower employment in the previous period lead to a lower bargained wage. This effect can be understood as follows: the firm is indifferent with respect to \( x_1 \), since all workers are identical from the firm's point of view, but a fall in \( x_1 \), all else given, makes the median worker better off. The Nash bargaining solution requires that part of this utility gain is transferred to the firm through a lower wage. Of course, this effect comes in addition to the three effects contained in \( U_{wx} \), which were discussed in the previous section.

4. **Effects of Monetary Shocks**

   We will now integrate the trade union model, which was developed in section 2, with a macroeconomic model. This will enable us to analyze some consequences of demand management policy. To make the demand side as simple as possible we specify a velocity equation

\[
y_t = m_t,
\]

where \( y_t \) is aggregate (nominal) income, \( m_t \) is money supply and velocity
is normalized to unity. Money supply follows the Markow process:

\[ m_t = \mu_t m_{t-1}, \]

where \( \mu_t \) is an i.i.d. random variable with a distribution function \( G(\mu_t) \).

The product market in this economy is monopolistically competitive except for that there is no exit or entry of firms. The market is modelled similar to that in Spence (1976), and Dixit and Stiglitz (1977). Firms, indexed by \( i = 1, \ldots, n \), produce under constant returns to scale, using labor as the only input. Units are defined so that one unit of labor produces one unit of output. All individuals share a CES utility function. Each firm is owned by a capitalist who consumes all of the profit, which is his only source of income. The nominal national income \( y \) is hence spent so as to maximize

\[ \bar{V}(p_t, y_t) = \left[ \sum_{j=1}^{n} \rho_j \right]^{-\frac{\alpha}{\rho}} y^\sigma; \ \sigma < \rho < 0, \ \sigma < \alpha < 1; \]

where \( p_t \) is the vector of the \( n \) goods prices and where \( 1/(1 - \rho) \) is the constant elasticity of demand. Associated with the utility function are the product demand functions

\[ x_{it} = p^{-1}_it \left[ \sum_{j=1}^{n} \rho_j \right]^{-1} y_t. \]

Firms entertain Nash conjectures, and when the number of firms is
large, the condition for profit maximization in each firms \( i \) is

\[
P_{it} = (\rho - 1)P^{-1}_{it} w_{it}
\]

where \( w_{it} \) is the nominal wage in firm \( i \). Substituting (9), (10) and (13) into the demand function (12) we get employment as a function of wages, money supply in the previous period and the monetary shock:

\[
x_{it} = D^i(w_t)\mu_{t}m_{t-1},
\]

where \( D^i(w_t) \equiv (\rho - 1)^{-1}\rho w_{it}^{\rho - 1}/\sum_{j=1}^{n} w_{jt}^{\rho} \)

\( w_t \) being the vector of wages \((w_{it}, \ldots, w_{jt}, \ldots, w_{nt})\).

Taking the pricing rule (13) into account we can write the utility of a worker employed in firm \( i \) as a function of the wage vector:

\[
V^{i}(w_t) \equiv (\rho - 1)^{-\alpha}\rho^{\alpha}\sum_{j=1}^{n} w_{jt}^{\rho - \alpha} w_{it}^{-\rho \alpha}
\]

When unemployed, the worker obtains utility \( v^u \) from activities outside the market. As in e.g. Fischer (1977) the unions set nominal wages before they know the current period's money supply. Analogously to in section 2, we can write the probability of employment for a worker who was employed in the previous period as

\[
\Pi^{i}(w_{it}, x_{it-1}, m_{t-1}) \equiv \int_{0}^{\infty} \min(D^i(w_t)m_{t-1}\mu_{t}/x_{it-1}, 1)dG(\mu_{t}).
\]
As in section 2 we assume that unions set wages and we examine wage determination in the last period (period 2), while the decision problem in period 1 is examined in the next section. The optimal wage of union 1 in period 2 is the one that maximizes

\[
\max_{w_{12}} \Pi^i(w_2, x_{11}, m_1) V^i(w_2) + [1 - \Pi^i(w_2, x_{11}, m_1)] v^u,
\]

yielding the first-order condition

\[
A^i(w_2, x_{11}, m_1) \equiv 
\]

\[
\Pi^i(w_2, x_{11}, m_1)(V^i(w_2) - v^u) + \Pi^i(w_2, x_{11}, m_1)V^i(w_2) = 0
\]

where subscript \( i \) denotes the partial derivative with respect to \( w_{12} \) when attached to function operators. Consider the symmetric Nash equilibrium in which

\[
x_{11} = x_1 \text{ and } w_{12} = w_2^*; \ i = 1, \ldots, n.
\]

From (18) and (19) we get the effect on wages of an increase in employment in the previous period

\[
\frac{dw_{22}}{dx_{12}} = -\frac{A^i_{x} x}{A^i_{w}},
\]

where \( A^i_{w} \) is the vector of derivatives with respect to \( w \) and \( e \) is the unit
vector. We impose the stability condition that $A_{w}^{i} < 0$, i.e. if all wages are higher (lower) than the equilibrium level, each single union has an incentive to reduce (increase) its wage.\footnote{This stability condition would be implied by an adjustment mechanism $\dot{w}_i = A(w_i - \bar{w}_i); A > 0$, where $\bar{w}_i$ is defined by the first order condition (see Hahn (1962)).} As in section 2, the sign of $A_{X}^{i}$ is ambiguous. Provided that $A_{X}^{i} < 0$, lower employment in period one implies higher wages and lower expected employment in the subsequent period, so that a monetary shock has a persistent effect on employment.\footnote{Somewhat surprisingly it turns out that the stability condition $A_{w}^{i} < 0$ implies $A_{X}^{i} < 0$ and conversely, so that $dw_{2}/dx_{1}$ is generally negative in this case: Since $x_{10}$ and $m_{0}$ enter the first-order condition only as a ratio, the sign of $A_{X}^{i}$ is opposite to that of $A_{m}^{i}$. Furthermore, the first-order condition is homogeneous of degree zero in nominal variables, so that $w_{2}^{i}A_{w}^{i} + m_{1}A_{m}^{i} = 0$, implying that the sign of $A_{w}^{i}$ is opposite to that of $A_{m}^{i}$. These two conditions together imply that the sign of $A_{X}^{i}$ is the same as that of $A_{w}^{i}$. However, this is a special result, which does not carry over to e.g. a multi-period model.} This result is in line with empirical observations (see e.g. Barro 1977, 1981).

5. **Dynamic Considerations: The Decision Problem in Period 1**

So far we have concentrated on the one period decision problem in the last period (period 2), since this allowed us to make the basic point as simply as possible. To illustrate what additional considerations arise when workers care about the future, let us examine the decision problem in the next-to-last period (period 1).

Before we do this it is convenient to introduce some notation.
Define the vector valued function $\mathbf{W}(\underline{x}_1)$ as the function that gives the equilibrium wage vector in period 2 for a given employment vector, $\underline{x}_1$. Further, denote the equilibrium expected utility at the start of period 2 for a worker employed in firm $i$ by $\varphi^i(\underline{x}_1)$, i.e.

$$\varphi^i(\underline{x}_1) \equiv \Pi^i_\mathbf{(W(\underline{x}_1),\underline{x}_{11},\underline{m}_2)}(V^i(W(\underline{x}_1)) - v^u) + v^u.$$  

Denote by $\varphi^i_1(\underline{x}_1)$ the derivative of $\varphi^i(\underline{x}_1)$ with respect to $\underline{x}_{11}$. Since $w_{11}$ is set so as to maximize expected utility in union $i$, the envelope theorem implies that

$$\varphi^i_1(\underline{x}_1) = \Pi^i_\mathbf{(W(\underline{x}_1),\underline{x}_{11},\underline{m}_2)}(V^i(W(\underline{x}_1)) - v^u) < 0.$$  

Not surprisingly, a worker's expected utility in period 2 is lower if he enters that period employed in a firm with more employees (given employment in other firms). Further, denote by $\phi(\underline{x}_1)$ the expected utility for a worker who enters period 2 unemployed, it is given by

$$\phi(\underline{x}_1) \equiv \int_0^{\infty} \sum_{i=1}^n \min \left( \frac{B^i_\mathbf{(W(\underline{x}_1))}(\underline{m}_2 - \underline{x}_{11})}{0} \right) dG(\underline{\mu}_2)(V^i(W(\underline{x}_1)) - v^u) + v^u$$

$$\bar{x} - \sum_{j=1}^n x_{j1}$$

where $\bar{x}$ is the total labor supply. The first term after the integral sign yields, for a given realization of $\underline{\mu}_2$, the probability of employment for the worker who enters period 2 unemployed. It is the ratio of firings to the number of people who were unemployed at the beginning of the period.
The decision problem in period 1 can now be stated as

\[
\text{(24) } \max_{\mu_1} \int \min_{\mu_0} \left( \frac{D_1^i(w_1)m_0}{x_1} \right) [V_1^i(w_1) - v^u + \delta(\phi^i(x_1) - \phi(x_1))] + v^u + \phi(x_1) \ dG(\mu_1) \]

where each element in $x_1$ is given by $x_{1j} = D_1^j(w_1)m_0\mu_1$, and where $\delta$ is the discount factor. We assume that there is a large number of firm-union pairs and that each union disregards the effect of its wage on employment in other firms and on the expected utility for an unemployed worker, $\phi(x_1)$. The first order condition is then

\[
B_{1}^i(w_1, x_{10}, m_0) = \infty \]

\[
\text{(25) } \min_{\mu_0} \left( \frac{D_1^i(w_1)m_0}{x_1} \right) [V_1^i(w_1) + \delta \phi^i(x_1) D_1^i(w_1)m_0 \mu_1] dG(\mu_1) \]

\[
+ \int \min_{\mu_0} \left( \frac{D_1^i(w_1)m_0}{x_1} \right) [V_1^i(w_1) - v^u + \delta(\phi^i(x_1) - \phi(x_1))] dG(\mu_1) = 0. \]

We see that when the union cares about a future period, both terms in the first order condition increase as compared to one period decision problem. A higher wage in the current period reduces employment and thus increases expected future utility for those who are lucky enough not to be laid off. On the other hand, the reduced probability of employment, associated with a higher wage, is now more costly, since if a worker loses his job in period 1, not only current income but also expected future income is reduced. Thus, it is not clear whether the concern about future
employment should induce workers to set a higher or a lower wage as compared to myopic behavior.

This can also be explained in a slightly different way: A lower wage in the current period increases the probability that a worker keeps his job this period and thus the probability that he enters next period as an employed worker. But unless next period's wage is also reduced, there is a greater risk that he looses his job next period since at the beginning of that period there is a larger group of workers employed. Thus, while a permanent wage reduction increases the probability of employment in the future period it is not clear how a temporary wage reduction affects the probability of employment in the future employment. Therefore, we cannot say in general whether the workers should vote for a lower or higher wage today in order to increase the probability of employment in the future.

Our prime concern is the effect of employment in period zero on the wages and employment in period one, however. Assuming again a symmetric equilibrium, this effect is given by

\[
\frac{d w^*_i}{dx^*_o} = - \frac{B^*_i}{B^*_W x^*_i e}
\]

Again, we invoke the stability condition that \( B^*_W e < 0 \), but we cannot determine the sign of \( B^*_W \) in general. The effects of \( x_{10} \) on the first order condition are exactly analogous to those discussed in section 2. If \( B^*_x < 0 \) higher employment in period zero results in lower wages and higher expected employment in subsequent periods.

Clearly, it would be more realistic to model workers as maximizing expected utility over a lifetime involving more than two periods.
Unfortunately, it seems very difficult to characterize behavior in such a model. We have therefore chosen to analyze one and two period decision problems so as to illustrate some economic ideas, although we are very aware of the lack of realism in this respect.

6. Concluding Remarks

This paper shows that a negative demand shock, in the presence of short run nominal wage stickiness, may result in persistent unemployment. The inspiration of the paper stems from the present European unemployment situation, which is characterized by a low turnover rate among the unemployed. The analysis suggests that once an unemployment situation has emerged, the return to full employment may take time because of induced effects on wage formation.

A common source of controversy is whether the European situation should be attributed to deficient aggregate demand, due to contractionary fiscal and monetary policies, or to excessive real wages. The analysis here suggests that the two kinds of unemployment may be related. Contractions induced by policy or e.g. by the contractionary effects of increases in oil prices may, in combination with nominal wage stickiness, lead to Keynesian unemployment in the short run. The unemployment persists, however, even after wages have been renegotiated, since unions raise wages more when fewer people are employed.

The result here may also be related to the rational expectations literature where various "propagation mechanisms" have been suggested to explain why (by assumption) serially uncorrelated forecast errors may have persistent effects on real variables. The explanations of Lucas (1975), Sargent (1978, ch 16) and Blinder and Fischer (1981) rely on stock
variables (capital, inventories) being affected by the forecast errors. The stock variables then affect production decisions of firms in future periods. These explanations for persistence are discussed by Barro (1981). This paper suggests a different reason why serially uncorrelated forecast errors may lead to persistent effects on output and employment, namely that forecast errors result in changes in employment, which in turn affect the wage formation process in an economy where unions play an important role.

The model may seem irrelevant for economies like the US, where unions organize only a small fraction of the labor force. It is sometimes claimed, however, that non-unionized firms typically set wages slightly above wages in comparable unionized firms in order to prevent unionization among the firm's own workers. If this behavior is common, the argument presented in this paper may apply also to economies in which a relatively small fraction of the labor force is organized.

Finally, in the present model there is a very sharp distinction between employed and unemployed workers, since previously employed workers have a "first shot" at whatever jobs that are offered in the current period. On the other hand there is no seniority ranking within the group of employed workers since layoffs are made by random draw. These assumptions serve to highlight the conflict of interest between employed and unemployed workers. But the assumption about layoffs by random draw is not essential to the argument. What is essential is that wage decisions primarily reflect the interest of the insiders. If, for instance, layoffs were done by seniority, and if not all workers laid off in any period stayed with the firm, the main result would remain qualitatively unaffected.

11 Horn and Wolinsky (1985) show analytically how such behaviour may be profitable to the firm.
Appendix

Define $\tilde{\gamma}_2 = x_1 / D(w_2)$ and let

$$\tilde{\Pi}(\tilde{\gamma}_2) = \int_0^\infty \min(\gamma_2 / \tilde{\gamma}_2, 1) \, dF(\gamma_2).$$

Further, let the labor demand function be $D(w_2) = w_2^{-\varepsilon}$, and let the utility function be $V(w_2) = w_2^\alpha$. The first order condition can then be written

$$\varepsilon \, E(x_1 / w_2^{-\varepsilon}) + \frac{\alpha}{1 - v^u / w_2^\alpha} = 0,$$

where $E(\tilde{\gamma}_2)$ is the elasticity of $\tilde{\Pi}$ with respect to $\tilde{\gamma}_2$. Assuming that the second order condition is fulfilled, the effect of a change in $x_1$ on the wage hence depends on whether $E(\tilde{\gamma}_2)$ increases or decreases in $\tilde{\gamma}_2$.

It is possible to show that if the distribution $F(\gamma_2)$ is unimodal with a peak at $\gamma_2 = \gamma^0$, then $E(\tilde{\gamma}_2)$ decreases in $\tilde{\gamma}_2$ at least for $\tilde{\gamma}_2 < \gamma^0$. One can further show that for $\alpha$ and $v^u$ sufficiently small, the latter condition will be fulfilled, so that a reduction in $x_1$ implies a higher wage and lower expected employment in period 2.

Also, one can show that if the distribution $F$ is uniform, the above result will hold independently of the degree of risk aversion.
REFERENCES


