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COUNTER-INFLATIONARY POLICY IN A UNIONISED ECONOMY
WITH NON-SYNCHRONISED WAGE SETTING

by
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ABSTRACT

This paper presents a model of the determination of wages and employment in a unionised economy with non-synchronised wage-setting. It is shown that a monetary deflation can lead to prolonged unemployment even though the unions act rationally and with full information about the change in policy. The model generates a "statistical" Phillips curve in which the rate of change of money wages depends on the anticipated growth rate of the money supply and on "disequilibrium" unemployment. Conventional incomes policies are shown to have desirable social effects but run counter to the perceived self-interest of the trade unions and are therefore likely to be resisted. Taxes on wage increases have desirable long-run effects, but do not appear able to reduce the transitional unemployment costs of monetary deflation.

COUNTER-INFLATIONARY POLICY IN A UNIONISED ECONOMY
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R. Jackman*

As a stylised fact, it appears that the more synchronised a country's system of wage bargaining the more flexible its aggregate wage level. At one extreme, according to Blyth (1979 p.79), Japan is the "clear and classic example" of a country with a "wage round concentrated into a relatively short period of time with a lengthy interval between wage rounds" while at the other, the United States is characterised by a "wage round spread over a long period of time, in which individual unions negotiate in sequence". Gordon (1982) has contrasted the "remarkable" degree of wage flexibility in Japan with the "unique nature of the sluggish wage response in the United States" (p.22), which he attributes at least in part to the synchronisation of Japanese wage bargaining. In an earlier paper, Sachs (1979 pp.303-306) had linked the flexibility of money wages in Germany, as compared to their rigidity in the United States, in part to the synchronisation of wage contracts in Germany.

This paper proposes a model which is consistent with these observations. In common with the recent and well-known work of Phelps (1978) and Taylor (e.g. 1980), it attributes nominal inertia in the economy to the existence of non-synchronised money wage contracts. However, in those papers the wage setting equation takes a form originally proposed by Phelps (1970), namely

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that the wage set in each sector depends on the average level of wages expected to prevail over the lifetime of a particular contract moderated by the state of excess demand in the labour market. This particular form of wage equation is not explicitly derived from a model of optimising behaviour, and it is therefore difficult to analyse whether (or how) the parameters of the equation may change in response, say, to changes in the government policy regime.

In an earlier paper (Jackman, 1984) I constructed a model of non-synchronised wage setting in which wages are determined by utility maximising trade unions, and showed that such a model would generate the wage setting equations, and the persistence (or nominal inertia) results of the Phelps and Taylor papers. This paper investigates the operation of various counter-inflationary policies within the context of an essentially similar model.

Section 1 of the paper sets out the model and shows that, in the steady state, average real wages and employment are independent of the inflation rate, but the relative wage in the two sectors at any point in time does depend on the rate of inflation. It is this fundamental non-neutrality which prevents the economy adjusting from one steady state inflation rate to another without an accompanying change in real (relative) values. The actual adjustment of the economy to monetary deflation is analysed in Section 2. It is shown that the movement to a lower (steady state) inflation rate may entail prolonged unemployment even though the unions are fully informed about the change in monetary policy.

Section 3 examines the prospects for interventionary policy within such a model. The main results are that incomes policies or other forms of direct intervention in the wage setting process can in principle make everyone better off, but that it is never in the interest of individual unions to adhere to

the policy. (This result can of course be obtained in a wide variety of models.) Fiscal devices such as a tax on wages in excess of a norm operate, as in simpler models, to raise equilibrium employment but, rather curiously, do not appear to assist in easing the economy from a higher to a lower inflationary path.

1. The model with steady state inflation

The basic institutional assumptions of the paper are, in common with those of the Phelps and Taylor models, that wage rates are governed by annual wage contracts which specify a given nominal wage, and that wage contracts are determined in different sectors of the economy at different dates in the year. While these assumptions are obviously in accordance with everyday empirical observation in an economy such as that of the U.K., the theoretical rationale for wage contracts is less clear. For example, Lucas (1981 p.564) has argued that "none of these models offers an explanation as to why people should choose to bind themselves to contracts which appear to be in no-one's self-interest".

In general, however, it seems sufficient to postulate that it costs resources to change nominal wages or prices to generate a model in which it will be optimal for wage and price changes to be infrequent and in which, therefore, markets will generally not be in equilibrium (Mussa, 1981; Rotemberg, 1982). Similar administrative considerations may help explain why contracts are typically of some given length from one time period to the next and are generally not indexed. Initially, I simply assume that wage contracts are not synchronised; the (private and social) benefits of contract synchronisation are discussed later.

In the formal model of the paper we examine an economy with just two trade unions. This simplification eases the exposition very greatly. While in a model with many unions the structure of the system is much the same, the exact characterisation of the disequilibrium adjustment process cannot be determined explicitly. The two union model should thus be regarded as giving some qualitative indication of the type of solution that would be obtained in the general case.* Thus the two unions are not allowed to collude

* An earlier version of this paper (Centre for Labour Economics Working Paper No.493) describes the model with many trade unions.

or behave co-operatively. Each union is modelled as maximising its welfare taking as given the wages set by the other union. The solution thus takes the form of a non-cooperative (Nash) equilibrium.

I assume there are two industries in the economy, each consisting of a large number of firms so that there is perfect competition in the product market. In each industry there is a single trade union to which all workers in the industry belong. Wages in each industry are assumed to be determined by the trade union and common to all firms in the industry. For simplicity, I assume labour is the only factor of production and there are constant returns to scale. Labour is homogeneous so that, by choice of units, output in each industry can be equated with employment, and the product price in each industry with the money wage.

In each industry there are annual wage contracts, but the contract dates are not synchronised. Again for simplicity I assume the contract dates are six months apart so that the model can be analysed in terms of symmetrical half-year periods. For further symmetry, the two industries are assumed the same size in equilibrium (in terms of employment and thus of output shares).

The two industries are denoted A and B, and time periods measured in half-years. Thus the model is one of two-period overlapping contracts. The logarithm of the money wage in period t is denoted $w_{A,t}$ in industry A and $w_{B,t}$ in industry B, and the corresponding product prices are $p_{A,t}$ and $p_{B,t}$ respectively. The average money wage (w_t) and the general price level (p_t) in the economy are defined as fixed weight geometric averages of money wages and of prices in the two industries respectively:

$$w_t = \frac{1}{2} (w_{A,t} + w_{B,t}) \quad (1)$$

$$p_t = \frac{1}{2} (p_{A,t} + p_{B,t}) \quad (2)$$

Since by choice of units $w_{A,t} = p_{A,t}$ and $w_{B,t} = p_{B,t}$ we also have

$$w_t = p_t \quad (3)$$

We next define the product demand curve for each industry. Because the model is symmetric it is only necessary to set down equations for one industry, with exactly equivalent expressions applying to the other. We assume that the demand for the product of industry A in period t is given by

$$y_{A,t} = \bar{a} + (m_t + \bar{v} - p_t) - \gamma(p_{A,t} - p_t)$$

where all the variables are expressed in logarithms, $y_{A,t}$ is industry A output in time t , $\bar{a}$ is a constant, m_t is the nominal money stock, and $\bar{v}$ the velocity of circulation of money. The second term in the expression, $(m_t - p_t - \bar{v})$, measures real aggregate demand, and the third the price of elasticity of demand for the product.* Since aggregate demand is not the focus of interest of this paper it is modelled in the simplest possible way: that is I take the velocity of circulation as constant, and further measure the money stock in units such that $\bar{a} + \bar{v} = 0$. The demand function then simplifies to

$$y_{A,t} = m_t - p_t - \gamma(p_{A,t} - p_t)$$

whence, from (1), (2) and (3),

$$y_{A,t} = m_t - \frac{1}{2} (1+\gamma)w_{A,t} - \frac{1}{2} (1-\gamma)w_{B,t} \quad (4)$$

* This demand function has recently been used by Rotemberg (1982).

We assume that, when the union sets a wage of $w_{A,t}$ to take effect for the two periods t and $t+1$, it at the same time determines a level of employment $l_{A,t}$ also to take effect for the two periods t and $t+1$. The firm sets a level of employment sufficient to satisfy the average level of product demand over the two periods (it could, for example, be assumed that it is costless to hold inventories of the finished product). Then, recalling that units have been chosen such that employment is equal to output, we have

$$\begin{aligned} l_{A,t} &= \frac{1}{2} (y_{A,t} + y_{A,t+1}) \\ &= \frac{1}{2} (m_t + m_{t+1}^e) - \frac{1}{2} (1+\gamma)w_{A,t} - \frac{1}{4} (1-\gamma)(w_{B,t} + w_{B,t+1}^e) \end{aligned} \quad (5)$$

In setting the wage in period t the union is assumed to know the values of period t variables, but it cannot of course know the values of period $t+1$ variables. Its expectation of the values of such variables is denoted by a superscript e .

We assume that the union is concerned about the level of employment and the average real wage its members obtain over the period of the contract. The average real wage ($x_{A,t}$) is given by

$$x_{A,t} = \frac{1}{2} (w_{A,t} - p_t) + \frac{1}{2} (w_{A,t} - p_{t+1})$$

which, using (1) and (3) can be written

$$x_{A,t} = \frac{1}{2} (w_{A,t} - \frac{1}{2} (w_{B,t} + w_{B,t+1}^e)) \quad (6)$$

Equations (5) and (6) thus describe the constraints facing the industry A union: the level of average real wages and employment it will obtain over the contract by setting any money wage $w_{A,t}$. It remains to specify the union's objective function. Following Dertouzos and Pencavel (1981), it is convenient

to adopt a particular functional form, similar to the Stone-Geary function that has been frequently used in consumer demand analysis. Thus, let the union's utility be given by:

$$V_{A,t} = (x_{A,t} - x_0)^\theta (l_{A,t} - l_0)^{1-\theta} \quad (7)$$

where x_0 and l_0 are exogenously given minimum acceptable, "fallback" or "baseline" levels of real wages and employment. x_0 , l_0 and the parameter θ are assumed common to the two unions.

While the choice of functional form for the union utility function is, of itself, of no fundamental significance, the Stone-Geary specification is particularly convenient because the union's preferences are captured by the single parameter θ , which itself has an obvious interpretation. Thus imagine a situation in which the union faces an exogenously given income, available to be paid out in the form of wages.* The union first calculates the wage cost of providing its minimum acceptable level of wages (x_0) and minimum acceptable level of employment (l_0). If the total income available to it exceeds this amount, the implication of the Stone-Geary form is that it allocates the "discretionary" or "supernumerary" income such that each one per cent of the excess is used to raise real wages by θ per cent and employment by $(1-\theta)$ per cent. If the union is then faced with fluctuations in its income, the extent to which such fluctuations are shared between wages and employment will again depend on the value of θ . If θ is large (close to one) real wages will fluctuate while employment will be stable, and conversely a low value of θ will imply stable real wages and fluctuations in employment.

* Of course in general the total income available to the union will not be independent of the wage it sets.

Thus θ can be interpreted as measuring the union's preferences for wage stability as against employment stability in the face of fluctuations in demand.

The Stone-Geary form may nonetheless be criticised on the grounds that it cannot be derived from individual utility maximisation (as can, for example, the utilitarian function discussed by Oswald, 1982) and hence lacks a proper theoretical rationale. However, the decision-making process of unions does not seem sufficiently well understood to impose any specific requirement on the relationship between union decisions and the welfare of individual members. In particular, unions may not treat all their members equally, but be more concerned with senior and established members than with junior employees or new recruits. In this paper, I do not attempt to impose any internal structure on the political process within the union (Grossman, 1983) but instead adopt a general form of the utility function.

We first solve the system under conditions of steady state inflation. There is a constant, and fully anticipated, growth rate of the money stock at a rate μ , so that

$$m_t = m_0 + \mu t \quad (8)$$

It follows, from (5), (6) and (8), that

$$x_{A,t} = m_0 + \mu t + \frac{1}{2}\mu - \frac{1}{2}(1+\gamma)w_{A,t} - \frac{1}{4}(1-\gamma)(w_{B,t} + w_{B,t+1}^e). \quad (9)$$

The union maximises (7) subject to (6) and (9), so that, for any given expectation of the wage the industry B union will set in period $t+1$, we have the first order condition

$$(1+\gamma)w_{A,t} = \frac{1}{2}(1+\gamma-2\theta)(w_{B,t} + w_{B,t+1}^e) + 2(1+\gamma)(1-\theta)x_0 + 2\theta(m_0 + \mu t + \frac{1}{2}\mu - x_0). \quad (10)$$

If expectations are fulfilled along the steady state inflation path, (10) can be written in the form of a second order difference equation which will hold at each period in time. Let w_t^S be the wage set at the beginning of any period t , by whichever union, so that, in (10) $w_{A,t} = w_t^S$, $w_{B,t} = w_{t-1}^S$ and $w_{B,t+1}^e = w_{t+1}^S$. Then (10) becomes

$$w_{t+1}^S - 2 \frac{1+\gamma}{1+\gamma-2\theta} w_t^S + w_{t-1}^S = -4 \frac{(K+\theta\mu t)}{1+\gamma-2\theta} \quad (11)$$

where

$$K = (1-\theta)(1+\gamma)x_0 + \theta(m_0 + \frac{1}{2}\mu - \ell_0) .$$

~~The particular solution for steady state inflation will take the form~~

$w_t^S = w_0 + \pi t$, from which it may readily be established that

$$w_0 = m_0 + \frac{1}{2}\mu + \frac{1-\theta}{\theta} (1+\gamma)x_0 - \ell_0$$

$$\pi = \mu$$

so that

$$w_t^S = m_0 + \mu t + \frac{1}{2}\mu + \frac{1-\theta}{\theta} (1+\gamma)x_0 - \ell_0 . \quad (12)$$

Equation (12) shows that the money wage set in each period depends not only on the money stock at that point in time ($m_0 + \mu t$) but also on the anticipated inflation rate in such a way as to achieve the desired real wage over the life of the contract. This requires that the current settlement take into account half the monetary growth expected over the period of the contract as represented by the term $\frac{1}{2}\mu$. The final terms of expression (12) takes account of the "real" determinants of the wage: the parameters of the union utility function (θ , x_0 , ℓ_0) and the perceived elasticity of demand it faces (γ).

The steady state equilibrium level of employment in industry A is derived from (9), noting that from (12),

$$\frac{1}{2} (w_{B,t} + w_{B,t+1}^S) = \frac{1}{2} (w_{t-1}^S + w_{t+1}^S) = w_t^S = w_{A,t}$$

and thus

$$\ell_{A,t}^* = \ell_0 - \frac{1-\theta}{\theta} (1+\gamma)x_0. \quad (13)$$

Also, from (6) and (12), in the steady state the average real wage

$$x_{A,t}^* = 0 \quad (14)$$

Thus, in the steady state, inflation is neutral. Employment and the real wage over the contract period are independent of the (fully anticipated) inflation rate.* Employment is determined by the preferences of the trade unions and by the demand elasticity they face (the measure of their monopoly power). In interpreting equations (13) and (14) it should be noted that $x_0 < 0$, because by choice of units the logarithm of the actual real wage is zero and $x_0 < x$. Hence $\frac{d\ell^*}{d\gamma} > 0$, $\frac{d\ell^*}{d\theta} < 0$ and $\ell^* > \ell_0$, as the logic of the model requires.

Within the annual contract, the variance of employment has been assumed to be zero, but the variance of the real wage depends on the inflation rate. (The variance is $\frac{1}{4} \mu^2$.) It is apparent from (12) that the timepath of money wages in the economy will follow the "leap-frogging" pattern depicted in Figure 1. The relative wage of the two groups at any point in time depends on the expected rate of inflation, and this constitutes the basic non-neutrality in the model.

* This result appears inconsistent with the conclusion reached in an early paper by Akerlof (1969). Akerlof sets up a model of two unions and overlapping wage contracts within which there would be a long-run trade-off between employment and the (fully anticipated) inflation rate. However, Akerlof's result appears to depend on the assumption that government policy can affect the level of real aggregate demand.

2. Monetary deflation

We next investigate the dynamics of adjustment in response to a change in the rate of growth of the money supply. To be specific, we assume the money supply up to time $t=0$ has been growing at a constant and fully anticipated rate of μ_1 , and that at time $t=0$ a new policy entailing a slower, but again constant, growth rate of the money supply of μ_2 is introduced. Once introduced, the new policy is assumed to be credible, and expectations of monetary growth in wage determination are based upon it. However, the wage set at time $t=0$, determined before the change in policy, embodies expectations of the previous monetary growth (and inflation) rate μ_1 .

This example is intended to capture in a relatively simple way the idea that at the point in time at which any change in monetary policy is introduced there will exist in the economy nominal contracts embodying expectations of the previous inflation rate. Thus, at time $t=0$ and expecting a monetary growth rate of μ_1 , union A sets a wage $w_{A,t} = m_0 + \frac{1}{2} \mu_1 + \frac{1-\theta}{\theta} (1+\gamma)x_0 - \ell_0$ (from (12)). By contrast, the union A wage on the new steady state path is given by

$$\hat{w}_{A,t} = m_0 + \frac{1}{2} \mu_2 + \frac{1-\theta}{\theta} (1+\gamma)x_0 - \ell_0 .$$

Thus, in the event of an unanticipated change in monetary growth, the economy will find itself "off" the new steady state path, and it is thus necessary to examine the adjustment path out of equilibrium. For this purpose it is convenient to split up the wage set in period t into its "equilibrium" and "disequilibrium" components. The equilibrium component is that along the steady state inflation path given by the level of the money stock at time $t=0$ and its growth rate μ_2 . Thus, denoting the two components, by $\hat{w}_t^s$ and δ_t , we have

$$\hat{w}_t^S = m_0 + \frac{1}{2} \mu_2 + \mu_2 t + \frac{1-\theta}{\theta} (1+\gamma)x_0 - x_0 \quad (15)$$

$$w_t^S = \hat{w}_t^S + \delta_t \quad (16)$$

and the initial condition

$$\delta_0 = \frac{1}{2} (\mu_1 - \mu_2) \quad (17)$$

The solution to this system follows Taylor (1979). It is assumed that, along the adjustment path, expectations are fulfilled (this being the only adjustment path consistent with rational expectations) and hence that equation (11) for the time path of wages continues to hold. Substituting (15) and (16) into (11) gives a second order difference equation in δ_t

$$\delta_{t+1} - 2 \frac{1+\gamma}{1+\gamma-2\theta} \delta_t + \delta_{t-1} = 0 \quad (18)$$

The solution to (18) given the initial condition (17) takes the form

$$\delta_t = \frac{1}{2} (\mu_1 - \mu_2) \lambda^t \quad (19)$$

where

$$\lambda = \frac{1+\gamma}{1+\gamma-2\theta} \pm \sqrt{\left(\frac{1+\gamma}{1+\gamma-2\theta}\right)^2 - 1}$$

If, following standard procedure, we confine attention to values of λ corresponding to stable roots (on the grounds that unions will not choose an adjustment path that leads them ever further away from their desired position) it is apparent that λ takes the sign of the expression $(1+\gamma-2\theta)$. If unions have a preference for real wage stability over employment stability, which appears to be the empirically relevant case, we have $\theta < 0.5$ and hence $\lambda > 0$.

Even if $\theta > 0.5$, even moderate values of the demand elasticity (e.g. $\gamma = 1$) will be sufficient to ensure $\lambda > 0$. In what follows we therefore assume $\lambda > 0$ and that wages follow a timepath of monotonic convergence to equilibrium.*

The speed of convergence depends, of course, on the value of λ . In particular, as $\theta \rightarrow 0$ (or $\gamma \rightarrow \infty$), $\lambda \rightarrow 1$ and the timepath of adjustment becomes extremely slow. To see why this is, it is instructive to compute the level of real wages and of "disequilibrium" unemployment over the contract period along the adjustment path.

From (6), (14), (16) and (19) we have

$$x_{A,t} = -\frac{1}{8} (\mu_1 - \mu_2)(1-\lambda)^2 \lambda^{t-1} \quad (20)$$

which may be expressed as a proportion of existing disequilibrium (δ_{t-1}):

$$\frac{x_{A,t}}{\delta_{t-1}} = -\frac{1}{4} (1-\lambda)^2$$

so that the higher is λ (in the range $0 < \lambda < 1$) the smaller the real wage loss over the contract period.

Writing disequilibrium unemployment as $u_{A,t}$ where

$$u_{A,t} = \ell_{A,t}^* - \ell_{A,t}$$

we have, from (9), (13), (16) and (19)

$$u_{A,t} = \frac{1}{8} (\mu_1 - \mu_2) \lambda^{t-1} ((1+\lambda)^2 - \gamma(1-\lambda)^2) \quad (21)$$

* If λ were very small and θ close to one, giving $\lambda < 0$, the timepath of wages would oscillate. The first union to set its wage would "overshoot" the new equilibrium, the second union would make only a much smaller adjustment. The two unions would then converge on the equilibrium wage one from above and one from below.

or

$$\frac{u_{A,t}}{\delta_{t-1}} = \frac{1}{4} ((1+\lambda)^2 - \gamma(1-\lambda)^2)$$

the higher the value of λ the greater the level of unemployment (in relation to the existing disequilibrium).^{*}

Thus, confronted by a monetary deflation, each union has to choose, when it sets its wage contract, to what extent it will suffer the adjustment in the form of lower real wages and to what extent in the form of higher unemployment. It may, at first sight, appear strange that each union, in setting its wage suffers a real wage loss over the period of the contract given that at any point in time the sum of real wages in the economy is constant. However,

* It might appear that, if γ is large, monetary deflation might be associated with a negative value of $u_{A,t}$ (i.e. a fall rather than a rise in unemployment). In fact this cannot happen because the value of λ depends on γ and a high value of γ will be associated with a low value of λ .

$$\begin{aligned} \frac{u_{A,t}}{\delta_{t-1}} &= \frac{1}{4} ((1+\lambda)^2 - \gamma(1-\lambda)^2) \\ &= \frac{1}{4} ((1+\gamma)2\lambda + (1-\gamma)(1+\lambda^2)) \end{aligned}$$

but from the expression for λ set out below equation (19)

$$(1+\gamma)2\lambda = (1+\gamma-2\theta)(1+\lambda^2)$$

Hence

$$\begin{aligned} \frac{u_{A,t}}{\delta_{t-1}} &= \frac{1}{4} ((1+\lambda^2)(1+\gamma-2\theta+1-\gamma)) \\ &= \frac{1}{2} (1-\theta)(1+\lambda^2) > 0. \end{aligned}$$

this outcome is a simple consequence of overlapping contracts. The union which sets its wage immediately prior to the monetary deflation unintentionally enjoys a substantial real wage gain. The corresponding contemporaneous wage loss of the other union is shuttled forward through time by the overlapping contract structure. A simple numerical example is given in Table 1 (see also Blanchard, 1983, pp.10-13).

Each union has the choice when it sets its wage of selecting a wage which returns it quickly to the equilibrium path, or of maintaining its relative wage and thereby perpetuating the disequilibrium. The former option (of rapid adjustment) means choosing of low value of λ , which maximises the loss of real wages but minimises unemployment. By contrast slower adjustment means a smaller loss of real wages but higher unemployment. Hence, the speed of adjustment will depend on the union's preferences. If θ is small, the union prefers employment instability to real wage instability. It thus chooses a slow adjustment path. If θ is large (in the range $0 < \theta < 1$), the union prefers wage instability to employment instability and it chooses a more rapid adjustment path. Hence the speed of adjustment (λ) depends on the unions' preferences as derived formally in equation (19).

The speed of adjustment also depends on the demand elasticity, γ . The reason for this can be seen in equations (20) and (21). The real wage costs of any given adjustment path are unaffected by γ , but the unemployment costs are lower the higher is γ . Thus a high value of the demand elasticity reduces the actual cost of the slow adjustment paths to a greater extent, and hence

favours slower adjustment.*

We turn now to the behaviour of money wages and unemployment in the economy as a whole. The average money wage at any point in time

$$\begin{aligned} w_t &= \frac{1}{2} (w_t^S + w_{t-1}^S) \\ &= m_0 + \mu_2 t + \frac{1-\theta}{\theta} (1+\gamma)x_0 - \ell_0 + \frac{1}{4} (\mu_1 - \mu_2)(1+\lambda)\lambda^{t-1} \end{aligned} \quad (22)$$

and the aggregate unemployment rate

$$\begin{aligned} u_t &= \frac{1}{2} (u_{A,t} + u_{B,t}) \\ &= \frac{1}{16} (\mu_1 - \mu_2)((1+\lambda)^2 - \gamma(1-\lambda)^2)(1+\lambda)\lambda^{t-2} \end{aligned} \quad (23)$$

The time series relationship between the change in aggregate wages and disequilibrium unemployment thus takes the form of a "statistical" Phillips curve. The nominal shock can be substituted out from equations (22) and (23) to give

$$w_t - w_{t-1} = \mu_2 - \frac{4(1-\lambda)}{(1+\lambda)^2 - \gamma(1-\lambda)^2} u_t \quad (24)$$

This Phillips curve has the same form as that discussed, e.g., by Buiter and Miller (1981). The first term is a representation of the underlying rate of inflation (monetary growth rate) and the second term a disequilibrium adjustment factor.

* It is also the case that as $\gamma \rightarrow \infty$, $\lambda \rightarrow 1$. This case is similar to that discussed in recent models by Begg (1982) and Blanchard (1983). Each union sets its wage an infinitesimal amount below that of the other union, but the reduction is sufficient to restore its desired level of employment. In their models, demand shifts back and forth from one sector to the other, leaving unemployment in the sector with the higher wage. Only as money wages gradually edge down and the average money wage level falls, can aggregate employment start to recover. While these assumption do generate nominal inertia, they do so only at the expense of a wholly implausible characterisation of the behaviour of unemployment.

Without wishing to take the model too literally, it is interesting to calculate the magnitudes of the parameters γ and θ consistent with the estimated impact of unemployment on the rate of change of money wages in empirical Phillips curves. In equation (24) the time period is taken as half the length of the wage contract. The corresponding equation on an annual (two period) basis generated by the model is

$$w_T - w_{T-1} = 2\mu_2 - \frac{4(1-\lambda^2)}{(1+\lambda)^2 - \gamma(1-\lambda)^2} u_T \quad (24')$$

If the typical order of magnitude of the coefficient on unemployment in wage equations is unity, and we set $\gamma = 1$, the implied value of λ is 0.6 which in turn implies a value for θ of 0.1. This value of θ is low implying that unions have a strong preference for real wage stability over employment stability.

3. Interventionary policies

In the model described in this paper, neither the equilibrium path nor the disequilibrium adjustment process is socially efficient. Both can be affected either by direct controls (or other non-market devices) or by fiscal incentives. I first, and rather briefly, examine "permanent" policies that can raise social welfare along the equilibrium path. The second, and longer, part of the section is concerned with policies for reducing the costs of a monetary deflation.

Policies for reducing the "equilibrium" rate of unemployment

Let us first consider the effects of some hypothetical policy of wage restraint. The policy takes the form of each union setting its wage by a factor h lower than the equilibrium level as described by equation (12). If each union were to do this, along the new equilibrium path, employment in each union would be higher than before, by a factor of h , while real wages in each union would be the same. Workers in both industries would gain and no-one would be any worse off.

While wage restraint is in the collective interests of the two unions it is not in their individual interests if they act in isolation. Say, for example, that union B follows the wage restraint policy, and sets a wage in period $t-1$, and is expected to set a wage in period $t+1$ in accordance with the policy. Then

$$w_{B,t-1} = m_0 + \mu(t-1) + \frac{1}{2} \mu + \frac{1-\theta}{\theta} (1+\gamma)x_0 - x_0 - h \quad (12')$$

with a similar expression for $w_{B,t+1}^e$. If union A then maximises the utility of its members taking these decisions of union B as given, the substitution of these union B wage levels in equation (10) gives

$$w_{A,t} = m_0 + \mu t + \frac{1}{2} \mu + \frac{1-\theta}{\theta} (1+\gamma)x_0 - x_0 - (1 - \frac{2\theta}{1+\gamma})h \quad (12'')$$

Except in the extreme cases of $\theta = 0$ or $\gamma = \infty$, we will have $\frac{2\theta}{1+\gamma} > 0$, so that it is not in the individual interests of union A to adhere to the policy.*

In this model, as in many others, the policy of wage restraint can be represented as an example of the "prisoners' dilemma". The extent to which institutional arrangements allow or encourage unions to act in their collective interests may in practice be an important consideration in explaining why "equilibrium" unemployment rates differ between countries.

A second "permanent" policy is to reduce the effective elasticity of the demand curve which they face. As shown in equation (13), an increase in γ raises equilibrium employment. One device for increasing the elasticity is to tax wages above some level, remitting the proceeds in the form of, say, a subsidy to employment. The case for an "inflation tax" as presented by Layard and others (e.g. Layard 1982) has been argued largely in terms of its "static" effect on the perceived demand curve facing the union. In the Appendix it is shown that a wage tax, defined as a tax on wage levels in excess of some norm has exactly the same effects as an increase in the demand elasticity and thus raises equilibrium employment.**

Policies to reduce the costs of monetary deflation

In Section 2 of the paper it was shown that a monetary deflation reducing the long run inflation rate would be associated with transitional or disequilibrium unemployment in excess of the equilibrium rate. This section examines whether interventionary policies can reduce the amount or duration of such disequilibrium unemployment.

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- * In these circumstances, union A might well reckon that it would also be in union B's interests to break the policy, in which case the policy would collapse immediately.
 - ** In general in the steady state a tax on wage increases above a "norm" rate of increase levied at a rate t is equivalent to a tax on wage levels above some "norm" wage level levied at a rate rt , where r is the real interest rate (Jackman and Layard 1982; Oswald 1984).

We again consider the case of an economy where there has been steady state inflation at a rate μ_1 , and where, at time $t=0$ the government reduces the monetary growth rate to a new steady state rate of μ_2 . It might consider accompanying this monetary policy with an incomes policy, restricting wage increases to the new monetary growth rate. (Thus the incomes policy would limit wage increases to $2\mu_2$ since wages are set for two periods at a time).

Assuming the unions were to adhere to the incomes policy, it would clearly be successful, in the economy as a whole, in containing wage growth and thus in preventing the emergence of any transitional unemployment. But this success would be achieved at the expense of perpetuating an inappropriate structure of relative wages. As already noted, the structure of relative wages at each point in time depends on the underlying (or expected) rate of inflation. If the rate of inflation is reduced, wage relativities must change. The incomes policy prevents such an adjustment being made.

The operation of the policy is set out in Table 2. Up to period 0 the money stock grows at a steady rate μ_1 and the wages of the two unions jump about it as in the leapfrogging pattern depicted in Figure 1. In period 0, the incomes policy is introduced to accompany the slowdown in monetary growth. Thus in period 1 union A gets a wage increase of $2\mu_2$, as does union B in period 2. The general level of wages then grows at a rate μ_2 equal to the growth of the money supply and hence there is no transitional unemployment. However, the average wage of union A over periods 1 and 2 is $(-\frac{1}{2}\mu_1 + 2\mu_2)$ while that of union B is $(\frac{1}{2}\mu_1 + \mu_2)$. Union B's wage exceeds that of union A, on average, by $\frac{1}{2}(\mu_1 - \mu_2)$ and this difference will persist indefinitely. It will not be in the interest of either union to adhere to the incomes policy.

An alternative form of incomes policy is one in which each settlement is required to be a certain amount lower than the one which preceded it. (An example of such a policy is the "n-1" rule for public sector pay settlements introduced by the Heath Government in the U.K. in the early 1970s, or the Canadian wage and price controls of 1975-78 (see Reid, 1982).)

The rate of deceleration of successive wage claims, along the unions' desired adjustment path can be derived from equation (22). It is

$$(w_t^S - w_{t-2}^S) - (w_{t-1}^S - w_{t-3}^S) = \frac{1}{4} (\mu_1 - \mu_2)(1 - \lambda^2)^2 \lambda^{t-4}$$

If this expression is evaluated relative to the disequilibrium at time $t=0$, we have

$$\frac{1}{\delta_0} \left\{ (w_t^S - w_{t-2}^S) - (w_{t-1}^S - w_{t-3}^S) \right\} = (1 - \lambda^2)^2 \lambda^{-4}$$

which is a decreasing function of λ . Thus an incomes policy based on imposing a more rapid rate of pay deceleration than the unions would otherwise choose is equivalent to attempting to impose a lower value of λ . While such a policy leads to a more rapid return to the equilibrium level of employment, it imposes greater real wage cuts on each union at each wage contract. Thus the unions will resist the policy.

Nonetheless, the deceleration policy does have one major advantage over the flat rate policy previously discussed, which is that it does move relative wages towards their equilibrium level. If the policy is imposed for some periods and then removed there need be less pressure for wages to jump to attempt to reach the appropriate relative level. By contrast, the flat rate policy imposes an inappropriate level of relative wages, so that when such a policy is removed, the adjustment of relative wages still has to be tackled.

It might appear that a tax on wage increases would be a natural fiscal device for easing wage increases downwards more rapidly. Rather curiously, however, in the present model, a wage tax turns out to have the opposite effect. If again the wage tax is modelled as a tax on wage levels in excess of some norm, and the rate of growth of the norm above which wages are taxed is reduced in line with the reduced monetary growth rate, the tax is again equivalent in its effects to an increase in the perceived demand elasticity. But, as shown in Section 2, an increase in the demand elasticity tends to slow down the adjustment process.

If we imagine the unions selecting some given speed of adjustment (value of λ) and then the tax being imposed the value of λ remaining unchanged, we have a process in which each wage settlement is closer to the norm than its predecessor. Hence at each contract, each industry will be a net beneficiary from the tax,^{*} and hence for given wages each union will expect higher employment if the tax exists than if it does not. The union thus chooses a slower adjustment path.

While it is not possible to solve explicitly for the effects of a tax levied specifically on wage increases, during the adjustment process each wage increase is lower than its predecessor, and, as is shown in the Appendix, a tax on wage increases redistributes towards industries whose wage increases are smaller than their predecessors. Hence the redistributive effects of a tax on wage increases operate in the same way as those of a tax on wage levels in excess of a norm. The employment effects will go in the same direction, and hence one would expect the effects on the speed of adjustment to be similar.

* Each union can benefit from the tax over the lifetime of each contract even though the net proceeds of the tax are zero at each point in time.

4. Concluding remarks

The model described in this paper is one in which attempts by governments to reduce inflation by policies of monetary contraction can lead to prolonged recession. The mechanism through which this occurs does not depend on misperceptions about relative prices or policy variables, or on arbitrary expectations formation processes or on any lack of credibility of government policy pronouncements. The unions, whose wage setting determines the macroeconomic behaviour of the system are throughout rational and fully informed.

The crucial assumptions necessary to obtain our results are first that unions are concerned only with the well-being of their own members and not with the economic welfare of the community as a whole, and second that wage bargaining is non-synchronised (and non-indexed). As a result of the first of these assumptions, equilibrium is inefficient in that each union attempts to improve its own position by raising its money wage, but since the other union is doing exactly the same neither union gains an increase in real wages but prices rise and, in the economy as a whole, output and employment fall. (The inefficiency would thus disappear in a highly centralised economy with a single union, or in an economy where unions behaved in a co-operative rather than a self-interested manner.)

Given that the cost of monetary deflation in this paper arises because of the non-synchronisation of union wage contracts, it is natural to ask why contracts are not more closely synchronised. Clearly, the synchronisation of wage contracts requires first a recognition by individual unions that synchronisation is in their individual interests and second institutional

arrangements to achieve a co-ordination of wage contract dates. The benefit of pay synchronisation is that it reduces short-term employment fluctuations. However, it may be that unions are not greatly concerned about this problem.* Each union may have individual reasons for preferring particular settlement dates, and it may also value the flexibility of being able to vary its settlement date independently of other sectors.

In most countries where pay bargaining is decentralised, wage contract dates tend to be spread out rather regularly so that no individual union can, by choice of its own contract date, do much to affect the overall degree of synchronisation. Nor, in an economy with many unions, will it necessarily be easy for an individual union to organise collective action. It follows that pay synchronisation, even if socially desirable, is unlikely to arise spontaneously in a market economy. There are of course exceptions. In Japan, wage bargaining is decentralised but the largest of the labour federations were able to introduce a system of synchronised wage bargaining (the Shunto, or "spring wage offensive") which has remained in place since 1955. The particular political and historical circumstances of Japan in the 1950s find no parallel elsewhere, however (Gordon, 1982 p.37).

The assumptions of self-interested unions and non-synchronised wage setting are sufficient to generate nominal wage inertia. The degree of such inertia depends, as shown in Section 2, on the union's preferences and for the model to generate a speed of response consistent with empirical estimates it is necessary for unions to have a strong preference for wage stability as against employment

* Even if they were, it may be noted that the analysis of this paper has been concerned with only one possible type of shock, i.e. a shock to aggregate demand. Non-synchronised wage setting may reduce employment fluctuations in response to other types of shocks, .g. shocks to relative demands (Fethke and Policiano, 1982).

stability. One possible explanation is that while wage fluctuations affect all members of a union, employment fluctuations, because of the last-in-first-out convention, affect only recent and potential new recruits. A preference in the union utility function for wage stability thus represents a situation in which senior and established workers protect their pay packets at the expense of the employment opportunities of junior workers and those currently unemployed. It should be stressed, however, that the Stone-Geary formulation simply allows a representation of such behaviour; it is not in any way derived from an optimising behaviour of a union with such characteristics.

Turning to policy, the paper has analysed the case of an unheralded (and hence unanticipated) reduction in the monetary growth rate which once announced is assumed entirely credible and hence fully incorporated into expectations. This representation of policy is not intended to be particularly realistic but rather to provide an example of a nominal shock and to abstract from problems of misperceptions, credibility and so on. It is reasonable to ask whether some other form of monetary policy might be more sensible, given the assumptions of the model. In one of the first papers on the consequences of non-synchronised wage setting, Phelps (1978) showed that a gradualist policy of monetary contraction could reduce the output costs of disinflation. In his model, the form of the wage-setting equation was invariant with respect to the monetary policy rule, so his results do not carry over directly to the present model. Even so, it seems likely that a gradualist monetary policy would be less costly, since it would provide time for a required adjustment of relative prices. But it is clearly a limitation of the analysis of this paper that (in common with much recent literature) it assumes private sector behaviour rational and optimising, while government policy is taken as exogenous and arbitrary.

APPENDIX

The effect of a wage tax

We assume the tax takes the form of the government stipulating a norm for wages set in each period, expressed in terms of a wage level $\bar{w}_t$. In the steady state the wage norm increases at the monetary growth rate μ . Thus

$$\bar{w}_t = \bar{w}_0 + \mu t$$

The wage tax takes the form of a tax at rate τ on wages in excess of the norm, remitted in the form of a lump sum (per capita) subsidy, s . Thus if union A sets a wage of $w_{A,t}$ in period t , its tax liability is given by

$$\tau(w_{A,t} - \bar{w}_t) - s_t$$

If at the same time, union B has a wage (set in the previous period) of $w_{B,t-1}$, the tax liability of firms in the B industry is given by

$$\tau(w_{B,t-1} - \bar{w}_{t-1}) - s_t$$

If the tax-subsidy scheme is known to be operated in such a way that, in aggregate, its net revenue yield is zero, it follows that each union cannot take the other union's wage, the tax rate and the subsidy as given. Assume therefore that the tax rate is given, and the subsidy adjusted to ensure budget balance. The unions therefore assume the subsidy will be determined by the balanced budget condition

$$2s_t = \tau(w_{A,t} - \bar{w}_t) + \tau(w_{B,t-1} - \bar{w}_{t-1})$$

Since firms are competitive, the net tax burden in each sector will be passed on in the form of higher prices. Hence

$$\begin{aligned}
 P_{A,t} &= w_{A,t} + \tau(w_{A,t} - \bar{w}_t) - s_t \\
 &= w_{A,t} + \frac{1}{2}\tau(w_{A,t} - \bar{w}_t) - \frac{1}{2}\tau(w_{B,t-1} - \bar{w}_{t-1})
 \end{aligned} \tag{A.1}$$

The industry A product price depends positively on the excess wage in industry A and negatively on the excess wage in industry B. There is a corresponding price equation for industry B, so that, in aggregate the tax terms drop out and the aggregate price level is again equal to the general level of wages

$$P_t = w_t = \frac{1}{2}(w_{A,t} + w_{B,t}) \tag{A.2}$$

The union in industry A chooses its wages by the same procedure as in Section 1 of the text. The corresponding equations for output, employment and the real wage are:

$$\begin{aligned}
 y_{A,t} &= m_t - p_t - \gamma(p_{A,t} - p_t) \\
 &= m_t - \frac{1}{2}(1+\gamma(1+\tau))w_{A,t} - \frac{1}{2}(1-\gamma(1+\tau))w_{B,t} - \frac{1}{2}\gamma\tau(\bar{w}_t - \bar{w}_{t-1})
 \end{aligned} \tag{A.3}$$

The next period's output

$$\begin{aligned}
 y_{A,t+1} &= m_{t+1} - p_{t+1} - \gamma(p_{A,t+1} - p_{t+1}) \\
 &= m_{t+1} - \frac{1}{2}(1+\gamma(1+\tau))w_{A,t} - \frac{1}{2}(1-\gamma(1+\tau))w_{B,t+1} - \frac{1}{2}\gamma\tau(\bar{w}_t - \bar{w}_{t+1})
 \end{aligned}$$

Hence, employment is given by

$$l_{A,t} = \tilde{m}_t - \frac{1}{2}(1+\gamma(1+\tau))w_{A,t} - \frac{1}{2}(1-\gamma(1+\tau))\tilde{w}_{B,t} \tag{A.4}$$

where

$$\tilde{m}_t = \frac{1}{2}(m_t + m_{t+1}) = m_0 + \mu t + \frac{1}{2}\mu$$

$$\tilde{w}_{B,t} = \frac{1}{2}(w_{B,t} + w_{B,t+1})$$

and note that, on account of the rule for setting the pay norms $\bar{w}$, the terms in $\bar{w}$ sum to zero. The real wage is defined, as before, by

$$x_{A,t} = \frac{1}{2} (w_{A,t} - \tilde{w}_{B,t}) \quad (A.5)$$

Evidently the system described by (A.4) and (A.5) is the exact counterpart of that of the text with γ replaced by $\gamma(1+\tau)$ throughout. The money wage is thus the same at each point in time, and equilibrium employment higher, as can be seen from equations (12) and (13) (recalling that $x_0 < 0$).

The analysis of a tax on wage increases is more complex. Let the tax take the form of a proportional tax on wage increases in excess of some fixed norm, $\bar{n}$, the tax proceeds again being remitted in the form of a lump sum (per capita) subsidy, s . Thus if union A sets a wage of $w_{A,t}$ at time t , its tax liability is given by

$$\tau(w_{A,t} - w_{A,t-2} - \bar{n}) - s_t$$

The corresponding tax liability in industry B in the same time period is

$$\tau(w_{B,t-1} - w_{B,t-3} - \bar{n}) - s_t$$

Proceeding as before, we have

$$2s_t = \tau(w_{A,t} - w_{A,t-2} - \bar{n}) + \tau(w_{B,t-1} - w_{B,t-3} - \bar{n})$$

and

$$\begin{aligned} p_{A,t} &= w_{A,t} + \tau(w_{A,t} - w_{A,t-2} - \bar{n}) - s_t \\ &= w_{A,t} + \frac{1}{2} \tau(w_{A,t} - w_{A,t-2}) - \frac{1}{2} \tau(w_{B,t-1} - w_{B,t-3}) \end{aligned} \quad (A.6)$$

The industry A product price is increased if wages in industry A, rise more rapidly than in industry B and is reduced if wages rise more slowly. Given that the tax proceeds are remitted by the subsidy, the norm is irrelevant to the redistributive effects of the tax. The aggregate price level is again given by equation (A.2). Hence

$$\begin{aligned} \ell_{A,t} = & \tilde{m}_t - \frac{1}{2} (1+\gamma(1+\tau))w_{A,t} - \frac{1}{4} (1-\gamma(1+\tau))w_{B,t+1} \\ & - \frac{1}{4} (1-\gamma)w_{B,t-1} + \frac{1}{2} \gamma \tau w_{A,t-2} - \frac{1}{4} \gamma \tau w_{B,t-3} \end{aligned} \quad (A.7)$$

Equation (A.7) indicates why the analysis of a tax on wage increases is not straightforward. Employment in industry A in periods t and $t+1$ depends not only on the wage set in industry A in period t , and the wages set in industry B, but also on the wage set in industry A in period $t-2$, which constitutes the base for the calculation of the tax. It follows that, in setting a wage in period t , the A union must take into account not only the direct effects on employment in period t of that wage, but also of the effect on employment in periods $t+2$ and $t+3$. The optimisation exercise thus involves a sixth order, in place of a second order, difference equation.

TABLE 1

Real wages and employment in the adjustment process

Example: let $\mu_1 = 10$ $\mu_2 = 5$ $\lambda = 0.6$ and $m_0 = 100$

Period t	m_t	$w_{A,t}$	$w_{B,t}$	$P_t = w_t$	$w_{A,t} - P_t$	$w_{B,t} - P_t$	$x_{A,t}$	$x_{B,t}$
-2	80	85	75	80	+5	-5	0	
-1	90	85	95	90	-5	+5		0
0	100	105	95	100	+5	-5	+1.5	
1	105	105	109	107	-2	+2		-0.1
2	110	113.4	109	111.2	+2.2	-2.2	-0.06	
3	115	113.4	118.04	115.72	-2.32	+2.32		-0.036
4	120	122.82	118.04	120.43	+2.39	-2.39	-0.022	
5	125	122.82	127.69	125.26	-2.44	+2.44		-0.013
6	130	132.61	127.69	130.15	+2.46	-2.46	-0.008	
7	135	132.61	137.57	135.09	-2.48	+2.48		

Note: The figures in the example are calculated to three decimal places in the last two columns (two elsewhere) and do not necessarily add up due to rounding.

TABLE 2

The operation of incomes policy

<u>Period</u>	t	-2	-1	0	1	2
<u>Money stock</u>	m_t	$-2\mu_1$	$-\mu_1$	0	μ_2	$2\mu_2$
<u>Money wage</u>	$w_{A,t}$	$-2 \frac{1}{2} \mu_1$	$-\frac{1}{2} \mu_1$	$-\frac{1}{2} \mu_1$	$-\frac{1}{2} \mu_1 + 2\mu_2$	$-\frac{1}{2} \mu_1 + 2\mu_2$
	$w_{B,t}$	$-1 \frac{1}{2} \mu_1$	$-1 \frac{1}{2} \mu_1$	$\frac{1}{2} \mu_1$	$\frac{1}{2} \mu_1$	$\frac{1}{2} \mu_1 + 2\mu_2$
	w_t	$-2\mu_1$	$-\mu_1$	0	μ_2	$2\mu_2$

FIGURE 1

Relative wages in the steady state

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