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ABSTRACT

This paper shows that the explicit consideration of the "expected inflation effect" makes it more likely that increases in wage and price flexibility reduce employment variability. This result, obtained in a variant of a model with synchronized contracts presented by Ball, casts doubts on some existing consensus in the literature pointing towards the opposite view. Wage and price flexibility, although ceteris paribus desirable, is however shown to be an inferior substitute for optimally designed demand management.

1. Introduction

The renewed appeal of the "neo-Keynesian" account of economic fluctuations (see, for example, McCallum (1986)) has stimulated an important area of research directed at providing sound microeconomic underpinnings for the rigidity of wages and prices. As stressed by Blanchard (1988), Keynesian macroeconomics came under attack in the early seventies mainly for the difficulty of producing satisfactory theoretical foundations rather than its capability to explain the business cycle. If frictions in the labour and goods markets are the culprits for the observed fluctuations in economic activity, the obvious and most telling criticism is why agents do not make an effort in trying to remove them. This is the essence of Barro's (1977) argument (see Fischer, 1988), questioning the theoretical and practical relevance of the neo-Keynesian approach. Substantial progress has recently been achieved in developing macroeconomic models based on monopolistic competition and near-rational behaviour (see, for example, Akerlof and Yellen (1985), Ball (1987), Blanchard and Kiyotaki (1987), and the reviews by Blanchard (1988) and Fischer (1988)). Price and wage rigidities can be compatible with optimising behaviour of individual agents, although undesirable fluctuations inevitably emerge in the aggregate.

Appropriate macroeconomic cures would appear to be either active demand management or, if at all feasible, sweeping rigidities in the labour and goods markets away. However, it has long been known that increased wage and price flexibility is not necessarily a good thing. Reducing rigidities in the labour and goods markets may exacerbate cycles in economic activity in a non-Walrasian world. For example, Keynes (1936, p.270) argued that the "money wage level as a whole should be maintained as stable as possible, at any rate in the short period". One of the main reasons against price flexibility is that the stabilizing effects of changes in the price level could well be outweighted by the destabilizing effects on aggregate demand of changes in the expected rate of change in the price level. In other words, price flexibility may not only be an unsatisfactory substitute for active demand management but could also lead to greater rather than lower output and employment fluctuations for given monetary and fiscal policies. A proper formalization of these ideas was provided in Tobin's (1975) analysis of the destabilizing effects of wage flexibility in a dynamic context under the hypothesis of adaptive expectations. The issue of the stabilization effects of price flexibility has recently been re-examined both at the theoretical (DeLong and Summers (1986b), Driskill and Sheffrin (1986), Blanchard (1988)) and empirical level (DeLong and Summers (1986a), Summers and Wadhwani (1987)). The theoretical analysis has concentrated on versions of Taylor's (1979, 1980) staggered wages framework. The prevailing consensus in the literature (see, e.g. DeLong and Summers (1986b) and Blanchard (1988)) is that, when inflation expectations and demand shocks are properly taken into account, increased price flexibility may well be destabilizing. The explanation for this result is that, while price flexibility is in one sense stabilizing, the associated change in expected inflation and thus in the ex-ante real interest rate is destabilizing. The latter effect would seem to dominate the former, re-establishing thus the validity of the ideas expressed by Keynes (1936) and Fisher (1923, 1925) and, to some extent, reproducing in a rational expectations framework the results obtained by Tobin (1975) under adaptive expectations. DeLong and Summers (1986b) present simulation results and interpret them as confirming this view.

It should be noted that Taylor's (1979) original model inevitably yields the prediction that an increased responsiveness of wages to excess demand conditions would be stabilizing. It is also worth pointing out that the possibility of destabilizing price flexibility presented by

DeLong and Summers (1986b) requires not only some restrictions on parameter values but also demand shocks to be autoregressive and not approaching a random walk.[1]

This still largely unsettled issue is undoubtedly of considerable importance for macroeconomic analysis and policy design (see Blanchard (1988), Fischer (1988)). However, to our knowledge, it has not attracted yet the deserved attention in the literature. We propose to further investigate this problem together with the effectiveness of countercyclical monetary rules in a variant of a model presented by Ball (1987). This model is particularly interesting, since it is explicitly based on monopolistic competition and therefore offers a satisfactory framework for the analysis of the externalities associated with the existence of contracts. Ball's (1987) claim that wages are too rigid can be interpreted as basically replicating the results emerging from the original Taylor's (1979) model, that is increased wage flexibility, now in the form of reduced contract length, would be stabilizing. It is of interest, therefore, to verify whether explicitly modelling anticipated inflation could produce possible destabilizing effects along the lines described by DeLong and Summers (1986b). Our analytical results show that the expected inflation effect unambiguously strengthens the case for reducing contract length, irrespective of the nature and degree of persistence of demand and supply shocks. It is formally demonstrated that the negative externalities associated with long contracts actually increase. We also show that leaning against the wind policies can be extremely powerful if and only if the expected inflation effect is present.

The scheme of the paper is as follows. Section 2 presents a version of Ball's (1987) model modified to explicitly incorporate the expected inflation effect and demonstrates that increased wage flexibility is likely to be stabilizing. Section 3 considers the case of autoregressive demand shocks and relates the results to earlier findings in the literature. Section 4 illustrates how lagged feedback monetary rules can be effective only in presence of the expected inflation effect and compares their relative desirability versus increasing wage flexibility. A summary of the main results is provided in the concluding Section 5.

2. Expected inflation and wage flexibility

We now provide an appraisal of the expected inflation effect upon aggregate demand, in a rational expectations model with predetermined labour contracts.[2] The specific framework chosen is a variant of the discrete time version of Ball's (1987) model of long-term contracts under monopolistic competition, modified to incorporate inflation expectations. Our aim is to evaluate the implications for employment variability of a shift in the economy from short to longer term contracts.

In a standard monopolistically competitive environment, an individual firm's labour demand depends on the firm's real wage and on aggregate demand (see e.g. Blanchard and Kiyotaki, 1987). An increase in the average contract length in the economy makes nominal wages and prices less responsive to aggregate demand shocks: this dampens the variability of the real wage over the cycle, but exacerbates the variability of aggregate demand. The net effect of longer contracts on the variance of the demand for labour and hence of output will therefore depend on the relative weight of real wages and demand for goods in the firm's labour demand. A single firm decides on the length of the contract with its workers, neglecting the consequences that its decision will have on the aggregate wage and price levels. In so doing, it creates externalities upon the other firms. Ball (1987) shows that shorter contracts than the equilibrium ones would be socially optimal if and only if an increase in contract length creates <u>negative</u> externalities to the single firms, in the sense of increasing the variability of the responses of employment and output to nominal shocks.[3]

We now show that a negative dependence of aggregate demand on the ex-ante real interest rate makes it <u>more</u> likely, in the present context, that increases in contract length generate negative externalities compared to a situation in which this effect is absent; in other words, increased wage and price flexibility is more likely to be desirable[4]. The intuition behind this result is fairly simple: under a long-term contract regime the current price level does not respond to current innovations which are instead always incorporated in the current expectations of the next period price level. Hence, the presence of expected inflation in the labour demand increases the volatility of employment and output over the cycle as labour contracts become longer.

The structure of the model is as follows. The technology of the economy is summarized by the following constant returns to scale production function

$$(1) \qquad y_{it} = \ell_{it}$$

where "i" is a firm-specific index, uniformly distributed over [0,1], and where y_{it} and ℓ_{it} are the logs of output and labour input respectively. The log of the money supply follows the process

$$(2) \qquad m_t = m_{t-1} + \xi_t$$

where ξ_t is a white noise with variance σ_ξ^2. The disturbance ξ_t is an exogenous nominal shock, not controllable by the monetary authorities. The aggregate demand is given by[5]

$$(3) \qquad y_t = \alpha\,(m_t - p_t) + \beta\,(E_t p_{t+1} - p_t) + \eta_t$$

where y_t and p_t are aggregate output and price, respectively:

$$y_t = \int_0^1 y_{it} di \qquad p_t = \int_0^1 p_{it} di$$

and where η_t is a white noise with variance σ_η^2. $E_t\, x_{t+s}$ is the expectation of the variable x_{t+s} conditional on the information set at time t, which contains the structure of the model and all past and current values of the relevant variables; in particular, agents can directly observe the two different demand shocks ξ_t and η_t. The real aggregate demand shock, η_t, is assumed to be serially uncorrelated; this assumption will be relaxed in the next section, where our results will be compared with other results in the literature. In (3), the coefficient $\beta > 0$ represents the negative effect on aggregate demand of expectations of decreasing inflation.

The firms operate under conditions of monopolistic competition. The share of firm "i"'s demand is

(4) $$y_{it} - y_t = - \gamma\, (p_{it} - p_t)$$

where $\gamma > 1$. Substituting (3) into (4) we obtain

(5) $$y_{it} = \alpha\, (m_t - p_t) + \beta\, (E_t\, p_{t+1} - p_t) - \gamma\, (p_{it} - p_t) + \eta_t$$

Using (1) and (5), the profit maximizing demand for labour of firm "i" is[6]

(6) $$\ell_{it} = \alpha\, (m_t - p_t) + \beta\, (E_t\, p_{t+1} - p_t) - \gamma\, (w_{it} - p_t) + \eta_t$$

where w_{it} is the nominal wage. The size of the labour pool of firm "i" is assumed to be wage inelastic and is normalized to zero for analytical convenience. The market clearing level of employment is thus $\ell_{it}^* = 0$. The losses from the discrepancy between actual labour demand and its market clearing level are given by the following quadratic function:

$$(7) \qquad z_{it} = E\left[(\ell_{it} - \ell^{*}_{it})^2 \right] = E(\ell^2_{it})$$

We can now examine the behaviour of wages, prices and employment under different contracting regimes. Formally, we consider contracts spanning either one or two periods and analyse how the loss function and the value of the externalities are affected in each case when $\beta > 0$, that is when the expected inflation effect upon aggregate demand is present, compared to a situation in which such an effect is absent, that is $\beta = 0$. Using (1), (5) and (6) and aggregating, one obtains

$$(8) \qquad p_t = w_t$$

where w_t is the aggregate nominal wage.

When all firms sign contracts which last one period only, they are virtually executing spot contracts and can therefore fix employment at the market clearing level: $\ell_{it} = \ell^{*}_{it} = 0$, which obviously implies $z_{it} = 0$. From (6) and $\ell_{it} = 0$ we have

$$(9) \qquad w_{it} = \frac{\alpha}{\gamma} m_t + \left[1 - \frac{\alpha+\beta}{\gamma}\right] p_t + \frac{\beta}{\gamma} E_t p_{t+1} + \frac{1}{\gamma} \eta_t$$

Aggregating and using (8) one obtains

$$(10) \qquad p_t = \frac{\alpha}{\alpha+\beta} m_t + \frac{\beta}{\alpha+\beta} E_t p_{t+1} + \frac{1}{\alpha+\beta} \eta_t$$

Equation (10) can be solved by the method of undetermined coefficients (see e.g. McCallum, 1983) to obtain[7]

(11) $$p_t = m_t + \frac{1}{\alpha+\beta}\,\eta_t$$

Consider now the case in which all firms predetermine wages for two periods. There is no staggering: all contracts are perfectly synchronized. In the first period, wages are set at the market clearing level and thus equations (9) and (11) still hold true. In the second period wages are set at the level for which $E_{t-1}(\ell_{it}) = 0$. Taking conditional expectations of the labour demand (6) and rearranging we obtain

(12) $$w_{it} = \frac{\alpha}{\gamma} E_{t-1}\, m_t + \left[1 - \frac{\alpha+\beta}{\gamma}\right] E_{t-1}\, p_t + \frac{\beta}{\gamma} E_{t-1}\, p_{t+1} + \frac{1}{\gamma} E_{t-1}\, \eta_t$$

After aggregating and using (8) the solution for the price level turns out to be

(13) $$p_t = m_{t-1}$$

We can now address the issue of the value of externalities in each regime. Since each firm has zero measure, the externalities are defined as 'the effects on firm "i" of a change in the contract lengths of <u>other</u> firms' (Ball, 1987, p.619). If the net externalities from an increase in contract length are negative, then it would be optimal for a social planner to reduce, if possible, the length of the contracts, thereby increasing the degree of flexibility of wages and prices. We show that the presence of the expected inflation effect on aggregate demand makes it indeed <u>more</u> likely that negative externalities might arise.

Let all firms, with the exception of firm "i", move from one to two-period labour contracts. If firm "i" is in a one-period contract, or in the first period of a two-period contract, then the condition $\ell_{it} = 0$ implies that there cannot be any externalities from the behaviour of other firms, since any increase in their contract length will be exactly offset by firm "i". Hence, externalities can only occur in the second period of a two-period contract.

Suppose now that all other firms are in a one-period contract, and firm "i" is in the second period of a two-period contract. Equation (11) for the aggregate price level still holds true, since firm "i"'s behaviour cannot affect aggregate magnitudes. Together with the wage setting equation (12), this implies

$$(14) \qquad w_{it} = m_{t-1}$$

By substitution of (2), (11) and (14) into the labour demand equation (6), we obtain

$$(15) \qquad \ell_{it} = \gamma \, \xi_t + \frac{\gamma}{\alpha+\beta} \eta_t$$

whence, using (7):

$$(16) \qquad z_{it}^{(1)} = \gamma^2 \sigma_\xi^2 + \frac{\gamma^2}{(\alpha+\beta)^2} \sigma_\eta^2$$

The loss function $z_{it}^{(1)}$ is a decreasing function of the parameter β: the variability of employment and output is lower the more responsive aggregate demand is to changes in expected inflation.

The intuition of this result is straightforward. All other firms observe the current realizations of the stochastic shocks and can thus replicate the competitive solution. Wages and prices fully reflect changed demand conditions. The only externality for firm "i" is due to real wage variability. Since its nominal wage is predetermined, the welfare loss is monotonically related to the variance of the aggregate, non-predetermined, price level. Following exogenous demand shocks, the price level will change less since expected inflation varies anticyclically and exerts thus a built-in stabilizing effect on aggregate demand.

Let us now assume that all other firms are in a two-period contract. Equations (12) and (13) imply

(17) $$w_{it} = m_{t-1}$$

By substitution in (6), we obtain

(18) $$\ell_{it} = (\alpha + \beta)\, \xi_t + \eta_t$$

and therefore

(19) $$z_{it}^{(2)} = (\alpha + \beta)^2\, \sigma_\xi^2 + \sigma_\eta^2$$

The loss $z_{it}^{(2)}$ is now an <u>increasing</u> function of the expected inflation effect (as measured by β). In this case externalities arise only from variability in real aggregate demand, since the price level is predetermined. Expected inflation now varies procyclically (following demand shocks) and thus amplifies the destabilizing effects of the exogenous disturbances. The expected inflation effect acts now as an automatic destabilizer.

It follows from (16) and (19) that the necessary and sufficient condition for negative externalities from an increase in contract length (i.e., the condition for $z_{it}^{(1)} < z_{it}^{(2)}$) is

(20) $$\gamma < \alpha + \beta$$

Condition (20) has an immediate interpretation in terms of the parameters of equations (3) and (4). Long-term contracts have a negative net externality if the real wage elasticity of the demand for labour, γ, is lower than the sum of the elasticities of aggregate demand with respect to real money balances, α, and expected inflation, β. The presence of the last term reduces the externalities from short-term contracts and increases the externalities from long-run contracts, thereby making it more likely that the latter are not socially desirable.

The reason why a greater wage and price variability might be preferable is that long contracts, whilst reducing the variability of real wages over the cycle, also enhance the volatility of real money balances and expected inflation: nominal prices are predetermined and do not respond to current shocks, which are instead incorporated in the nominal money level and in inflation expectations.

It should be stressed that out analysis could be criticized on the grounds that the one-period contract regime is observationally equivalent to the Walrasian case. As noted by DeLong and Summers (1986b, 1988), it is hardly surprising that the expected inflation effect is stabilizing in a situation of perfect markets. However, our results do not depend on the particular specification employed, as shown in Appendix B where both contracting regimes are lagged one period. It is demonstrated that the necessary and sufficient condition for negative externalities when the contract length increases is unchanged. Without loss of generality we can thus retain the much simpler framework adopted so far for the following discussion.

3. Persistent demand shocks and externalities

In the previous section we have considered white noise disturbances to aggregate demand. It has been argued by DeLong and Summers (1986b), however, that in a Taylor-type framework with autoregressive demand shocks the expected inflation effect has a destabilizing influence on the level of output. The variance of output is shown to increase, over a certain range of parameter values, as wages become more responsive to excess demand in the goods market or as the length of contracts decreases. In the case of serially uncorrelated disturbances, however, wage flexibility is still stabilizing as in the original Taylor's (1980) model. Hence, some elements of persistence in the demand shocks appear to be necessary in order to generate a destabilization outcome.

In order to investigate this issue in a framework as similar as possible to the model of DeLong and Summers (1986b), we assume that the aggregate demand shock η_t in equation (3) follows a stationary AR(1) process:

(21) $$\eta_t = \rho\, \eta_{t-1} + \epsilon_t$$

where $0 < \rho < 1$ and ϵ_t is white noise with variance σ^2_ϵ. Our model is now given by equations (1) - (7) and (21), and can also be interpreted as a particular case of a policy rule reacting to the contemporaneous nominal interest rate.

Using the same solution procedure as before, we find that in one-period contracts the aggregate price level is given by

(22) $$p_t = m_t + \frac{1}{\alpha+\beta(1-\rho)}\, \eta_t$$

while in two-period contracts it is given by

(23) $$p_t = m_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)}\, \eta_{t-1}$$

If all firms, with the exception of firm "i", are in a one-period contract while firm "i" is in the second period of a two-period contract, the wage set by the latter is equal to

$$(24) \qquad w_{it} = m_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)} \eta_{t-1}$$

from which

$$(25) \qquad \ell_{it} = \gamma \xi_t + \frac{\gamma}{\alpha+\beta(1-\rho)} \epsilon_t$$

and

$$(26) \qquad z_{it}^{(1)} = \gamma^2 \sigma_\xi^2 + \frac{\gamma^2}{[\alpha+\beta(1-\rho)]^2} \sigma_\epsilon^2$$

If instead all other firms are in a two-period contract, then

$$(27) \qquad w_{it} = p_t = m_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)} \eta_{t-1}$$

whence

$$(28) \qquad \ell_{it} = (\alpha+\beta) \xi_t + \frac{\alpha+\beta}{\alpha+\beta(1-\rho)} \epsilon_t$$

and

$$(29) \qquad z_{it}^{(2)} = (\alpha+\beta)^2 \sigma_\xi{}^2 + \left[\frac{\alpha+\beta}{\alpha+\beta(1-\rho)} \right]^2 \sigma_\epsilon^2$$

From (26) and (29) it is apparent that the value of the externalities in either regime is an increasing function of the autoregressive parameter ρ, provided $\beta \neq 0$. The persistence of demand shocks can thus actually increase the volatility of employment and output in presence of the expected inflation effect. When demand shocks are autoregressive, expected inflation varies less in the short contract case (when it is stabilizing) and varies more when the price level is predetermined (that is, when it is destabilizing). This does not imply, of course, that increased wage flexibility in the form of shorter contracts may now be destabilizing. Inspection of (26) and (29) immediately reveals that the necessary and sufficient condition for negative externalities from an increase in contract length is

$$(30) \qquad \gamma < \alpha + \beta$$

which exactly coincides with the condition (20) obtained in the case of serially uncorrelated demand disturbances, that is when $\rho = 0$. The condition is unchanged because the lower stabilizing influence of the expected inflation effect in the short contracts regime is exactly compensated by the greater destabilizing effects in the longer contracts case (see equations (A22b) and (A25b) in Appendix A). The persistence of demand shocks, therefore, does not affect the relative desirability of short versus long-term contracts from a welfare point of view. In particular, the presence of the expected inflation effect still makes it more likely that shorter contracts might be preferred to longer ones, in the sense that they minimize the externalities arising from the existence of contracts in the economy.[8]

4. Active policy and welfare

As demonstrated in the previous sections, increased wage flexibility, in the form of reduced contract length, is more likely to be stabilizing in presence of the expected inflation effect under a passive monetary policy of the kind presented by Driskill and Sheffrin (1986) and DeLong and Summers (1986b). The conclusion emerging from our analysis is that either institutional reforms or policies aimed at penalizing longer contracts, if feasible, ought to improve welfare.

We now turn to the issue of what active demand management can do in such a framework. We investigate the effectiveness of a leaning against the wind policy, that is a rule designed to alter the rate of growth of money around a fixed trend (here normalized to zero, for simplicity) in response to lagged excess demand conditions. Specifically, we assume that the monetary authorities relate the rate of growth of the money supply to the lagged values of the random shocks, which are here assumed to be white noise processes[9]:

(31) $$m_t = m_{t-1} + \xi_t - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1}$$

If all firms follow one-period contracts, the aggregate price level is given by

(32) $$p_t = m_t - \frac{\beta \delta_1}{\alpha+\beta} \xi_t + \frac{1-\beta\delta_2}{\alpha+\beta} \eta_t$$

which clearly collapses to equation (11) when $\delta_1 = \delta_2 = 0$. If by contrast all firms sign two-period contracts, the price level becomes a predetermined variable:

(33) $$p_t = m_{t-1} - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1}$$

which again reduces to (13) for $\delta_1 = \delta_2 = 0$. If now all firms are in a one-period contract while firm "i" is in the second period of a two-period contract, we have

(34) $$w_{it} = m_{t-1} - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1}$$

and

(35) $$\ell_{it} = \frac{\gamma}{\alpha+\beta} \left\{ [\alpha + \beta\ (1-\delta_1)]\ \xi_t + (1 - \beta\ \delta_2)\ \eta_t \right\}$$

and thus

(36) $$z_{it}^{(1)} = \frac{\gamma^2}{(\alpha+\beta)^2} \left\{ [\alpha + \beta\ (1-\delta_1)]^2 \sigma_\xi^2 + (1-\beta\delta_2)^2 \sigma_\eta^2 \right\}$$

It is apparent from (35) and (36) that the monetary authority can reduce to zero the externalities by setting

(37a) $$\delta_1^* = \frac{\alpha+\beta}{\beta}$$

(37b) $$\delta_2^* = \frac{1}{\beta}$$

For the countercyclical policy to be at all viable it must be $\beta > 0$: the presence of the expected inflation effect in the aggregate demand is a necessary condition for the effectiveness of (lagged feedback) active demand management.

If all firms are in the second period of a two-period contract, then

(38) $$w_{it} = p_t = m_{t-1} - \delta_1\ \xi_{t-1} - \delta_2 \eta_{t-1}$$

from which

(39) $$\ell_{it} = [\alpha + \beta\ (1-\delta_1)]\ \xi_t + (1-\beta\delta_2)\ \eta_t$$

and

$$z_{it}^{(2)} = [\alpha + \beta\ (1-\delta_1)]^2\sigma_\xi^2 + (1-\beta\delta_2)^2\sigma_\eta^2 \tag{40}$$

The optimal policy rule is again given by (37a) and (37b). Under this rule, the policy authority makes the choice of contract length completely irrelevant. This can be seen by substituting (31), (37a) and (37b) into the one-period price (32):

$$p_t = m_{t-1} - \delta_1^* \xi_{t-1} - \delta_2^* \eta_{t-1} \tag{41}$$

Under the optimal countercyclical policy, the one-period price will be identical to the two-period price (33)[10].

The intuition of the result is the following. Under a passive monetary growth rule, expected inflation is unaffected by the systematic component of monetary policy (see equations (A12b) and (A13b) in the Appendix). A countercyclical rule, on the other hand, affects expected inflation (equations (A36b) and (A39b)); it thus follows that externalities can be eliminated by optimally choosing the values of the feedback parameters. The channel for policy effectiveness is the existence of a non-predetermined[11] intertemporal substitution term[12], that is the expected inflation effect.

The policy objective is to stabilize aggregate demand in the face of stochastic shocks; this is achieved by manipulating monetary growth and thus expected inflation in such a way as to choke off the effects of random disturbances on real aggregate demand. In other words, the ex-post price in the short-term contracts regime is forced to be the same as in the case of longer contracts. Perfect stabilization of aggregate demand thus makes the price level a predetermined variable in either case. Active policy can so replicate the first best of the economy irrespective of the actual length of contracts. In this sense we can reaffirm the validity of the Keynesian prediction that increased wage flexibility is an imperfect substitute for active policy.[13]

5. Conclusions

In a synchronized wage setting framework, the explicit consideration of the expected inflation effect makes employment variability more likely to increase with contract length. A greater wage flexibility, in the form of reduced contract length, would appear to be desirable for a given conduct of demand management.

However, we have shown that leaning against the wind monetary rules can reduce the externalities arising from the existence of contracts, irrespective of their length. The Keynesian prediction that increased wage flexibility may not be a good substitute for active policy is thus exactly replicated.

Notes

1. It could easily be shown, for example, that, in presence of white noise demand shocks, increased price flexibility would be stabilizing even in Taylor's model augmented for the expected inflation effect. In such a case, in fact, the analytical "stabilizing" results obtained by Driskill and Sheffrin (1986) in absence of demand shocks would be qualitatively replicated.
2. This set-up can be justified on the grounds that transaction costs can prevent agents from signing contracts which are contingent upon current economic conditions (as in Fischer, 1977).
3. Following the literature (see e.g. Barro, 1977) the ad hoc policy criterion chosen is minimising the fluctuations of actual employment about its market clearing level. A rigorous analysis of welfare in this kind of models is rather difficult, as shown by Ball and Romer (1987).
4. Ball (1987) compares the length of the contracts chosen by the firm in a decentralized economy (Nash equilibrium) in the presence of fixed (exogenously given) contracting costs to the Pareto-optimal contract length. In equilibrium, the firms equate the gains from a shorter length to the increase in contracting costs. The presence of negative externalities implies that shorter contracts would bring about net welfare gains and therefore would be socially desirable.
5. Equation (3) can be seen as the reduced form of a standard IS-LM model (see e.g. DeLong and Summers, 1986b, and Blanchard, 1988).
6. See Appendix A.
7. Details of this and later proofs can be found in Appendix A.
8. As argued by King (1988), one of the reasons why the inflation effect is destabilizing in the DeLong and Summers (1986b) framework is that current prices never respond to the contemporaneous demand shocks.

King allows for a contemporaneous response by assuming the existence of a sector of the labour market which is not covered by contracts. It is not clear, however, how a non-contract sector can be reconciled with the existence of a contract sector in the economy (see also DeLong and Summers, 1988).

9. The relevant model is thus the one presented in section 2.

10. From the comparison of (36) with (40), one could immediately see that, whenever

$$(\delta_1, \delta_2) \neq (\delta_1^*, \delta_2^*)$$

the necessary and sufficient condition for negative externalities from an increase in contract length is still $\gamma < \alpha + \beta$. If the monetary authorities follow a different policy than the optimal one, the relative losses associated with the externalities in the short and the long-term regimes are unchanged.

11. Following Buiter's (1982) classification, a variable is non-predetermined if and only if "its <u>current</u> value is a function of <u>current</u> anticipations of future values of endogenous and/or exogenous variables".

12. The same condition would ensure policy effectiveness even for "contract-free" new classical macroeconomic models, as shown in Marini (1985, 1986, 1988) and Buiter (1987).

13. Perfect stabilization is of course not achievable when current shocks are not contemporaneously observable. Hovewer the result that active policy dominate increased wage flexibility still holds, as demonstrated in Appendix B.3.

Appendix A

1. Demand for labour

The output demand for firm "i" is assumed to be

(A1) $$Y_{it} = \left[\frac{M_t}{P_t}\right]^{\alpha} \left[1 + \pi_t^e\right]^{\beta} \left[\frac{P_{it}}{P_t}\right]^{-\gamma} H_t$$

where $\pi_t^e = (E_t P_{t+1} - P_t)/P_t$ and where capital letters denote antilogarithms. Profits are then given by

(A2) $$\Pi_{it} = P_t L_{it}^{(\gamma-1)/\gamma} \left[\frac{M_t}{P_t}\right]^{\alpha/\gamma} \left[\frac{E_t P_{t+1}}{P_t}\right]^{\beta/\gamma} H_t^{1/\gamma} - W_{it} L_{it}$$

The first order condition for employment is

(A3) $$\frac{\gamma-1}{\gamma} P_t L_{it}^{-1/\gamma} \left[\frac{M_t}{P_t}\right]^{\alpha/\gamma} \left[\frac{E_t P_{t+1}}{P_t}\right]^{\beta/\gamma} H_t^{1/\gamma} = W_{it}$$

or

(A3') $$L_{it} = \left[\frac{\gamma}{\gamma-1}\right]^{-\gamma} \left[\frac{M_t}{P_t}\right]^{\alpha} \left[\frac{E_t P_{t+1}}{P_t}\right]^{\beta} \left[\frac{W_{it}}{P_t}\right]^{-\gamma} H_t$$

which coincides with equation (6) in the text, apart from a constant factor.

2. Uncorrelated shocks

2.(i) One-period contracts

The 'guess' solution is

(A4) $$p_t = \pi_0 m_t + \pi_1 \eta_t$$

Upon taking expectations,

(A5) $$E_t p_{t+1} = \pi_0 E_t m_{t+1} + \pi_1 \eta_{t+1}$$
$$= \pi_0 m_t$$

using (2) and the assumption that η_t is a white noise. Substituting (A5) into (10) we obtain

(A6) $$p_t = \frac{\alpha + \beta\pi_0}{\alpha+\beta} m_t + \frac{1}{\alpha+\beta} \eta_t$$

Equating (A4) to (A6) one has

(A7) $$\pi_0 = 1, \qquad \pi_1 = \frac{1}{\alpha+\beta}$$

which yield equation (11) in the text.

(iii) Two-period contracts

Aggregate equation (12) and use (8) to obtain

(A8) $$p_t = \frac{\alpha}{\gamma} m_{t-1} + \left[1 - \frac{\alpha+\beta}{\gamma}\right] E_{t-1}p_t + \frac{\beta}{\gamma} E_{t-1}p_{t+1}$$

The guess solution is

(A9) $$p_t = \pi_0 m_{t-1}$$

Substituting (A9) into (A8) we obtain

(A10) $$p_t = \left[\frac{\alpha}{\gamma} (1 - \pi_0) + \pi_0\right] m_{t-1}$$

and equating coefficients in (A9) and (A10) we obtain $\pi_0 = 1$, i.e. equation (13).

(iv) Externalities

If all other firms sign one-period contracts, then the wage for firm "i" is given by (12) while the aggregate price level is given by (11). Since $E_{t-1}p_t = E_{t-1}p_{t+1} = m_{t-1}$, we obtain

(A11) $$w_{it} = m_{t-1}$$

The components of labour demand (6) are

(A12a) $$m_t - p_t = -\frac{1}{\alpha+\beta}\eta_t$$

(A12b) $$E_t p_{t+1} - p_t = -\frac{1}{\alpha+\beta}\eta_t$$

(A12c) $$w_{it} - p_t = -\xi_t - \frac{1}{\alpha+\beta}\eta_t$$

from which we obtain equation (15).

If instead the other firms are in the second period of a two-period contract the price level is (13). The components of labour demand are

(A13a) $$m_t - p_t = \xi_t$$

(A13b) $$E_t p_{t+1} - p_t = \xi_t$$

(A13c) $$w_{it} - p_t = 0$$

and by substitution in (6) we obtain equation (18).

3. Autocorrelated shocks

(i) One-period contracts

The price equation is (10), which is here reported for convenience:

$$(10) \qquad p_t = \frac{\alpha}{\alpha+\beta} m_t + \frac{\beta}{\alpha+\beta} E_t p_{t+1} + \frac{1}{\alpha+\beta} \eta_t$$

The guess solution is

$$(A14) \qquad p_t = \pi_0 m_t + \pi_1 \eta_t$$

Take expectations of (A14) using (21):

$$(A14') \qquad E_t p_{t+1} = \pi_0 m_t + \pi_1 \rho \eta_t$$

After substituting into (10), one has

$$(A15) \qquad p_t = \frac{\alpha+\beta\pi_0}{\alpha+\beta} m_t + \frac{1+\beta\rho\pi_1}{\alpha+\beta} \eta_t$$

Equate (A14) and (A15) to obtain

$$(A16) \qquad \pi_0 = 1 \qquad\qquad \pi_1 = \frac{1}{\alpha+\beta(1-\rho)}$$

which yield the price equation (22) in the text.

(ii) Two-period contracts

Aggregate equation (12) to obtain

$$(A17) \qquad p_t = \frac{\alpha}{\gamma} m_{t-1} + \left[1 - \frac{\alpha+\beta}{\gamma}\right] E_{t-1} p_t + \frac{\beta}{\gamma} E_{t-1} p_{t+1} + \frac{1}{\gamma} \rho \, \eta_{t-1}$$

The guess solution is

(A18) $$p_t = \pi_0 m_{t-1} + \pi_1 \eta_{t-1}$$

Taking expectations,

(A18') $$E_{t-1}p_t = \pi_0 m_{t-1} + \pi_1 \eta_{t-1}$$

(A18") $$E_{t-1}p_{t+1} = \pi_0 m_{t-1} + \pi_1 \rho \eta_{t-1}$$

and hence (A17) becomes

(A19) $$p_t = \left[\frac{\alpha}{\gamma} + \pi_0 - \frac{\alpha}{\gamma}\pi_0\right] m_{t-1} +$$

$$+ \left[\pi_1 - \frac{\alpha+\beta}{\gamma}\pi_1 + \frac{\beta}{\gamma}\rho\pi_1 + \frac{1}{\gamma}\rho\right]\eta_{t-1}$$

By comparison of (A18) with (A19) we obtain the coefficients of equation (24):

(A20) $$\pi_0 = 1 \qquad\qquad \pi_1 = \frac{\rho}{\alpha+\beta(1-\rho)}$$

(iii) Externalities

All other firms are in a one-period contract. Using the price equation (22), the wage for firm "i" is given by

(A21) $$w_{it} = \frac{\alpha}{\gamma} E_{t-1}m_t + \left[1 - \frac{\alpha+\beta}{\gamma}\right] E_{t-1}p_t + \frac{\beta}{\gamma} E_{t-1}p_{t+1} + \frac{1}{\gamma} E_{t-1}\eta_t$$

$$= m_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)} \eta_{t-1}$$

The components of labour demand are thus

(A22a) $$m_t - p_t = - \frac{1}{\alpha+\beta(1-\rho)} \eta_t$$

(A22b) $$E_t p_{t+1} - p_t = - \frac{1-\rho}{\alpha+\beta(1-\rho)} \eta_t$$

(A22c) $$w_{it} - p_t = - \xi_t - \frac{1}{\alpha+\beta(1-\rho)} \xi_t$$

Hence,

(A23) $$\ell_{it} = - \frac{\alpha}{\alpha+\beta(1-\rho)} \eta_t - \frac{\beta(1-\rho)}{\alpha+\beta(1-\rho)} \eta_t + \gamma \xi_t +$$

$$+ \frac{\gamma}{\alpha+\beta(1-\rho)} \xi_t + \eta_t$$

$$= \gamma \xi_t + \frac{\gamma}{\alpha+\beta(1-\rho)} \xi_t$$

which coincides with equation (25).

Let all other firms be in a two-period contract. The price is given by equation (23), which immediately implies

(A24) $$w_{it} = m_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)} \eta_{t-1}$$

Then we have

(A25a) $$m_t - p_t = \xi_t - \frac{\rho}{\alpha+\beta(1-\rho)} \eta_{t-1}$$

(A25b) $$E_t p_{t+1} - p_t = \xi_t + \frac{\rho(\rho-1)}{\alpha+\beta(1-\rho)} \eta_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)} \xi_t$$

(A25c) $$w_{it} - p_t = 0$$

and by substitution in (6) we obtain

(A26) $$\ell_{it} = \alpha\, \xi_t - \frac{\alpha\rho}{\alpha+\beta(1-\rho)}\, \eta_{t-1} + \beta\, \xi_t + \frac{\beta\rho(\rho-1)}{\alpha+\beta(1-\rho)}\, \eta_{t-1}$$

$$+ \frac{\beta\rho}{\alpha+\beta(1-\rho)}\, \xi_t + \rho\, \eta_{t-1} + \xi_t$$

$$= (\alpha+\beta)\, \xi_t + \frac{\alpha+\beta}{\alpha+\beta(1-\rho)}\, \xi_t$$

which is equation (28) in the text.

4. Countercyclical money rule

(i) One-period contracts

The aggregate price is given by equation (10). Given the money rule (31), the guess solution is

(A27) $$p_t = \pi_0 m_t + \pi_1 \xi_t + \pi_2 \eta_t$$

and implies

(A28) $$E_t p_{t-1} = \pi_0 (m_t - \delta_1 \xi_t - \delta_2 \eta_t)$$

By substitution in (10) one obtains

(A29) $$p_t = \frac{\alpha+\beta\pi_0}{\alpha+\beta}\, m_t - \frac{\beta\delta_1\pi_0}{\alpha+\beta}\, \xi_t + \frac{1-\beta\delta_2\pi_0}{\alpha+\beta}\, \eta_t$$

and by comparison of (A27) with (A29) we get

$$\pi_0 = 1$$

(30) $$\pi_1 = -\frac{\beta\delta_1}{\alpha+\beta}$$

$$\pi_2 = \frac{1-\beta\delta_2}{\alpha+\beta}$$

(ii) <u>Two-period contracts</u>

Aggregating the wage equation (12) we obtain

(A31) $$p_t = \frac{\alpha}{\gamma} E_{t-1}m_t + \left[1 - \frac{\alpha+\beta}{\gamma}\right] E_{t-1}p_t + \frac{\beta}{\gamma} E_{t-1}p_{t+1} + \frac{1}{\gamma} E_{t-1}\eta_t$$

The guess solution is

(A32) $$p_t = \pi_0 m_{t-1} + \pi_1 \xi_{t-1} + \pi_2\eta_{t-1}$$

Take expectations of (A32) and substitute into (A31) to get

(A33) $$p_t = \left[\frac{\alpha}{\gamma} + \pi_0 - \frac{\alpha}{\gamma}\pi_0\right]m_{t-1} + \left[\frac{\alpha}{\gamma}\delta_1 + \pi_1 - \frac{\alpha+\beta}{\gamma}\pi_1 - \frac{\beta}{\gamma}\delta_1\pi_0\right]\xi_{t-1} + \left[-\frac{\alpha}{\gamma}\delta_2 + \pi_2 - \frac{\alpha+\beta}{\gamma}\pi_2 - \frac{\beta}{\gamma}\delta_2\pi_0\right]\eta_{t-1}$$

from which

$$\pi_0 = 1$$

(A34) $\pi_1 = -\delta_1$

$\pi_2 = -\delta_2$

which give equation (33).

(iii) Externalities

Let us assume that all firms with the exception of firm "i" sign one-period contracts. The wage equation (12) together with the price equation (32) imply

(A35) $$w_{it} = m_{t-1} - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1}$$

The components of labour demand are

(A36a) $$m_t - p_t = \frac{\beta\delta_1}{\alpha+\beta} \xi_t - \frac{1-\beta\delta_2}{\alpha+\beta} \eta_t$$

(A36b) $$E_t p_{t+1} - p_t = -\frac{\alpha\delta_1}{\alpha+\beta} \xi_t - \frac{\alpha\delta_2+1}{\alpha+\beta} \eta_t$$

(A36c) $$w_{it} - p_t = -\frac{\alpha+\beta(1-\delta_1)}{\alpha+\beta} \xi_t - \frac{1-\beta\delta_2}{\alpha+\beta} \eta_t$$

and hence

(A37) $$\ell_{it} = \frac{\gamma}{\alpha+\beta} (\alpha+\beta - \beta\delta_1) \xi_t + \frac{\gamma}{\alpha+\beta} (1-\beta\delta_2) \eta_t$$

which coincides with equation (35).

If instead all other firms are in a two-period contract, combine equations (12) and (33) to obtain

(A38) $$w_{it} = m_{t-1} - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1} = p_t$$

and

(A39a) $$m_t - p_t = \xi_t$$

(A39b) $$E_t p_{t+1} - p_t = (1 - \delta_1) \xi_t - \delta_2 \eta_t$$

(A39c) $$w_{it} - p_t = 0$$

By substitution of (A39a) - (A39c) into the labour demand (6) we can so obtain equation (39).

Appendix B

In the present Appendix we derive the critical conditions for negative externalities in contract length, under the assumption that current shocks cannot be observed when contracts are signed. Our previous results are not affected in any substantial way by this change in the informational assumptions of the model: the necessary and sufficient condition for negative externalities is still shown to be given by

$$\gamma < \alpha + \beta$$

(equation (20) in the text) for each of the cases that we consider.

We retain the assumption that the firms have the option of signing either one- or two-period contracts. These are however redifined as follows. In the one-period contract, firms set wages for time t at the end of period t-1, before the shocks ξ_t, η_t are known: employment is instead set after the uncertainty about the current shocks is resolved. In the two-period contracts, wages are set at the end of period t-2.

Formally, the one-period contracts in the present context are comparable to the two-period contracts of the analysis developed in the text and in Appendix A: we can thus use for the former the analytical results already obtained for the latter. The model is then given by the money supply (2), the labour demand equation (6), and the wage setting rules which are derived below.

1. Uncorrelated shocks

(i) One-period contracts

Let the shock η_t be a white noise process with variance σ_η^2. Firm "i" sets w_{it} at the end of period t-1 by solving the equation $E_{t-1}(l_{it})=0$.

Therefore the analysis can proceed as in section A.2.(ii), and the solution for the price level is

(B1) $$p_t = m_{t-1}$$

(ii) <u>Two-period contracts</u>

If all firms are in the first period of a two-period contract, prices are given by equation (B1) above. Let firms at time t be in the last period of a two-period contract. Then

(B2) $$w_{it} = \frac{\alpha}{\gamma} E_{t-2} m_t + \left[1 - \frac{\alpha+\beta}{\gamma} \right] E_{t-2} p_t + \frac{\beta}{\gamma} E_{t-2} p_{t+1} + \frac{1}{\gamma} E_{t-2} \eta_t$$

Aggregating,

(B3) $$p_t = \frac{\alpha}{\gamma} m_{t-2} + \left[1- \frac{\alpha+\beta}{\gamma} \right] E_{t-2} p_t + \frac{\beta}{\gamma} E_{t-2} p_{t+1}$$

The guess solution for the level of prices has the form

(B4) $$p_t = \pi_0 m_{t-2}$$

which of course also implies

(B5) $$E_{t-2} p_t = \pi_0 m_{t-2}$$

By contrast, since there is no staggering, prices at t+1 must be given according to (B1) by

(B6) $$p_{t+1} = m_t$$

and hence

(B7) $$E_{t-2}\, p_{t+1} = m_{t-2}$$

By substitution of (B5) and (B7) into (B3) and solving we obtain

(B8) $$p_t = m_{t-2}$$

(iii) <u>Externalities</u>

When firm "i" is in the last period of a two-period contract and all other firms are in one-period contracts, we have $p_t = m_{t-1}$, $E_t p_{t+1} = m_t$, and $w_{it} = m_{t-2}$, which imply

(B9a) $$m_t - p_t = \xi_t$$

(B9a) $$E_t\, p_{t+1} - p_t = \xi_t$$

(B9c) $$w_{it} - p_t = -\xi_{t-1}$$

The value of the externalities is thus

(B10) $$z_{it}^{(1)} = [(\alpha+\beta)^2 + \gamma^2]\, \sigma_\xi^2 + \sigma_\eta^2$$

Suppose now that all firms are in the last period of a two-period contract. Then $p_t = m_{t-2}$, $E_t p_{t+1} = m_t$ (since price setting is synchronized), and $w_{it} = m_{t-2}$, and therefore

(B11a) $$m_t - p_t = \xi_t + \xi_{t-1}$$

(B11b) $$E_t p_{t+1} - p_t = \xi_t + \xi_{t-1}$$

(B11c) $$w_{it} - p_t = 0$$

The externalities are given by

(B12) $$z_{it}^{(2)} = 2(\alpha+\beta)^2 \sigma_\xi^2 + \sigma_\eta^2$$

By comparing (B10) with (B12), the critical condition for negative externalities from an increase in contract length is seen to be

$$\gamma < \alpha + \beta$$

By contrast, if firm "i" is in the first period of a two-period contract, its losses are easily shown to be independent of other firms' contract length. Formally, if all firms are in one-period contracts then the components of firm "i" 's labour demand are given by

(B13a) $$m_t - p_t = \xi_t$$

(B13b) $$E_t p_{t+1} - p_t = \xi_t$$

(B14c) $$w_{it} - p_t = 0$$

and its losses are

(B14) $$z_{it}^{(1')} = (\alpha+\beta)^2 \sigma_\xi^2 + \sigma_\eta^2$$

If instead all firms, with the exception of firm "i", are in the second period of two-period contracts then

(B15a) $$m_t - p_t = \xi_t + \xi_{t-1}$$

(B15b) $$E_t p_{t+1} - p_t = \xi_t + \xi_{t-1}$$

(B15c) $$w_{it} - p_t = \frac{\alpha+\beta}{\gamma} \xi_{t-1}$$

whence

(B16) $$z_{it}^{(2')} = (\alpha+\beta)^2 \sigma_\xi^2 + \sigma_\eta^2$$

which coincides with (B14). Therefore, if firm "i" signs short-term contracts its losses do not depend on whether the other firms are in short or long-term contracts. The intuition behind this result is clear: in the above framework, externalities arise due to the inability of firms to adjust wages in the face of changes of the aggregate price level. When firm "i" signs one-period contracts, it is at least as fast in adjusting to aggregate shocks as the other firms. It is therefore always able to react to any changes in aggregate prices. The losses (B14) (or (B16)) are indeed always lower than the expressions (B10) or (B12): they are thus reduced to a level which cannot be further decreased given the information lag in the wage setting process.

This finding is a general result, which does not depend on the absence of serial correlation between the shocks nor on the assumed properties of the money supply process. Hence, in the next sections of the present Appendix we shall only compute the losses for the case in which firm "i" is in the second period of a two-period contract.

2. Autocorrelated shocks

The demand shock η_t evolves now according to equation (21) in the text:

$$\eta_t = \rho\eta_{t-1} + \epsilon_t$$

If all firms sign one-period contracts, the price level is given by

(B17) $$p_t = m_{t-1} + \frac{\rho}{\alpha+\beta(1-\rho)} \eta_{t-1}$$

In the second period of a two period contract, prices are

(B18) $$p_t = m_{t-2} + \frac{\rho^2}{\alpha+\beta(1-\rho)} \eta_{t-2}$$

Let us now assume that firm "i" is in the second period of a two-period contract. If all other other firms shift from one to two-period contracts, firm "i" 's losses are respectively given by

(B19) $$z_{it}^{(1)} = [(\alpha+\beta)^2+\gamma^2]\ \sigma_\xi^2 + \frac{[(\alpha+\beta)^2 + \gamma^2\rho^2]}{[\alpha+\beta(1-\rho)]^2} \sigma_\epsilon^2$$

and

(B20) $$z_{it}^{(2)} = 2(\alpha+\beta)^2\sigma_\xi^2 + \frac{(1+\rho^2)(\alpha+\beta)^2}{[\alpha+\beta(1-\rho)]^2} \sigma_\epsilon^2$$

in the usual notation. Condition (20) still applies.

3. Countercyclical money rule

The monetary authorities follow the lagged feedback policy rule (31), which is here reported for convenience:

$$m_t = m_{t-1} + \xi_t - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1}$$

Under one-period contracts, the aggregate price level is

(B21) $$p_t = m_{t-1} - \delta_1 \xi_{t-1} - \delta_2 \eta_{t-1}$$

whilst in the second period of two-period contracts prices are

(B22) $$p_t = m_{t-2} - \delta_1 \xi_{t-2} - \delta_2 \eta_{t-2}$$

If firm "i" is in the second period of a two-period contract while all other firms are in a one-period contract, then

(B23) $$z_{it}^{(1)} = \{[\alpha+\beta(1-\delta_1)]^2 + \gamma^2(1-\delta_1)^2\} \sigma_\xi^2 + [(1-\beta\delta_2)^2 + \gamma^2\delta_2^2] \sigma_\eta^2$$

If all firms are in two-period contracts,

$$\text{(B24)} \qquad z_{it}^{(2)} = \{[\alpha+\beta(1-\delta_1)]^2 + (\alpha+\beta)^2(1-\delta_1)^2\}\, \sigma_\xi^2$$

$$+ [(1-\beta\delta_2)^2 + (\alpha+\beta)^2\delta_2^2]\, \sigma_\eta^2$$

and $z_{it}^{(2)} > z_{it}^{(1)}$ iff $\alpha+\beta > \gamma$.

It is interesting to notice that in this case the monetary authorities can no longer completely eliminate the losses by means of a suitable choice of the policy parameters δ_1 and δ_2. They can however still exert a stabilizing influence, and indeed it would be easy to show that employment variability would now be minimized by setting

$$\text{(B25a)} \qquad \delta_1^* = 1 + \frac{\alpha\beta}{\beta^2+\varphi^2}$$

$$\text{(B25b)} \qquad \delta_2^* = \frac{\beta}{\beta^2+\varphi^2}$$

where

$$\varphi = \begin{cases} \gamma & \text{under one-period contracts} \\ \alpha+\beta & \text{under two-period contracts} \end{cases}$$

It is apparent that δ_1^*, δ_2^* as defined in (B25a), (B25b) do not reduce the losses to zero. There exist externalities which cannot be removed by a lagged-feedback policy rule. The reason for this is that, in the framework considered here, wages and prices are entirely predetermined, whilst employment is free to react to contemporaneous disturbances.

Perfect stabilization is therefore no longer a feasible target. Active policy is however always capable of reducing the variability of the level of employment as compared to a situation of no intervention ($\delta_1 = \delta_2 = 0$).

Moreover, when short contracts prevail, the value of the externalities in the absence of a feedback policy is given by

$$\text{(B26)} \qquad z_{it}^{(1)}\Big|_{\delta_1=\delta_2=0} = [(\alpha+\beta)^2+\gamma^2]\,\sigma_\xi^2 + \sigma_\eta^2$$

On the other hand, optimal policy reduces the losses from long contracts to

$$\text{(B27)} \qquad z_{it}^{(2)}\Big|_{\delta_1=\delta_1^*,\,\delta_2=\delta_2^*} = \frac{\alpha^2(\alpha^2+2\alpha\beta)(\alpha+\beta)^2}{[\beta^2+(\alpha+\beta)^2]^2}\,\sigma^2_\xi + \frac{(\alpha+\beta)^2}{\beta^2+(\alpha+\beta)^2}\,\sigma^2_\eta$$

Since (B27) is always smaller than (B26), we can restate the superiority of active policy vis-à-vis wage flexibility.

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