Macroeconomic Shocks and Central Bank Disclosure Policy: Is Increased Transparency Necessarily Beneficial?

Jonathan G. James

University of Wales Swansea

and

Phillip Lawler*

University of Wales Swansea

July 2005

Abstract

The paper investigates the implications of disclosure by the central bank to the private sector of information relating to the current realizations of macroeconomic disturbances. In the context of an economy in which the goods market is monopolistically competitive and where wages are set by atomistic unions, we find that greater precision of information provided to wage setters in respect of supply shocks has ambiguous welfare effects, both from the perspective of the social loss function and from the viewpoint of unions who act on the information. An important feature of the model is an externality in union wage setting which implies the outcome of the wage determination process is collectively inefficient.

Keywords: Central bank; information quality; union wage setting

JEL Classification: E58, J51

* Corresponding Author. Department of Economics, University of Wales Swansea, Singleton Park, Swansea SA2 8PP, United Kingdom. Fax: +44-1792-295-872. E-mail: p.lawler@swan.ac.uk

1. Introduction

One of the most significant trends in the conduct of monetary policy over recent years has been the move towards greater transparency by the world's principal central banks. It is now the norm to find information relating to central bank objectives, operating procedures and decision-making processes all placed within the public domain. In part, this drive towards increased transparency can be explained in terms of the parallel shift to greater central bank independence and the need, in this context, to ensure continued accountability of monetary policy institutions to government and the wider public. Additionally, though, fuller disclosure of central bank goals and the factors underlying its policy decisions, in particular its assessment of the current and likely future state of the economy, is argued by many to enhance the efficacy of monetary policy and, hence, to aid the central bank in pursuit of its objectives: see Blinder et al. (2001) for a clear statement of this view.

Although this latter motivation for openness in policymaking may hold an immediate appeal, existing theoretical models appear to provide a less than unequivocal endorsement of its general validity. The ambiguous welfare effects of increased transparency are a key finding of Cukierman and Meltzer's (1986) influential study[1], and this theme is present in a range of papers which examine different dimensions of the issue: see, for example: Eijffinger et al. (2000); Grüner (2002); and Jensen (2002). A comprehensive review of the relevant literature and a clear analysis of the conflicting forces which may arise as a consequence of greater transparency in monetary policy are presented in Geraats' (2002) recent survey.

While the literature on central bank transparency has considered the issue from a variety of perspectives, a feature which is common to much of it is the central role played by the stabilization function of monetary policy, with the realized values of exogenous shocks, or alternatively their forecast values, assumed to be private information of the central bank. This latter assumption, a standard feature of much monetary policy analysis raises the question of the extent to which it is desirable for the central bank to disclose its information relating to shocks to the private sector, an issue which has been at the centre

[1] Though we note that Faust and Svensson's (2001, 2002) refinement of their approach gives somewhat more definite support to the notion that greater transparency is beneficial.

of a number of recent contributions. Jensen (2000) and Geraats (2004) both explore the relationship between transparency concerning shocks and central bank credibility using models which assume some uncertainty on the part of the private sector with regard to central bank objectives. Reflecting the different economic structures assumed, the two studies come to contrasting conclusions about the likely benefits to be derived from greater transparency. The papers by Cukierman (2001) and Gersbach (2002), on the other hand, abstract from reputational considerations by assuming the private sector to have complete knowledge of central bank objectives and focus on the direct consequences of disclosure for private sector expectations and the resulting output and employment outcomes. The common approach adopted in these two contributions leads to an identical and striking result: specifically, they find that increased transparency in respect of supply shocks is associated with greater instability in output and employment and consequently, given the standard specification of the social loss function employed, has an unambiguously detrimental effect on welfare.

Because the present paper shares a common focus with the contributions of Cukierman and Gersbach, it is worthwhile identifying the economic logic which underlies their finding. Both studies assume aggregate employment, *l*, to be determined by a relationship of the form: $l = a(\pi - \pi^e) + \theta$, where π and π^e are, respectively, actual and expected inflation and θ represents a random supply shock. In this context, so long as θ remains the private information of the central bank, the latter can adjust actual inflation relative to expected inflation in such a fashion as to offset the impact of the shock on employment. However, if the value of θ is disclosed to the public, knowledge of central bank objectives allows the policy response of the central bank to be fully anticipated. Consequently actual inflation cannot diverge from its expected value, and non-zero realizations of θ are reflected fully in movements in employment.

A potential limitation of the foregoing argument derives from the augmented Phillips curve relationship which underlies it. In particular, the latter's specification appears to preclude any private sector response to anticipated supply shocks other than that working indirectly through inflation expectations. This implication of the employment-determination equation seems unduly restrictive and it is certainly possible to conceive of structural underpinnings for the relationship which imply a direct private sector response

(i.e. additional to that associated with expected inflation) to anticipated shocks. The present paper develops this argument using a model of an economy characterized by a monopolistically competitive product market and where wages are set by atomistic unions. The realized values of the supply shocks to which the economy is subject are the private information of the central bank, to which it can respond in terms of its setting of monetary policy. However, prior to the setting of wages, the central bank can supply a potentially noisy signal of the shock's value to unions. In this context, we associate transparency with the degree of accuracy of the signal and our interest lies in the relationship between signal precision and welfare outcomes, as reflected in the expected values of the union and social losses.

A key aspect of the analysis is the assumption that each union's objective function contains both employment and the real wage as arguments. Given its expectation of the supply shock, conditional on the signal provided by the central bank, each union will set its nominal wage with the aim of attaining the optimal trade-off between employment and real wage stability. Thus, the aggregate nominal wage response to any signal of a non-zero realization of the shock will depend on the weight attached by unions to employment relative to the real wage. The interaction between union wage setting and monetary policy then determines aggregate employment and the price level.

While our framework is shown to capture the results of Cukierman (2001) and Gersbach (2002) as a limiting case, we find that, in general, the welfare effects of greater transparency are ambiguous in direction, and depend crucially on the relative significance placed by unions on employment stability compared to society, with other key characteristics of economic structure also playing a role. Of particular importance for our results is an externality present in union wage setting, which leads to an inefficient aggregate wage response to the central bank's signal. This feature gives rise to a further noteworthy aspect of our findings: that is, the possibility that an improvement in signal quality may be detrimental to unions as well as society, with this outcome more likely the closer are the relative weights attached to employment stability in the union and social loss functions.

The remainder of the paper is organized as follows. Section 2 provides an outline of the model, with the characteristics of the equilibrium identified in Section 3. Section 4

derives our principal results, relating to the welfare implications of the quality of information provided by the central bank to the private sector. Variations of the basic model are discussed in Section 5, while Section 6 concludes.

2. **The Model**

The economy's output is produced by a continuum of monopolistically competitive firms, uniformly distributed over the unit interval, and sharing a common Cobb-Douglas production technology. Labour is assumed to be the only variable input, with the relationship between firm *i* output, y_i^s, and employment, l_i, described by[2]:

$$y_i^s = \alpha l_i + \theta \qquad 0 < \alpha < 1 \tag{1}$$

where θ represents a productivity, or supply, shock, distributed $N(0,\sigma_\theta^2)$ and identical across firms.

The demand for firm *i*'s output, y_i, as a proportion of aggregate demand, y, is determined by its price, p_i, relative to the aggregate price level, p:

$$y_i - y = -\varepsilon(p_i - p) \qquad \text{where} \quad y = \int_{i=0}^{1} y_i di \quad , \quad p = \int_{i=0}^{1} p_i di \tag{2}$$

Thus the parameter $\varepsilon > 1$ represents the relative price elasticity of product demand and provides a measure of the degree of competition in the goods market; the limiting case of perfect competition occurs as $\varepsilon \to \infty$.

Aggregate demand is determined by the real money stock, i.e. the nominal money supply, m, deflated by the price level:

$$y = \phi(m - p) \tag{3}$$

[2] All variables are specified in logarithmic form, with all parameters constrained to be positive.

with ϕ identifying the elasticity of aggregate demand with respect to real balances. The specification of (3) abstracts from the potential presence of velocity shocks: however, this simplification has no significance for the results derived.

Combining (2) and (3), firm *i*'s product demand is:

$$y_i = \phi(m - p) - \varepsilon(p_i - p) \tag{4}$$

Product prices are set by firms after wages have been determined, following the realization of the supply shock, θ, and having observed the central bank's choice of m. Given nominal wage w_i, firm *i*'s profit-maximizing demand for labour is:

$$l_i^d = \frac{\phi(m - p) - \varepsilon(w_i - p) + (\varepsilon - 1)\theta}{\alpha + \varepsilon(1 - \alpha)} \tag{5}$$

Each firm has an immobile pool of workers, represented by an individual firm-specific union which has monopoly power over wage-setting within that firm. The supply of labour by union i members l_i, is assumed to be completely inelastic, with its value normalized, for convenience, at zero, i.e.:

$$l_i^s = 0 \tag{6}$$

We interpret l_i^s as the total potential supply of labour to firm i and, thus, it corresponds to the market-clearing employment level within the respective individual labour market.

Nominal wages are determined at the beginning of each period and embodied in single-period contracts, with employment demand-determined within the period. Union i sets its nominal wage, w_i, to minimize the expected value of the following loss function:

$$L_i^u = \gamma l_i^2 + (w_i - p)^2 \tag{7}$$

This specification of union objectives is standard in the literature concerned with the macroeconomic consequences of union wage setting (see, for example: Herrendorf and Lockwood, 1997; Hutchison and Walsh, 1998; Bratsiotis and Martin, 1999; and Holden, 2005), with a microeconomic rationale provided in Oswald (1985).[3] The quadratic formulation implies that fluctuations in both employment and the real wage around their target values are viewed by unions as intrinsically undesirable. The parameter γ, of course, identifies the relative weight which each union attaches to the employment objective when setting its nominal wage. Implicit in (7) is the assumption that the target values of both employment and the real wage are consistent with expected labour market clearing. Thus, while unions have monopoly power within their individual labour markets, they are assumed not to exploit it in such a way as to raise the real wage above its expected market-clearing value. To (realistically) assume otherwise[4] would have no consequences for our principal results, but would simply give rise to a positive trend inflation rate in the discretionary policy environment which characterizes our framework. Thus the specification of (7) is adopted to provide a sharper focus for the analysis which follows, where the principal issue of concern is the impact of information quality on fluctuations of key macroeconomic variables around their mean values.

Wage determination takes place in advance of the implementation of monetary policy and prior to unions observing the actual value of the supply shock. However, immediately before setting their respective nominal wages, all unions receive an identical noisy signal, *s*, of the shock, where:

$$s = \theta + u \,, \qquad u \sim N(0, \sigma_u^2) \tag{8}$$

Hence each union's expectation of $\theta, E(\theta \mid s)$, is given by:

$$E(\theta \mid s) = \beta s \,, \qquad \beta = \sigma_\theta^2 / (\sigma_\theta^2 + \sigma_u^2) \tag{9}$$

[3] See also Alesina and Tabellini (1987) for a brief discussion.

[4] By, for example, introducing a positive target real wage into the second term in (7) or, alternatively, by placing an additional, linear, real wage term in the union objective function.

We interpret the signal as information provided to wage setters by the central bank.[5] Such an interpretation is consistent with the major role which central banks often play as a source of data and forecasts relating to important macroeconomic variables, and allows us to directly consider the welfare consequences of central bank disclosure policy. Our focus is on the implications of the quality of information provided by the central bank, as reflected in the precision of the signal, with improvement in the quality of information corresponding to a reduction in the variance of the signal noise. The more precise is the signal the larger is β and the greater is the weight attached to s by unions when forming expectations.

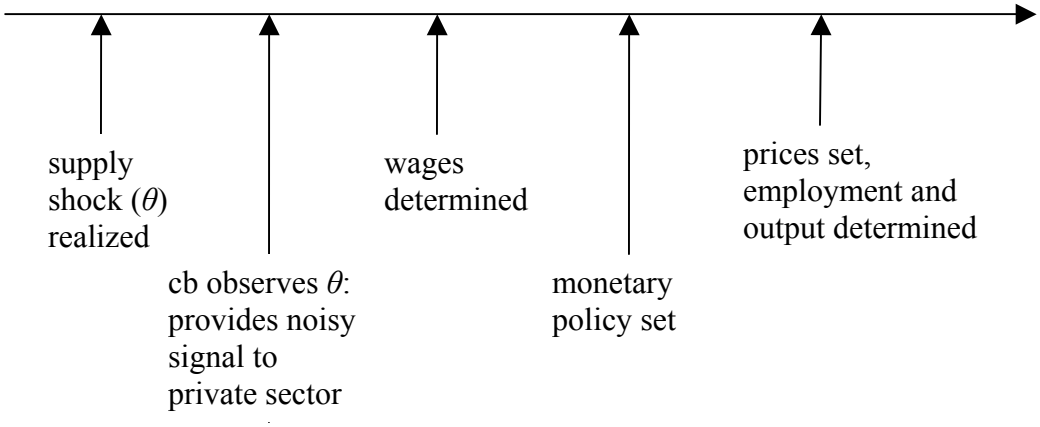
The central bank is assumed to have 'representative' preferences, with monetary policy directed at minimizing a conventionally-specified social loss function:

$$L^s = \lambda l^2 + \pi^2, \qquad l = \int_0^1 l_i di \tag{10}$$

Thus the social loss is increasing in departures of aggregate employment, l, from the level consistent with market-clearing within individual labour markets, and of inflation from its socially-optimal value, assumed to be zero. Because central bank objectives are assumed to be public information, our analysis abstracts from any reputational issues which might otherwise arise.

We view the central bank as observing the realized value of the supply shock, following which it provides the noisy signal, s, of θ to wage setters; then, after completion of the wage-determination process, it implements monetary policy. The sequence of events underlying our analysis can be described by the following time line:

[5] We note that introducing private information in addition to the public signal would make no essential difference to our analysis and results.



Other scenarios consistent with our results arise if the central bank itself has only imperfect information concerning the realization of θ when it makes its disclosure and hence, the quality of the signal provided to wage setters is not entirely at the central bank's discretion. In this context, assuming monetary policy to be set either before full information concerning θ becomes available to the central bank, or, alternatively, in the light of complete knowledge of the realized value of θ gives rise to identical conclusions to those derived in what follows.

3. Macroeconomic Equilibrium

The first stage in identifying the equilibrium of the model is to determine the price level as a function of the nominal money stock, the average nominal wage, $w \equiv \int_0^1 w_i di$, and θ.

Imposing the constraint that employment is demand-determined in (5), substituting into (1) then aggregating over firms, the resulting expression for aggregate output can be combined with the aggregate demand equation (3) to solve for p :

$$p = \frac{\alpha w + \phi(1-\alpha)m - \theta}{\left[\alpha + \phi(1-\alpha)\right]} \tag{11}$$

The associated expression for aggregate employment is :

$$l = \frac{\phi m - \phi w + (\phi - 1)\theta}{[\alpha + \phi(1-\alpha)]} \tag{12}$$

The monetary policy decision of the central bank can now be considered. The setting of m is chosen to minimize (10), subject to (11) and (12) and the realized value of θ, taking as given the aggregate nominal wage. For convenience, and without loss of generality, we set $p_{-1} = 0$ implying $\pi = p$. Solving the central bank's optimization problem :

$$m = \frac{[\lambda\phi - \alpha(1-\alpha)]w + [\lambda(1-\phi) + (1-\alpha)]\theta}{\phi[\lambda + (1-\alpha)^2]} \tag{13}$$

Equation (13) in combination with (11) and (12) determines the price level and aggregate employment respectively as functions of the average nominal wage and θ. The former represents the aggregate outcome of individual union wage setting decisions and it is to this issue we now turn.

Union i chooses its nominal wage to minimize the expected value of (7), taking the nominal wages of all other unions as given, and subject to its expectation of the productivity shock, as identified by (9). In making its decision each union is aware of the objective function of the central bank and is thus able to infer its monetary policy reaction to non-zero realizations of θ. However, since each union is small in relation to the economy as a whole, it perceives itself as having no influence on the setting of m. Substituting (5) into (7) and minimizing with respect to w_i, union i's first order condition can be expressed, using (11) and (13), as :

$$w_i = \frac{1}{\{\gamma\varepsilon^2 + [\alpha + \varepsilon(1-\alpha)]^2\}[\lambda + (1-\alpha)^2]}\Big[\ \{\lambda\gamma\varepsilon^2 + \lambda[\alpha + \varepsilon(1-\alpha)]^2 - \gamma\alpha\varepsilon(1-\alpha)\}w$$
$$+ [\alpha + \varepsilon(1-\alpha)]\{\gamma\varepsilon(1-\alpha) - \lambda[\alpha + \varepsilon(1-\alpha)]\}\beta s\ \Big] \tag{14}$$

Setting $w_i = w$ yields the unique symmetric Nash equilibrium value of w :

$$w = \frac{\{\gamma\varepsilon(1-\alpha) - \lambda[\alpha + \varepsilon(1-\alpha)]\}\beta s}{(1-\alpha)\{\gamma\varepsilon + (1-\alpha)[\alpha + \varepsilon(1-\alpha)]\}} \tag{15}$$

It is evident from (15) that the relationship between w and s is ambiguous in sign : thus the expectation of a positive supply shock can lead unions either to increase or reduce their nominal wage. In fact the aggregate nominal wage response to the expectation of a non-zero value of θ is, as will be seen, central to the welfare implications of the quality of information provided by the central bank to wage setters.

The values of p and $l(=l_i, \forall i)$ which result from the interaction between union wage setting and monetary policy can be found using (15) and (13) in combination with equations (11) and (12) respectively :

$$p = -\frac{\lambda[\alpha + \varepsilon(1-\alpha)]\beta s}{(1-\alpha)\{\gamma\varepsilon + (1-\alpha)[\alpha + \varepsilon(1-\alpha)]\}} - \frac{\lambda(\theta - \beta s)}{[\lambda + (1-\alpha)^2]} \tag{16}$$

$$l = \frac{[\alpha + \varepsilon(1-\alpha)]\beta s}{\{\gamma\varepsilon + (1-\alpha)[\alpha + \varepsilon(1-\alpha)]\}} + \frac{(1-\alpha)(\theta - \beta s)}{[\lambda + (1-\alpha)^2]} \tag{17}$$

Equations (16) and (17) decompose movements in the price level and employment into two elements. The first is attributable to the interaction between monetary policy and the wage-setting decisions of unions in response to the latter's expectation of the supply shock, while the second reflects the central bank's optimal policy reaction to union expectational errors. In fact, the first term in (16) identifies what Herrendorf and Lockwood (1997) refer to as the *stochastic inflation bias*.[6] This bias arises in the present discretionary policy context from the central bank's desire to achieve greater employment stability than would result as the outcome of the wage determination process, given the

[6] As distinct from the mean inflation bias, i.e. the positive trend inflation rate which would arise in a discretionary policy environment should the real wage target of unions differ from that associated with expected labour market clearing. As indicated in Section 2, our assumptions ensure that the mean inflation bias is zero in the present model.

expectation of a non-zero value of θ. Once wages have been set in the light of the latter, the central bank has the incentive to adjust monetary policy in an attempt to achieve its own optimal trade-off between price and employment stability. However, this incentive is understood by each union which, when making its wage decision, incorporates the consequences of the central bank's anticipated policy reaction into its choice of nominal wage. The implication of this interaction between wage determination and monetary policy in response to the anticipated component of supply shocks is greater price level volatility than if the central bank were able to precommit to the optimal policy rule[7], but without any reduction in employment variability.

It is apparent from equations (16) and (17) that the precise nature of the impact of supply shocks on the macroeconomy depends crucially on the extent to which they are anticipated by unions and, thus, on the precision of information provided by the central bank. It follows that signal quality is likely to have important implications for welfare outcomes and we now turn to examine this issue.

4. Welfare Effects of Information Quality

We initially identify the consequences of signal quality for the expected union loss. From the observation that better-informed agents are better placed to make decisions in their own interest, it appears self-evident that any improvement in the quality of information concerning supply shocks will be beneficial to unions. However, while such a view seems to be grounded in sound economic logic, it nonetheless requires formal consideration.

With $l_i = l$ and $w_i = w, \forall i$, the expected union loss can be found from equation (7) using (17) to substitute for l, and (15) and (16) to substitute for $w - p$. Differentiating the resulting expression with respect to σ_u^2 :[8]

[7] Which involves stabilizing the price level completely in response to the anticipated component of supply shocks.
[8] Henceforth dropping the *i* subscript.

$$\frac{\partial E(L^u)}{\partial \sigma_u^2} = \frac{\{\gamma\varepsilon(1-\alpha) - \lambda[\alpha + \varepsilon(1-\alpha)]\}}{\{\gamma\varepsilon + (1-\alpha)[\alpha + \varepsilon(1-\alpha)]\}^2[\lambda + (1-\alpha)^2]^2}\Big[\ \{\gamma\varepsilon(1-\alpha)$$

$$-\lambda[\alpha + \varepsilon(1-\alpha)]\}[\gamma + (1-\alpha)^2] + 2\alpha[\lambda + (1-\alpha)^2]\ \Big]\beta^2 \qquad (18)$$

Inspection of the expression on the right-hand side of (18) reveals that it is ambiguous in sign: thus it is possible for an improvement in the quality of information concerning the supply shock to produce an increase in the expected loss of wage setters. The conditions under which this is the case are identified by the following proposition :

Proposition 1: *An improvement in the precision of the signal, s, of the supply shock,* θ, *as represented by a reduction in* σ_u^2, *the variance of the signal noise, will increase the expected union loss if (and only if)* :

$$\frac{\alpha}{\varepsilon(1-\alpha)}\left\{1 - \frac{2\gamma[\lambda + (1-\alpha)^2]}{\lambda[\gamma + (1-\alpha)^2]}\right\} < \frac{\gamma - \lambda}{\lambda} < \frac{\alpha}{\varepsilon(1-\alpha)}$$

Now considering how the quality of information supplied by the central bank to unions impacts on the expected social loss, the expressions for the price level and employment described by equations (16) and (17) respectively are substituted into (10), expectations taken and the resulting expression differentiated with respect to σ_u^2:

$$\frac{\partial E(L^s)}{\partial \sigma_u^2} = \frac{\lambda\{\gamma\varepsilon(1-\alpha) - \lambda[\alpha + \varepsilon(1-\alpha)]\}}{(1-\alpha)^2\{\gamma\varepsilon + (1-\alpha)[\alpha + \varepsilon(1-\alpha)]\}^2[\lambda + (1-\alpha)^2]}\Big\{\ \gamma\varepsilon(1-\alpha)$$

$$+[\lambda + 2(1-\alpha)^2][\alpha + \varepsilon(1-\alpha)]\ \Big\}\beta^2 \qquad (19)$$

Equation (19) can be seen directly to imply :

Proposition 2: *An improvement in the quality of information relating to the supply shock provided by the central bank to unions will increase the expected social loss if (and only if)* :

$$\frac{\gamma-\lambda}{\lambda}<\frac{\alpha}{\varepsilon(1-\alpha)}$$

Thus, as with Cukierman (2001) and Gersbach (2002), greater central bank transparency may lead to an increase in the expected social loss. However, this is clearly not the only possibility, and we turn now to interpret the results encapsulated in Propositions 1 and 2.

In fact, underlying our findings are two distinct forces. The first of these is associated with the relationship between the relative weights placed by unions and the central bank on employment stability, and the resulting interaction between monetary policy and wage determination. The second has its source in an externality present in wage setting, the strength of which diminishes as the product market becomes more competitive. By initially considering the case of a perfectly competitive goods market, captured in our framework as $\varepsilon \to \infty$, the influence of the externality can be eliminated, allowing us to focus on the role of the relationship between central bank and union preferences.

We first note that as $\varepsilon \to \infty$ it is evident that the condition identified in Proposition 1 can never be satisfied: consequently, if the product market is perfectly competitive, an improvement in signal quality can never be detrimental from the viewpoint of unions. Now considering the implications of central bank transparency for the expected social loss, it can be seen from Proposition 2 that, as $\varepsilon \to \infty$, the condition $\gamma < \lambda$, i.e. that unions place a smaller relative weight on employment stability than does society, becomes necessary and sufficient for greater signal precision to generate a deterioration in social welfare.

In order to explain these implications of central bank disclosure, it is useful to examine the special case of $\gamma = \lambda$. Suppose, in this instance, wage setters are completely uninformed about the realization of θ. With the nominal wage constant, movements in the price level as the central bank responds to supply shocks will be mirrored exactly in movements in the real wage. Thus, with $\gamma = \lambda$ the implementation of monetary policy, directed at achieving society's optimal trade-off between price level and employment

stability will, as a by-product, achieve each union's desired trade-off between real wage and employment stability. Moreover, since each union is aware of this, the optimal response to any signal of a non-zero realization of θ is to maintain the nominal wage constant. As a consequence, in this special case, macroeconomic outcomes and the resulting expected values of both the social and union loss functions are independent of signal quality.

However, if $\gamma < \lambda$ stabilization policy achieves, from the perspective of unions, too much employment stability at the expense of excessive real wage variability. Any signal concerning the supply shock will therefore give rise to a nominal wage response as each union attempts to achieve the desired trade-off between the two arguments of its objective function, conditional on the information at its disposal. While evidently beneficial to unions, the consequence of increased transparency for social welfare is unambiguously detrimental with an increase in the variability of both employment and, reflecting the induced stochastic inflation bias, the price level. In fact, the analysis of Cukierman (2001) and Gersbach (2002) can be viewed as representing an extreme case of this scenario, associated with $\gamma = 0$, that is where unions are concerned only with stabilizing the real wage. In this instance, in the absence of any real wage adjustment to counteract its direct impact, the anticipated component of any supply shock has its maximum effect on employment[9] and, through the consequent policy response of the central bank, the price level.

Our framework does, however, capture the alternative possibility, i.e. that greater central bank transparency may be desirable from society's viewpoint: with a perfectly competitive product market this is true if $\lambda < \gamma$. In this instance, given an unchanged nominal wage, the outcome of stabilization policy is, from the union perspective, too little real wage adjustment and, consequently, an undesirably high degree of employment variability. Hence, any information concerning the realization of supply shocks will lead to a nominal wage response directed at attaining greater employment stability. This outcome is beneficial not only to unions, but also to society: the latter gains directly from the reduction in employment volatility, and also as a result of the induced fall in the

[9] With union objectives relating only to the real wage, the semi-reduced-form relationship determining aggregate employment can be written as $l = (p - Ep + \theta)/(1-\alpha)$.

stochastic inflation bias. Indeed, as $\gamma \to \infty$, in which case union concerns relate solely to employment, full transparency would allow complete stabilization of both employment and prices.

The preceding discussion relates to the consequences of central bank disclosure policy in the context of a perfectly competitive goods market, which our framework encapsulates as a limiting case. However, as already noted, when the product market is characterized by monopolistic competition, a further influence on the macroeconomic effects of transparency, specifically an externality present in union wage setting, comes into play. The externality referred to derives from the fact that, given the atomistic nature of the labour market, each union regards its influence on the price level, and hence, via (3), on aggregate demand as negligible. The consequence of this is that the perceived trade-off between employment and the real wage at the level of the individual union differs from that which actually prevails at the aggregate level.[10] As a result, following the receipt of any signal indicating a non-zero realization of θ, the aggregate adjustment of the nominal wage departs from the efficient response : specifically, it produces a less than optimal change in the real wage at the expense of a larger than optimal variation in employment.

The implications of this are most easily seen by again considering the special case in which the union and social loss functions attach identical relative weights to employment stability. Suppose, initially, that unions are completely uninformed about the realization of supply shocks. Then, as previously discussed in the context of a perfectly competitive goods market, when $\gamma = \lambda$ stabilization policy achieves the optimal outcome in response to shocks from the perspectives of both unions and society. In the presence of the externality, however, macroeconomic equilibrium is no longer independent of whether a signal is provided to unions. Any information relating to θ now leads to an aggregate nominal wage response, reflecting the (invalid) perception by each individual union that it can improve on the outcome associated with an unchanged nominal wage. Thus any signal gives rise to a movement away from the efficient equilibrium in the form of a

[10] The individual union's perceived trade-off can be found directly from (5) as $dl_i/d(w_i - p) = -\varepsilon/[\alpha + \varepsilon(1-\alpha)]$. The aggregate trade-off, on the other hand, identified using equations (11), (12) and (13), is described by $dl/d(w-p) = -1/(1-\alpha)$. Clearly, the two coincide only as $\varepsilon \to \infty$.

larger than optimal adjustment in employment, with the magnitude of the departure increasing in the precision of the signal. Greater central bank transparency is therefore associated with more volatile employment and will result in higher expected losses for both unions and society.

While $\gamma = \lambda$ represents a particular case, the principle extends over a range of relative values for these two preference parameters. Although for $\gamma \neq \lambda$ the conduct of monetary policy will result in macroeconomic outcomes which diverge from those which are optimal from the collective union viewpoint, within the limits defined by Proposition 1 it approximates the latter more closely than would the uncoordinated decisions of fully-informed individual unions. From the perspective of the social loss function, the detrimental impact on social welfare arising from the wage setting externality is exacerbated for $\gamma < \lambda$ since, as discussed, even in the absence of the externality, a smaller relative weight placed on employment stability by unions than by society will mean greater variability in employment and a larger stochastic inflation bias as unions become better informed. Indeed, as is apparent from equation (20), greater signal precision will enhance social welfare only if γ exceeds λ by some margin. In the case of $\gamma = \lambda[\alpha + \varepsilon(1-\alpha)]/\varepsilon(1-\alpha)$, the larger relative weight placed on employment stability by unions is just sufficient to compensate for the effect of the wage setting externality on employment variability and, in this instance, the expected social loss is independent of signal quality. However, for all γ less than this value $\partial E(L^s)/\partial \sigma_u^2 < 0$.

We conclude this section by drawing attention to a parallel between our findings with regard to the implications of signal quality for the expected union loss and the results of Morris and Shin (2002), who also identify the possibility that greater access to information may be disadvantageous to those who acquire it. As in the present analysis, an externality is the source of their result. However, whilst in Morris and Shin the externality is intrinsic to the information process itself, in our framework the externality arises from the uncoordinated decisions of atomistic unions. This latter aspect of our findings is one of the issues discussed in the next section.

5. Extensions to the Basic Model

Strategic wage setting by non-atomistic unions

A substantial literature examining the consequences of strategic interaction between the central bank and non-atomistic wage setters has developed in recent years: examples include Skott (1997), Cukierman and Lippi (1999), Lawler (2000), Soskice and Iversen (2000), Coricelli *et al.* (2005), and Holden (2005). It is reasonably straightforward to adapt the present model to incorporate a potentially finite number (n) of unions, each of which acts as a monopoly supplier of labour to a fraction ($1/n$) of the totality of firms in the economy. Such an extension encapsulates as limiting cases both the atomistic union structure employed to this point and the case of a single economy-wide union. The significance of this modification is that, for $n < \infty$, each union will partially internalize the externality to which its wage decision gives rise. As a result, the inefficiency present in union wage setting diminishes and, consequently, greater signal precision is more likely to be beneficial from the viewpoints of both the union and social loss functions.[11] Nonetheless, for any $n > 1$ the possibility that an improvement in signal quality is detrimental to both unions and society remains.

Imperfect monetary control

In conducting the preceding analysis it has been assumed that the central bank exerts exact control over the nominal money supply. In practice, of course, the relationship between policy instruments and intermediate variables such as the money stock is far from precise. The implications of relaxing the assumption of perfect monetary control will depend on the form such an amendment takes. Introducing an additive disturbance term into the money supply process will leave our findings entirely unaffected, reflecting the principle of certainty equivalence in our linear-quadratic model. Multiplicative uncertainty[12], on the other hand, does imply some modification to our results, albeit one which is relatively minor in nature.

Suppose the money supply process takes the form:

---

[11] More precisely, the ranges of relative values of γ and λ for which $\partial E(L^u)/\partial \sigma_u^2 < 0$ and $\partial E(L^s)/\partial \sigma_u^2 < 0$ are truncated.

[12] Recent papers which have examined the consequences of multiplicative uncertainty for the conduct of monetary policy include Letterie (1997), Pearce and Sobue (1997), Lawler (2002) and Schellekens (2002).

$$m = (1+v)\hat{m} \tag{20}$$

where $\hat{m}$ is the central bank's intended setting of the money stock and v is a random disturbance term distributed $N(0,\sigma_v^2)$. The multiplicative nature of the shock will incline the central bank to use monetary policy less actively (Brainard, 1967), since the stabilizing influence of any intended adjustments in monetary policy has to be weighed against the macroeconomic volatility induced by money supply shocks as $\hat{m}$ departs from its neutral value (zero). The curtailment in the stabilization role of monetary policy has an ambiguous impact on the relationship between the quality of union information in respect of the productivity shock and the expected union and social losses.[13] The crucial consideration here is whether, in the absence of a monetary policy reaction, the aggregate wage response to the anticipated component of any supply shock will lead to a superior or an inferior macroeconomic outcome when judged in terms of each individual loss function, than would result from an unchanged nominal wage. If the former, the range of relative parameter values for which an improvement in information quality reduces the respective expected loss is extended; if the latter, the reverse is true.

Precommitment to the optimal policy rule

Underlying the focus of our main analysis on a discretionary policy environment is the view that precommitment to the optimal state-contingent rule is infeasible. While such a view characterizes much of the monetary policy literature[14], it is nonetheless of interest to consider the extent to which our findings are specific to discretionary policymaking. Significantly, because adherence to the optimal rule gives rise to identical real outcomes to those achieved under discretion, while the union expected loss is determined purely by the stochastic behaviour of real variables, i.e. employment and the real wage, the relationship between signal quality and union welfare, as identified in Proposition 1, is identical under the two regimes. However, commitment to the optimal rule eliminates the

[13] Though, of course, the presence of monetary uncertainty invariably increases the expected losses of both society and unions.
[14] For the contrary viewpoint see McCallum (1995) and Blinder (1997) for example.

source of the stochastic inflation bias. Reflecting this, the greater the precision of information received by unions concerning supply shocks, the more is monetary policy directed at price stability. Thus, although for $\gamma < \lambda[\alpha + \varepsilon(1-\alpha)]/\varepsilon(1-\alpha)$ improved signal quality inevitably leads to greater employment variability, the impact this has on the expected social loss may be outweighed by the accompanying reduction in price level volatility. As a consequence, while there exists a range of relative values of γ and λ for which $\partial E(L^s)/\partial\sigma_u^2 < 0$, this range does not inevitably encompass the case of $\gamma = \lambda$, nor does it necessarily intersect with the range for which $\partial E(L^u)/\partial\sigma_u^2 < 0$.

6. Concluding Remarks

The macroeconomic implications of increased central bank transparency provide the focus for an important and growing strand of literature, with the issue explored from a number of alternative angles and in the context of a variety of different models. The analysis of the present paper has centred on the consequences of greater transparency in relation to supply shocks and the resulting interaction between monetary policy and the uncoordinated wage decisions of atomistic unions. In providing a detailed analysis of the implications of goods and labour market structure and the objectives of wage setters, the paper arrives at somewhat less negative conclusions with regard to the desirability of increased transparency than do the related contributions of Cukierman (2001) and Gersbach (2002). Nonetheless its findings offer far from unequivocal support for the view that greater transparency is likely to be beneficial: in this regard its conclusions echo those of the wider literature. However, the paper also provides a more distinctive contribution in drawing attention to a number of factors, abstracted from in previous work, but which are likely to be significant for the desirability, or otherwise, of increased transparency in monetary policy. Moreover, since the economic characteristics identified as relevant to this issue, in particular the relative importance attached to employment stability by unions and by society, the degree of product market competition and the economy's wage bargaining structure, differ significantly across economies, our results suggest that a universally valid prescription in respect of central bank disclosure policy is unlikely to be found.

References

Alesina, A., Tabellini, G., (1987) 'Rules and Discretion with Noncoordinated Monetary and Fiscal Policies' *Economic Inquiry* 25, 619-630.

Blinder, A.S., (1997) 'What Central Bankers Could Learn from Academics - and Vice-Versa' *Journal of Economic Of Perspectives*, 11, 3-19.

Blinder, A.S., Goodhart, C.A., Hildebrand, P.M., Lipton, D., Wyplosz, C., (2001) *How Do Central Banks Talk? Geneva Reports on the World Economy No. 3*, London, Centre for Economic Policy Research.

Brainard, W., (1967) 'Uncertainty and the Effectiveness of Policy' *American Economic Review* 57, 411-425.

Bratsiotis, G., Martin, C., (1999) 'Stabilization, Policy Targets, and Unemployment in Imperfectly Competitive Economies' *Scandinavian Journal of Economics* 101, 241-257.

Coricelli, F., Cukierman, A., and Dalmazzo, A., (2005) 'Monetary Institutions, Monopolistic Competition, Unionized Labor Markets and Economic Performance', *Scandinavian Journal of Economics* (forthcoming).

Cukierman, A., (2001) 'Accountability, Credibility, Transparency and Stabilization Policy in the Eurosystem', in C. Wyplosz (ed.) *The Impact of EMU on Europe and the Developing Countries*, Oxford: Oxford University press, chapter 3, pp.40-75.

Cukierman, A., Lippi, F., (1999) 'Central bank independence, centralization of wage bargaining, inflation and unemployment: Theory and some evidence' *European Economic Review* 43, 1395-1434.

Cukierman, A., Meltzer, A.H., (1986) 'A Theory of Ambiguity, Credibility, and Inflation under Discretion and Asymmetric Information' *Econometrica* 54, 1099-1128.

Eijffinger, S.C., Hoeberichts, M., Schaling E., (2000) 'Why money talks and wealth whispers: monetary uncertainty and mystique' *Journal of Money, Credit and Banking* 32, 218-235.

Faust, J., Svensson, L.E.O., (2001) 'Transparency and Credibility with Unobservable Goals' *International Economic Review* 42, 369-397.

Faust, J., Svensson, L.E.O., (2002) 'The Equilibrium Degree of Transparency and Control in Monetary Policy' *Journal of Money, Credit and Banking* 34, 520-539.

Geraats, P.M., (2002) 'Central Bank Transparency' *Economic Journal* 112, F532-F565.

Geraats, P.M., (2004) 'Transparency and Reputation: the Publication of Central Bank Forecasts', mimeo *CWPE* 0473, Cambridge University.

Gersbach, H., (2002) 'On the Negative Social Value of Central Banks' Knowledge Transparency', mimeo, University of Heidelberg.

Grüner, H.P., (2002) 'How much should central banks talk? A new argument' *Economics Letters* 77, 195-198.

Herrendorf, B., Lockwood, B., (1997) 'Rogoff's "Conservative" Central Banker Restored' *Journal of Money, Credit, and Banking* 29, 476-495.

Holden, S., (2005) 'Monetary regimes and the co-ordination of wage setting' *European Economic Review* (forthcoming).

Hutchison, M.M., Walsh, C.E., (1998) 'The Output-Inflation Tradeoff and Central Bank Reform: Evidence from New Zealand' *Economic Journal* 108, 703-725.

Jensen, H., (2000) 'Optimal Degrees of Transparency in Monetary Policymaking: The case of imperfect information about the cost-push shock', mimeo, University of Copenhagen.

Jensen, H., (2002) 'Optimal Degrees of Transparency in Monetary Policymaking' *Scandinavian Journal of Economics* 104(3), 399-422.

Lawler, P., (2000) 'Centralised Wage Setting, Inflation Contracts, and the Optimal Choice of Central Banker' *Economic Journal* 110, 559-575.

Lawler, P., (2002) 'Monetary uncertainty, strategic wage setting and equilibrium employment' *Economics Letters* 77, 35-40.

Letterie, W., (1997) 'Better Monetary Control May Decrease the Distortion of Stabilisation Policy: A Comment' *Scandinavian Journal of Economics* 99, 463-470.

McCallum, B.T., (1995) 'Two Fallacies Concerning Central-Bank Independence' *American Economic Review (Papers and Proceedings)* 85, 207-211.

Morris, S., Shin, H.S., (2002) 'Social Value of Public Information' *American Economic Review* 92, 1521-1534.

Oswald, A.J., (1985) 'The Economic Theory of Trade Unions: An Introductory Survey' *Scandinavian Journal of Economics* 87, 160-193.

Pearce, D.K., Sobue, M., (1997) 'Uncertainty and the inflation bias of monetary policy' *Economics Letters* 57, 203-207.

Schellekens, P., (2002) 'Caution and Conservatism in the Making of Monetary Policy' *Journal of Money, Credit and Banking* 34, 160-177.

Skott, P., (1997) ‘Stagflationary Consequences of Prudent Monetary Policy in a Unionized Economy’ *Oxford Economic Papers* 49, 609-622.

Soskice, D., Iversen, T., (2000) ‘The Non-Neutrality of Monetary Policy with Large Price or Wage Setters’ *Quarterly Journal of Economics* 115, 265-284.