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**SUPPLY-SIDE FISCAL POLICY,  
CONSERVATIVENESS, AND CENTRAL BANK  
TRANSPARENCY**

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## **Abstract**

This paper focuses on the “contingent” view of transparency. By introducing endogenous fiscal policy and labour market distortions, it studies the effects the uncertainty in central bank’s (CB) preferences on the behaviour of wage and fiscal authorities and thus on output and inflation. We consider the problem on both positive and normative perspectives. First, we investigate the effects of a given degree of uncertainty in CB’s preferences on inflation and real output. Second, in line with recent literature, by assuming the possibility that information on CB’s preferences may be an endogenous variable, we study the optimal degree of transparency from the CB’s viewpoint. Although a general analysis is presented, we focus on the case of a small-bounded variance of CB’s preference, i.e. we assume that the CB’s power of affecting information disclosure and influencing private beliefs is limited.

**J.E.L. classification:** E58

**Keywords:** Central bank transparency; Communication; Inflation uncertainty.

# SUPPLY-SIDE FISCAL POLICY, CONSERVATIVENESS, AND CENTRAL BANK TRANSPARENCY\*

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## 1. Introduction

The macroeconomic importance of central bank (CB from now onward) transparency is increasingly debated in the literature. According to a popular view, progressively supported by several central bankers,<sup>1</sup> transparency allows for Pareto-improving forecasts and decisions (Blinder, 1998; Blinder

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<sup>1</sup> Greenspan (2001) recalls that in past decades several central bankers believed that monetary policy is most effective when it is least transparent, as market uncertainty creates differences of opinion on the future prices of short-term debt instruments and thus thick markets, and an increased degree of liquidity. In the 1980s, they reckoned instead that being explicit about short-run targets would make such targets more difficult to change, hindering adjustments to evolving market and economic conditions. Today, central bankers reckon

*et al.*, 2001) and favours cooperative behaviour (Bini-Smaghi and Gros, 2001).<sup>2</sup> According to an opposite view, information disclosure reduces instead the possibility for CBs to use their private information strategically.<sup>3</sup> And this is no good as, for example, information asymmetries between CBs and the general public about the weight of the arguments in the authorities' objective functions<sup>4</sup> may affect trade union behaviour, induce wage moderation (Sorensen, 1991) and decrease both the level and the variance of inflation (Grüner, 2002). Other theoretical contributions have reached different results, and surveys of the subject matter are already available (see, e.g., Geerats, 2001; Posen, 2003).

In spite of these efforts, the theoretical literature seems to be unable to explain the heterogeneous behaviour of CBs in information disclosure (Bini-Smaghi and Gros, 2001; Eijffinger and Geraats, 2002; Di Bartolomeo and Marchetti, 2003; Demertzis and Hughes-Hallet, 2003) and several results remain alien to the scanty and conflicting findings of the empirical literature.<sup>5</sup> In particular, it is not clear whether transparency strongly affects the average level of inflation and output deviation,<sup>6</sup> while it remains

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that financial markets work more efficiently when effort need not be wasted to infer the stance of monetary policy.

<sup>2</sup> Ferguson (2002) stresses that CB transparency about its own actions and the way it perceives the economic outlook improves market participants' expectations of future short rates, bringing longer rates closer to those desired by the authorities. Moreover, transparency allows market participants to better anticipate policy responses in the face of unexpected developments, thus speeding economic adjustments.

<sup>3</sup> This line of research elaborates on the effects of information asymmetries between CBs and the general public documented by Canzoneri (1985).

<sup>4</sup> See Beetsma and Jensen (1998) and Walsh (2003).

<sup>5</sup> Given the strong limitations of the data, the empirical evidence should be seen in terms of correlations between variables rather than causal relations.

<sup>6</sup> For example, Demertzis and Hughes-Hallet (2003) claim that this is not the case for the nine countries for which Eijffinger and Geraats (2002) constructed their indexes.

difficult to establish its effects on output and inflation variability. According to Chortareas et al. (2001)<sup>7</sup> and to Demertzis and Hughes-Hallet (2003), disclosure reduces inflation volatility at the expense of a rise in output volatility, whereas Kuttner and Posen (1999, 2000, 2001) argue that inflation targeting central banks display higher flexibility in responding to shocks without reducing their ability to respond to output volatility. The most convincing evidence suggests however that conservative (i.e., anti-inflationary) and transparent CBs are able to reduce both levels and variances of output and inflation (Posen, 2002).

In this paper, we aim to provide an explanation for both the latter finding and the heterogeneous behaviour of actual CBs in information disclosure. To this aim, we focus on the so-called “contingent” view of transparency (Posen, 2003), i.e., that related to CB’s objectives, which originated from the Barro and Gordon (1983) approach to monetary policy,<sup>8</sup> but we reach different results from those achieved by this strand of the literature. According to that view, the optimal degree of transparency depends upon the CB’s degree of conservativeness.<sup>9</sup> More conservative CBs generate lower inflation variability (as higher credibility produces stronger reputation and higher ability to control inflation) and a steeper short-run Phillips curve (and/or less attention to output stabilization), and thus have

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<sup>7</sup> A critique of the measures of transparency used by Chortareas et al. (2001), as well as of their methodology, is in Posen (2001).

<sup>8</sup> According to this approach, since discretionary monetary policy produces suboptimal outcomes, monetary authorities should pre-commit to publicly announced policies, be independent and inflation averse (Rogoff, 1985). In order to be accountable, their behaviour must be predictable and verifiable by the public, and this cannot obtain if they do not disclose the information they possess.

<sup>9</sup> See Cukierman (2002), Faust and Svensson (2001a, 2001b), Gersbach and Hahn (2001a, 2001b), Jensen (2001) and Geraats (2001).

lower control on output. As a consequence, there should be a trade-off between inflation volatility and output volatility<sup>10</sup> which has been however rejected by the available cross-sectional evidence.<sup>11</sup> Moreover, an inverted U-shaped curve for the amount of desirable transparency there should exist: most and least credible CBs should disclose less than those of intermediate credibility.

By introducing endogenous supply-side fiscal policy and labour market distortion into the analysis,<sup>12</sup> and by treating transparency as an endogenous variable in the hands of the CB (in line with a suggestion by Faust and Svensson, 2002), we shall demonstrate that, if the uncertainty about the CB's preference is bounded to low values, the behaviour of different CBs in information disclosure is different because the optimal (for the CB) degree of transparency varies with the main institutional characteristics of the economy: degree of labour market competitiveness, degree of CB conservativeness, constraints on fiscal policy.

Transparency may have a significant impact on economic performances only in economies where real wages are highly distorted by union behaviour. In such contexts, if fiscal policy is inactive and uncertainty on CB's preferences is small, for a conservative CB it is optimal to be fully transparent (as this minimizes its loss, defined in terms of output and

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<sup>10</sup> See Ball (1999) and Svensson (1999) for a discussion of this trade-off in the context of inflation targeting.

<sup>11</sup> See Debelle and Fischer (1995), Blinder (1998), and Kuttner and Posen (1999).

<sup>12</sup> Despite some attempt (e. g. Huges-Hallet and Viegi 2001), the inclusion of fiscal policy in the analysis of transparency has not been generally pursued. And yet, as reported by Bini-Smaghi and Gros (2001), CBs have threatened to tighten monetary policy not only if wage negotiations were inconsistent with price stability, but also if budget projections were overshoot.

inflation), whereas for a populist CB it is optimal to be fully opaque. This is so because if the CB is conservative (populist), uncertainty has a small (great) impact on output and the cost for the union of underestimating monetary policy is higher (lower) than that of overestimating it. This implies that wage policies are more (less) aggressive when trade unions do not perfectly know the CB's preferences. Conservative (populist) monetary authorities hence (do not) prefer to eliminate this kind of uncertainty in order to moderate wage claims rather than relying on the wage discipline device represented by opacity.

If the government aims instead at supporting employment through supply-side fiscal policy, full transparency (opacity) is optimal when the CB is perceived as conservative (ultra-populist). If the CB is perceived as moderately populist, the optimal degree of transparency depends on the fiscal stance of the government: when this is very active in stabilising the economy (relative to controlling inflation), it is optimal for the CB to be fully transparent; when the government faces a tight constraint on budget deficits, it is instead optimal to be fully opaque.

Fiscal policy hence expands the range of possible results: conservativeness keeps on making always useless the wage discipline device represented by opacity, whereas this mechanism is always important when the CB is perceived as extremely populist. In intermediate cases, the less the government acts to support employment the more it is optimal for the CB to be opaque (in the limit, we hence go back to case of an inactive government). If unions are induced to increase wages by a government supporting employment through deficit spending, raising public

employment will compensate for the fall in private employment, but prices will increase with budget lassitude and it will be convenient for a moderately populist CB to constrain the unions' behaviour by letting them know that it would not be willing to fully accommodate the wage push.

Our final result is that an increase in transparency always reduces both inflation and output variance. This is in line with Posen's (2003) claim that fully transparent and conservative CBs are able to reduce levels and variances of both output and inflation.

The paper is structured as follows. In section 2 we construct a policy game between a money wage setting union, a fiscal authority and a CB, and we solve it under a Stackelberg sequence of players' moves. In section 3 we analyse the effects of an increase in CB transparency on the levels and the variances of inflation and output deviation, under different assumptions on the "type" of CB (more or less conservative) and on the stance of fiscal policy (fiscal authorities more or less concerned about losses induced by fiscal expansions). Section 4 offers concluding comments.

## 2. The model

In this section we lay down a simple policy game made up by two equations describing the economy and by three equations describing policymakers' preferences. Aggregate demand and aggregate supply are:

$$x = m - p \tag{1}$$

$$x = p - w + \eta b \tag{2}$$

where  $x$  is the output deviation for its non-distorted natural level,  $m$  is the money stock,  $p = \pi$  is the price level (inflation),  $w$  is the nominal wage and



$b$  is the net level of a supply-side fiscal policy. Equation (1) is a well-known and straightforward simple representation for the demand side. Equation (2) is the aggregate supply. In line with recent literature,<sup>13</sup> we express it in terms of real wage instead of price expectations to introduce endogenous labour market distortions – derived from a trade union optimization problem. Moreover, equation (2) also includes the possibility for fiscal policy to influence the aggregate supply of output. This idea, which has been increasingly employed in the recent literature, can be justified in several different ways.

1. First,  $b$  can be a fiscal surplus ( $b < 0$ ), or deficit ( $b > 0$ ), which has a permanent effect on output if maintained through time (Hughes-Hallett and Viegi, 2001; Demertzis, Hughes-Hallett and Viegi, 2004). In this case, equation (2) may summarise the idea that the aggregate supply of output can be split into a private component, produced by competitive and profit-maximising firms (which give rise to the usual inverse relationship between output and the real wage), and a public component, generated by a government producing the same (aggregate) good produced by private firms and expanding the level of output by directly purchasing labour through non-monetary budget deficits (Acocella and Ciccarone, 1997).

2. Second,  $b$  may be a public investment which raises the private sector productivity, or a production subsidy to the firms that raises the supply of goods and services and reduces prices, and which can be financed by per-head taxes and/or by taxation on sales or on income (Dixit and Lambertini, 2003).

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<sup>13</sup> See Cukierman (2004) for a survey.

3. Finally,  $b$  may be interpreted as a measure of social security or non-wage costs imposed on employers, or taxes on labour, or the costs of supply side constraints, or market restrictions, or job protection legislation imposed on producers; or the costs of any market imperfections in the wage-bargaining process that might keep real wages above market clearing levels (Demertzis, Hughes-Hallett and Viegi, 2004)

In any case, monetary policy operates on the demand side and fiscal policy on the supply side: an increase in  $b$  *ceteris paribus* reduces prices, and raises output and employment, thus favouring an increase in the nominal wage set by the union. This set-up is useful, as it enables us: (a) to study the effects of transparency on output and inflation in a simple model with fiscal policy, and so to take the government's preferences (and some institutional constraints, like the *European Stability and Growth Pact*) directly into account; (b) to compare our results with those of other models already present in the literature which take on board the idea that government deficit spending does not influence the demand side of the economy.

The players' preferences, with all variables in logs, are:

$$L_B = -E \left[ \frac{\beta_B}{2} \pi^2 + \frac{1}{2} x^2 \right] \quad (3)$$

$$L_G = -E \left[ \frac{\beta_G}{2} \pi^2 + \frac{1}{2} x^2 + \frac{\varphi_G}{4} b^2 \right] \quad (4)$$

$$L_U = E \left[ \alpha(w - \pi) - \frac{1}{2} x^2 \right] \quad (5)$$

where  $E[\cdot]$  is the expectation operator and subscripts indicate the player (CB, government and union). The objective functions are quadratic in all arguments but are linear in the real wage.<sup>14</sup> Whereas the hypothesis underlying equations (3) and (5) are rather common in the literature;<sup>15</sup> the Government objective function  $L_G$  deserves more attention.

In line with the existing literature, we do not include an explicit budget constraint into the model, but constrain fiscal policy by placing penalties on its use through the introduction of  $b$  in the government's loss function, with the parameter  $\varphi_G$  measuring the weight of such penalties. It can be thought of as influenced, among other things, by specific institutional constraints posed on fiscal policy: when the fiscal discipline becomes tight, due e.g. to international agreements (as the *Stability and Growth Pact*), the cost for the Government to pursue an active fiscal policy increases, and this can be represented by a higher level of  $\varphi_G$ .

The justification for this approach can be split in three steps.

1. It is possible to interpret the government's present value budget constraint (the liabilities to GDP ratio at time  $t$  is equal to the surplus to GDP ratio at time  $t$  plus the expected value of future discounted surplus to GDP ratios) as a condition that must be satisfied in equilibrium. This occurs if fiscal policy generates a

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<sup>14</sup> This has become a standard assumption in recent policy games. For an early use and justification see Acocella and Ciccarone (1997); see also Acocella and Di Bartolomeo (2004).

<sup>15</sup> The linear-quadratic nature of the union preference is common in literature (for a review, see Cukiermak, 2004). A double-quadratic function however does not alter qualitatively our results. For a complete discussion on linear-quadratic and double quadratic form in policy games, see Acocella and Di Bartolomeo (2004).

sequence of future surplus to GDP ratios which satisfies the condition independently of the values taken in equilibrium by the discount factors, or the initial liabilities to GDP ratio. Alternatively, if the sequence of future surplus to GDP ratios is arbitrary, the discount factors, or the initial liabilities to GDP ratio must move so as to satisfy the equilibrium condition.

2. Canzoneri, Cumby and Diba (2001) have shown that if (i) the sequence of surplus to GDP ratio is determined by the liabilities to GDP ratio (through a positive and bounded away from zero infinitely often time varying response parameter) and a bounded random variable (encapsulating political and economic factors), and (ii) the sum of the discount factors converges,<sup>16</sup> then the flow budget constraint is dynamically stable, and the government's present value budget constraint is respected for any initial liabilities to GDP ratio. We do not need the fiscal response to be strong enough, but only that the discounted value of the liabilities to GDP ratio at time  $t + T$  goes to zero as  $T$  goes to infinity. If the response parameter is constant, any positive value guarantees this result; in the case of a time varying fiscal response, it may be arbitrarily small and infrequent.
3. The inclusion of the fiscal deficit (or, more in general, of fiscal policy) in the government's cost function guarantees that the fiscal response will be such that the solutions of the model are both sustainable (i.e., they satisfy the long-run solvency

constraint) and can be financed in advance (i.e., they satisfy the “cash in advance” constraints): the budget constraint does not bind.<sup>17</sup>

The timing of the game is as follows: (i) the union sets  $w$ ; (ii) the government fixes  $b$ ; the CB chooses  $m$ . These assumptions encapsulate the idea that wage contracts are set for a period of time which is longer than that the time horizon of fiscal policy and, even more, than that of monetary policy. The game is solved backward.<sup>18</sup> In order to study the optimality of transparency, we also consider the possibility that the CB could endogenously choose the degree of transparency.<sup>19</sup> Technically, this corresponds to introduce an initial stage in which the CB decides the degree of information disclosure that becomes so endogenous.

The solution of the CB problem gives the following reaction function:

$$m = -Bw + \eta Bb \quad (6)$$

where  $B = \frac{\beta_B - 1}{\beta_B + 1}$  is an index of the CB’s degree of conservativeness: if

$B < 0$  ( $B > 0$ ) the CB follows a (non) accommodating policy with respect

<sup>16</sup> This implies that the growth rate exceeds the average real interest rate for only finitely many periods.

<sup>17</sup> See also Demertzis, Hughes-Hallett and Viegli (2004, Appendix A).

<sup>18</sup> Huges-Hallett and Viegli (2001) employ a similar model, but they envisage a Nash equilibrium between the CB and the government, with a private sector (not a union) acting as Stackelberg leader with respect to the public sector. We prefer the sequential timing since it seems to be the equilibrium concept that better captures fiscal and monetary interaction (see, e.g., Beetsma and Bovenberg, 1998; Beetsma and Uhlig, 1999). See also Dixit and Lambertini (2003) for a general discussion.

<sup>19</sup> We follow a suggestion by Faust and Svensson (2002), who envisage transparency as an endogenous variable in the hands of the CB. Differently from them, we do not however try to determine the optimal degree of CB’s transparency through simulations.

to wage expansion. Parameter  $B$  varies between  $-1$  and  $1$ , which correspond to the limit cases of an ultra-liberal and an ultra-conservative CB, respectively. Note that if the CB accommodates wage increases, it cannot accommodate fiscal expansions (i.e., increase  $m$  when  $b$  increases).

Given equation (6), output, inflation and the real wage can be written as:

$$x = -\frac{1+B}{2}(w-\eta b) \quad (7)$$

$$\pi = \frac{1-B}{2}(w-\eta b) \quad (8)$$

$$w-\pi = \frac{1+B}{2}w + \frac{1-B}{2}\eta b \quad (9)$$

However, in setting their policy, the government and the union cannot predict these equations since they are not perfectly informed about the CB's preferences. Both players know only the mean of the inflation reaction,  $E(B) = \bar{B}$ , and its variance,  $\sigma_B^2 = E[(B - \bar{B})^2]$ .

The government optimization problem is:

$$\max_b L_G = -E \left[ \frac{\beta_G}{2} \left( \frac{1-B}{2}(w-\eta b) \right)^2 + \frac{1}{2} \left( -\frac{1+B}{2}(w-\eta b) \right)^2 + \frac{\varphi_G}{4} b^2 \right] \quad (10)$$

the first order condition is:

$$E \left\{ -\beta_G \left[ (1-B)^2 (w-\eta b) \right] \eta - \left[ (1+B)^2 (w-\eta b) \right] \eta + 2\varphi_G b \right\} = 0 \quad (11)$$

and the corresponding fiscal rule is:

$$b = \frac{\eta \left[ \beta_G E(1-B)^2 + E(1+B)^2 \right]}{2\varphi_G + \eta^2 \left[ \beta_G E(1-B)^2 + E(1+B)^2 \right]} w = Kw \quad (12)$$

where:

$$K = \frac{\eta \left[ \beta_G \left( (1-\bar{B})^2 + \sigma_B^2 \right) + (1+\bar{B})^2 + \sigma_B^2 \right]}{2\varphi_G + \eta^2 \left[ \beta_G \left( (1-\bar{B})^2 + \sigma_B^2 \right) + (1+\bar{B})^2 + \sigma_B^2 \right]} \quad (13)$$

In equation (12) it is  $E[(1+B)^2] = (1+\bar{B})^2 + \sigma_B^2$ ; hence  $K$  is a constant and  $E[K] = K$ .

By using (12), the union's optimization problem can be written as:

$$\max_w E \left\{ \alpha \left[ 1 - \frac{1-B}{2} (1-\eta K) \right] w - \frac{1}{2} \left[ -\frac{1+B}{2} (1-\eta K) w \right]^2 \right\} \quad (14)$$

the first order condition is:

$$E \left\{ \alpha \left[ 1 - \frac{1-B}{2} (1-\eta K) \right] - \left[ -\frac{1+B}{2} (1-\eta K) \right]^2 w \right\} = 0 \quad (15)$$

and the wage rule is:

$$w = \frac{2 - (1-\bar{B})(1-\eta K)}{E[1+B^2](1-\eta K)^2} 2\alpha \quad (16)$$

Being  $x = -\frac{1+B}{2} (1-\eta K) w$  and  $\pi = \frac{1-B}{2} (1-\eta K) w$ , the equilibrium

outcomes are:

$$x = -\frac{1+\eta K + (1-\eta K)\bar{B}}{E[1+B^2](1-\eta K)} (1+B)\alpha \quad (17)$$

$$\pi = \frac{1 + \eta K + (1 - \eta K) \bar{B}}{E[1 + B^2]} (1 - B) \alpha \quad (18)$$

Being  $E[(1 + B)^2] = (1 + \bar{B})^2 + \sigma_B^2$ , equations (17) and (18) can be expressed in terms of the variance  $\sigma_B^2$ , which represents the degree of *opacity* of the CB:

$$x = - \frac{(1 + \bar{B}) \varphi_G + \eta^2 \beta_G (1 - \bar{B})^2 + \eta^2 (1 + \bar{B})^2 + \eta^2 (1 + \beta_G) \sigma_B^2}{\varphi_G [(1 + \bar{B})^2 + \sigma_B^2]} (1 + B) \alpha \quad (19)$$

$$\pi = \frac{(1 + \bar{B}) \varphi_G + \eta^2 \beta_G (1 - \bar{B})^2 + \eta^2 (1 + \bar{B})^2 + \eta^2 (1 + \beta_G) \sigma_B^2}{\varphi_G [(1 + \bar{B})^2 + \sigma_B^2]} (1 - B) \alpha \quad (20)$$

Equations (19) and (20) immediately clarify that opacity is relevant only if the wage distortion introduced by  $\alpha$  is significantly high. The higher is  $\alpha$  the higher are inflation and unemployment,<sup>20</sup> as in this economy the only distortion is due to the presence of unions and wage bargaining: in a competitive labour market the issue of transparency loses its relevance. At the same time, an increase in  $\beta_B$  increases  $B$  which, given expectations, increases unemployment but decreases inflation, in line with the traditional view introduced by Rogoff (1985). Finally, since the effects of CB's opacity are either positive or negative on both unemployment and inflation, we to focus only on the latter variable.

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<sup>20</sup> Although implicitly, the same result is obtained by Grüner (2002).



### 3. The effect of transparency on inflation and unemployment

Henceforth, we assume that:

$$\beta_B = \bar{\beta}_B + \varepsilon \quad (21)$$

where  $\varepsilon$  is a random error with  $E(\varepsilon) = 0$  and  $\text{var}(\varepsilon) = \sigma_\varepsilon^2$ . This means that the government and the union are correct on average, but may make mistakes when guessing the CB's preferences at certain points in time.<sup>21</sup>

From equation (21) it follows that:<sup>22</sup>

$$E[B] = E\left[\frac{\beta_B - 1}{\beta_B + 1}\right] = E\left[\frac{\bar{\beta}_B + \varepsilon - 1}{\bar{\beta}_B + \varepsilon}\right] = \frac{\bar{\beta}_B - 1}{\bar{\beta}_B + 1} - \frac{2\sigma_\varepsilon^2}{(\bar{\beta}_B + 1)^3} \quad (22)$$

$$\text{var}(B) = \sigma_B^2 = \frac{4\sigma_\varepsilon^2}{(\bar{\beta}_B + 1)^4} \quad (23)$$

Henceforth we assume that  $\sigma_\varepsilon^2 \in [0, \bar{\sigma}_\varepsilon^2]$  and define (an index of)

opacity as  $S = \frac{\sigma_\varepsilon^2}{\bar{\sigma}_\varepsilon^2}$  and therefore (an index of) transparency as

$T = 1 - S = \frac{\bar{\sigma}_\varepsilon^2 - \sigma_\varepsilon^2}{\bar{\sigma}_\varepsilon^2}$ . This implies that  $S = 1$  and  $T = 0$  when  $\sigma_\varepsilon^2 = \bar{\sigma}_\varepsilon^2$  and  $S$

$= 0$  and  $T = 1$  when  $\sigma_\varepsilon^2 = 0$ .

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<sup>21</sup> See Hughes-Hallet and Viegi (2001); Geeraats (2002); Demertzis and Hughes-Hallet (2003).

### 3.1 The Barro-Gordon case

When  $\varphi_G \rightarrow +\infty$ , i.e., when the fiscal authority is inactive, our model is equivalent to the policy-game formulation of the traditional Barro-Gordon framework;<sup>23</sup> the only difference is that, in our case, the model allows for the possibility of a non-transparent CB. In such a case the equilibrium outcomes are:<sup>24</sup>

$$x = -\frac{1+\bar{B}}{(1+\bar{B})^2 + \sigma_B^2}(1+B)\alpha \quad (24)$$

$$\pi = \frac{1+\bar{B}}{(1+\bar{B})^2 + \sigma_B^2}(1-B)\alpha \quad (25)$$

By applying equations (22) and (23) to equations (24) and (25) we get:

$$x = -\frac{\bar{\beta}_B(\bar{\beta}_B+1)^2 - \sigma_\varepsilon^2}{\left[\bar{\beta}_B(\bar{\beta}_B+1)^2 - \sigma_\varepsilon^2\right]^2 + \sigma_\varepsilon^2(\bar{\beta}_B+1)^2} \frac{1+B}{1+\bar{\beta}_B} \frac{\alpha}{2} \quad (26)$$

$$\pi = \frac{\bar{\beta}_B(\bar{\beta}_B+1)^2 - \sigma_\varepsilon^2}{\left[\bar{\beta}_B(\bar{\beta}_B+1)^2 - \sigma_\varepsilon^2\right]^2 + \sigma_\varepsilon^2(\bar{\beta}_B+1)^2} \frac{1-B}{1+\bar{\beta}_B} \frac{\alpha}{2} \quad (27)$$

In the case of absence of uncertainty in CB's preferences ( $\sigma_\varepsilon^2 = 0$ ),  $T = 1$  and equations (26) and (27) imply the traditional result of monetary policy neutrality, output deviation equal to the private-induced distortion,

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<sup>22</sup> More precisely, these are well-known approximations for the expected value and the variance of  $\bar{B}$  (see, for example, Mood *et al.*, 1974).

<sup>23</sup> See, e.g., Gylfason and Lindbeck (1994), Acocella and Ciccarone (1997), Acocella and Di Bartolomeo (2004).

i.e.  $x = -\alpha$ , and the inflation bias equal to  $\pi = \frac{\alpha}{\beta_B}$ . Allowing for uncertain

in CB's preference, it follows instead that for  $\sigma_\varepsilon^2 = \bar{\beta}_B (\bar{\beta}_B + 1)^2 \equiv \hat{\sigma}_\varepsilon^2$  the outcomes of the policy game are zero output deviation and zero inflation. The basic intuition is that a reduction in transparency leads to more wage discipline, as claimed by Sorensen (1991) and Grüner (2002), and thus to lower inflation and unemployment.

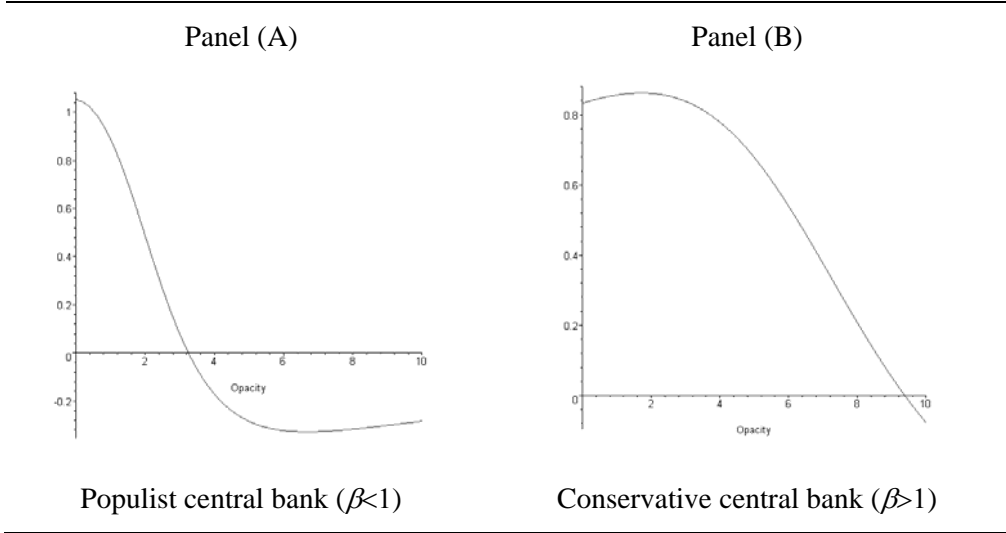
The optimal  $T$ , i.e., that which minimizes the CB' loss, depends however upon the perceived CB's degree of conservativeness which, as it is traditionally understood, is deeply connected with the level of credibility (the anti-inflationary attitude) of the CB. Two cases can be distinguished: (i) the CB is perceived as conservative ( $\bar{\beta}_B > 1$ ) when it is expected to react to a wage increase with a reduction in the money supply (i.e. a credible CB); (ii) the CB is perceived as populist ( $\bar{\beta}_B < 1$ ) when it is expected to react to a wage increase with an increase in the money supply (i.e. an inflationary CB).

The effects of  $\sigma_\varepsilon^2$  on inflation (and on output) are represented in the following figure.

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<sup>24</sup> They are simply obtained by applying the Hôpital rule to equations (19) and (20).

Figure 1 – Effects of opacity on inflation



Assuming that<sup>25</sup>  $0 < \bar{\sigma}_\varepsilon^2 \leq \hat{\sigma}_\varepsilon^2$ , for a populist CB it is optimal to have  $T = 0$ ,<sup>26</sup> that is,  $\sigma_\varepsilon^2 = \bar{\sigma}_\varepsilon^2$ , whereas for a conservative CB it is optimal to have  $T = 1$  if  $\bar{\sigma}_\varepsilon^2 < (\bar{\beta}_B - \sqrt{\bar{\beta}_B})(\bar{\beta}_B + 1)^2$  and  $T = 0$  otherwise, as the curve is hump shaped, with a maximum at  $\sigma_\varepsilon^2 = (\bar{\beta}_B - \sqrt{\bar{\beta}_B})(\bar{\beta}_B + 1)^2$ .

Hence, if the uncertainty on CB's preferences is small (close to zero), as it is realistic to assume, our analysis produces a neat result: for conservative CBs it is optimal to be fully transparent ( $T = 1$ ), whereas for

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<sup>25</sup> This assumption is without loss of generality: if  $\hat{\sigma}_\varepsilon^2$  is feasible, the optimal  $\sigma_\varepsilon^2$  of the CB is  $\hat{\sigma}_\varepsilon^2$  and, therefore, values greater than  $\hat{\sigma}_\varepsilon^2$  will never be optimal.

populist CBs it is optimal to be fully opaque ( $T = 0$ ). The economic explanation of this conclusion is clear. The union knows that, if the CB is conservative (populist), uncertainty has a small (great) impact on output (equation 24); as in the union's utility function the cost of a real wage decrease is linear and that of a greater output deviation is quadratic, under a conservative (populist) CB the cost of underestimating  $m$  is higher (lower) than that of overestimating it;<sup>27</sup> this implies that wage policies are more (less) aggressive when the trade union does not perfectly know the CB's preferences. Hence, a conservative CB has an incentive to eliminate this kind of uncertainty in order to moderate wage claims, rather than relying on the wage discipline device represented by opacity. The opposite applies in the case of a populist CB. Our result provides further support to the claim by Demertzis and Viegli (2002, p. 3) that credible policies do not necessitate transparency: only in the absence of credibility, transparency becomes a relevant issue.

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<sup>26</sup> This result is similar to that by Grüner (2002), but it emerges in our model only as a special case. The difference is due to a misspecification in Grüner's model (see Ciccarone *et al.*, 2003).

<sup>27</sup> This asymmetry in the costs produced by mistakes in the estimation of  $m$  can be explained by considering that: (i) such mistakes imply a cost for the union in terms of higher output and lower real wages, (ii) the union internalises the CB reaction and so (iii) the cost of higher output deviations decreases more than proportionally with  $\beta$ , whereas the cost of real wage decreases are linear in  $\beta$ .

### 3.2 Supply-side fiscal policy

When  $\varphi_G$  is finite, and so fiscal policy is active, the analysis becomes more complex. After tedious algebra, it turns out that the effect of opacity on the level of inflation (and of output) is determined by the following inequality:<sup>28</sup>

$$\frac{\partial \pi}{\partial \sigma_\varepsilon^2} > 0 \Leftrightarrow A_1 \varphi_G > \eta^2 A_2 \beta_G \quad (28)$$

where: 
$$A_1 = \frac{\sigma_\varepsilon^4}{2} - \beta(\beta+1)^2 \sigma_\varepsilon^2 + \frac{\beta}{2}(\beta-1)(\beta+1)^4$$

$$A_2 = \sigma_\varepsilon^4 - (\beta-1)(\beta+1)^2 \sigma_\varepsilon^2 + \frac{1}{2}(3\beta-1)(\beta+1)^4.$$

Henceforth we focus on  $T$  instead of  $\sigma_\varepsilon^2$  (recall that the two are inversely related). Since both  $A_1$  and  $A_2$  can be positive or negative, two mutual cases must be considered:

$$\text{for } A_1 > 0: \frac{\partial \pi}{\partial T} < 0 \Leftrightarrow \frac{\varphi_G}{\beta_G} > \eta^2 \frac{A_2}{A_1} \quad (29)$$

$$\text{for } A_1 < 0: \frac{\partial \pi}{\partial T} < 0 \Leftrightarrow \frac{\varphi_G}{\beta_G} < \eta^2 \frac{A_2}{A_1} \quad (30)$$

$A_1 > 0$  holds for  $\sigma_\varepsilon^2 > d_1$  and  $\sigma_\varepsilon^2 < d_2$ , where  $d_{(1,2)} = (\bar{\beta}_B \pm \sqrt{\bar{\beta}_B})(\bar{\beta}_B + 1)^2$  with  $d_1 > d_2$ ,  $d_1 > 0$ , and  $d_2 > 0$  iff  $\beta > 1$ ;  $A_2 > 0$  holds for  $\sigma_\varepsilon^2 > d_1$  and

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<sup>28</sup> The derivative of inflation with respect to opacity is, in fact,  $A_1 \varphi_G - \eta^2 A_2 \beta_G$ .

$\sigma_\varepsilon^2 < d_2$ , where  $n_{(1,2)} = \frac{1}{2}(\bar{\beta}_B - 1 \pm \sqrt{\bar{\beta}_B^2 + 4\bar{\beta}_B - 1})(\bar{\beta}_B + 1)^2$  with  $n_2 < 0$ , and  $n_1 > 0$  iff  $\beta > 1/3$ . Notice that it is always  $d_1 > n_1 > d_2 > n_2$  and  $n_2 < 0$ .

The effects of transparency on inflation and output deviation variances are determined by the following condition:

$$\frac{\partial \sigma_\pi^2}{\partial T} < 0 \Leftrightarrow e(\pi) = \frac{\partial \pi}{\partial \sigma_\varepsilon^2} \bigg/ \frac{\pi}{\sigma_\varepsilon^2} > -\frac{1}{2} \quad (31)$$

Where  $e(\pi)$  is the elasticity of inflation with respect to  $\sigma_\varepsilon^2$ . If  $\partial \pi / \partial T < 0$ , it is also  $\partial \sigma_\pi^2 / \partial T < 0$  (recall that  $\pi / \sigma_\varepsilon^2 > 0$ ): if transparency reduces the level of inflation, it also reduces its variability. When it is instead  $\partial \pi / \partial T > 0$  (i.e. opacity reduces inflation), if  $|e(\pi)| < \frac{1}{2}$ , then  $\partial \sigma_\pi^2 / \partial T < 0$ : increases in  $T$  reduce inflation and output variances when the increase in the level is small enough (i.e., the reduction in inflation induced by a one percent increase in opacity must be lower than one half, or the increase in inflation induced by a one percent increase in transparency must be lower than one half).

We again restrict our investigation to the most interesting (and realistic) case by assuming that the disturbance on CB's preference is bounded to a small value (i.e., we limit our investigation to the interval around zero).<sup>29</sup> The effect of opacity on the level of inflation (and of the

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<sup>29</sup> More precisely, our results hold according to the following conditions: for  $\sigma_\varepsilon^2 \in (0, d_2)$  if  $\bar{\beta}_B > 1$ ; for  $\sigma_\varepsilon^2 \in (0, n_1)$  if  $\bar{\beta}_B \in (1/3, 1)$ ; and for  $\sigma_\varepsilon^2 \in (0, d_1)$  if  $\bar{\beta}_B \in (0, 1/3)$ . A qualitative investigation for  $\sigma_\varepsilon^2 \in (0, +\infty)$ , based on equation (27), is available upon request.

output deviation) is determined by computing the derivative of equation (20) with respect to  $\sigma_\varepsilon^2$  in zero (remembering to take account of equations (22) and (24)):

$$\left. \frac{\partial \pi}{\partial \sigma_\varepsilon^2} \right|_{\sigma_\varepsilon^2=0} = \frac{1}{2} \frac{[\varphi_G \bar{\beta}_B (\bar{\beta}_B - 1) + 2\eta^2 \beta_G (3\bar{\beta}_B - 1)](1-B)\alpha}{\varphi_G \bar{\beta}_B^4 (\bar{\beta}_B + 1)} \quad (32)$$

Equation (27) is positive when the two following conditions hold:

$$\text{for } \bar{\beta}_B < 1: \left. \frac{\partial \pi}{\partial \sigma_\varepsilon^2} \right|_{\sigma_\varepsilon^2=0} > 0 \Leftrightarrow \frac{\varphi_G}{\beta_G} < \frac{2\eta^2 (3\bar{\beta}_B - 1)}{\bar{\beta}_B (1 - \bar{\beta}_B)} \quad (33)$$

$$\text{for } \bar{\beta}_B > 1: \left. \frac{\partial \pi}{\partial \sigma_\varepsilon^2} \right|_{\sigma_\varepsilon^2=0} > 0 \Leftrightarrow \frac{\varphi_G}{\beta_G} > -\frac{2\eta^2 (3\bar{\beta}_B - 1)}{\bar{\beta}_B (\bar{\beta}_B - 1)} \quad (34)$$

Equations (33) and (34) are associated with a populist and a conservative CB, respectively.

a) If the CB is populist, two cases are possible.

(i) If  $\bar{\beta}_B < 1/3$  (CB ultra-populist), equation (28) is never satisfied, thus full opacity (i.e.  $T = 0$ ) is always optimal.

(ii) If  $\bar{\beta}_B \in (1/3, 1)$  (CB moderately populist), both full transparency

and full opacity can be optimal. If  $\frac{\varphi_G}{\beta_G} > \frac{2\eta^2 (3\bar{\beta}_B - 1)}{\bar{\beta}_B (1 - \bar{\beta}_B)}$ , full

opacity (i.e.  $T = 0$ ) is optimal; if  $\frac{\varphi_G}{\beta_G} < \frac{2\eta^2 (3\bar{\beta}_B - 1)}{\bar{\beta}_B (1 - \bar{\beta}_B)}$ , full

transparency (i.e.  $T = 1$ ) is optimal.



b) If the CB is conservative, full transparency is always optimal (i.e.  $T = 1$ ), since equation (34) is always satisfied.

Hence, the incentives for the CB to be opaque depend upon the behaviour of the government only under a specific credibility regime. As in the case of an inactive fiscal authority, full transparency ( $T = 1$ ) is optimal when the CB is perceived as conservative, whereas full opacity ( $T = 0$ ) is optimal when the CB is perceived as ultra-populist. If the CB is perceived instead as moderately populist, the optimal degree of transparency depends on the relative fiscal stance of the government ( $\varphi_G/\beta_G$ ): when the government is very active in stabilising the economy (i.e. for low values of  $\varphi_G/\beta_G$ ), it is optimal for the CB to be fully transparent ( $T = 1$ ); when the government faces a tight fiscal constraint (i.e. for high values of  $\varphi_G/\beta_G$ ), it is optimal for the CB to be fully opaque ( $T = 0$ ).

As in the Barro-Gordon's case, credibility and opacity are substitutes as means to discipline workers' wage claims. However, the consideration of the government's action complicates the picture, since also fiscal policy affects the real output deviation and inflation. Opacity continues to discipline the union, but it also induces the government to adopt a more prudent behaviour. Hence, if the CB is not credible, it will use opacity to discipline wage setters only if the government is not very active. In the opposite case, the moderately populist CB will instead prefer to place the burden of stabilization on the fiscal authority (i.e., to induce a more active fiscal policy) by fully revealing its nature, as fiscal policy is able to compensate with public employment the fall in private employment due to increasing wages (the higher is  $\varphi_G$  the higher is  $K$  in equation (12), and so

the higher is  $b$  for a given  $w$ ), while having a lower impact on prices (as it expands the supply of goods) than monetary policy.

Finally, the effects of opacity on inflation and output variances are determined by computing the derivative of the inflation variance,

$$\sigma_\pi^2 = E[\pi - E(\pi)]^2 = \sigma_B^2 \left( \frac{1 + \eta K + (1 - \eta K) \bar{B}}{E[1 + B^2]} \alpha \right)^2, \text{ with respect to } \sigma_\varepsilon^2 \text{ in}$$

zero:

$$\left. \frac{\partial \sigma_\pi^2}{\partial \sigma_\varepsilon^2} \right|_{\sigma_\varepsilon^2=0} = \frac{\varphi_G \bar{\beta}_B (\bar{\beta}_B + 1) + 2\eta^2 (\bar{\beta}_B^2 + \bar{\beta}_G)}{\bar{\beta}_B^2 (\bar{\beta}_B + 1)^4 \varphi_G} 2\alpha^2 > 0 \quad (35)$$

Equation (35) implies that if the uncertainty about the CB's preference is bounded to low values, an increase in opacity always raises inflation (and output) variance.

As a conclusion, and in line with Posen's (2003) claim, fully transparent and conservative CBs are able to reduce levels and variances of both output and inflation.

#### 4. Conclusions

In this paper, we provided a theoretical explanation for both the empirical finding that fully transparent and conservative CBs are able to reduce levels and variances of both output and inflation (Posen, 2003) and for the heterogeneous behaviour of actual CBs in information disclosure. By focusing on the "contingent" view of transparency, by introducing endogenous fiscal policy into the analysis, and by treating information on the central bank's preference as an endogenous variable, we showed that an

increase in transparency always reduces both inflation and output variance and that the behaviour of different CBs in information disclosure is different because the optimal degree of transparency varies with the main institutional characteristics of the economy.

As long as information is considered as an endogenous strategic variable, it can be used by the CB as a substitute for credibility to discipline wage setters. The size of the effects of such a policy depends on the degree of labour market distortion which is present in the economy (i.e. the effects are stronger in highly unionised economies). For conservative (populist) CBs, if fiscal policy is inactive, it is optimal to be fully transparent (opaque) because they do not need (do need) to rely on the wage-discipline device represented by opacity. If the government aims instead at supporting employment through supply-side fiscal policies, full transparency (opacity) remains optimal when the CB is perceived as conservative (ultra-populist), but if the CB is perceived as moderately populist, the optimal degree of transparency depends on the fiscal attitude of the government: when this is very active in stabilising the economy, it is optimal for the CB to be fully transparent; when the government faces a tight constraint on budget deficits, it is optimal to be fully opaque.

Fiscal policy hence expands the range of possible results: the wage discipline device represented by opacity remains useless (important) when the CB is perceived as conservative (extremely populist). In intermediate cases, the more the government acts to support employment the more it is optimal for the CB to be transparent. In fact, by considering the government's action, the CB can still discipline the wage setters by

increasing opacity, but in so doing it also induces a more prudent fiscal policy. Hence, if the government is very active, the moderately populist CB prefers to reveal its nature and place the burden of stabilization on the fiscal authority, as fiscal policy is less inflationary than monetary policy.

These results are of course confined to the case of supply-side fiscal policies. We focused on such measures in order to consider, in a simplified way, the channels of policy transmission operating on the both the demand (monetary) and the supply (fiscal) sides of the economy. In principle, the same logic described for supply-side fiscal policies should however apply also in the case of Keynesian policy, as the benefit of the wage discipline effect would be lowered by the reduced stabilization activism of a government made more prudent by opacity.

An empirical evaluation of our results is difficult to carry out for several technical reasons, like the lack of observations, the subjective nature of the indexes measuring transparency and sampling problems.<sup>30</sup> Our theoretical conclusions are not however at odds with casual observations. As predicted by the model, highly credible CBs – i.e. those adopting inflation targeting procedures, as in New Zealand, the United Kingdom, and Sweden – are characterized by high degrees of transparency. By contrast, CBs attaching a low weight to inflation, perhaps as Japan, are characterized by high degrees of opacity.<sup>31</sup>

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<sup>30</sup> An attempt at evaluating the results of a similar model by using cross-country data has been performed by Demertzis and Hughes-Hallet (2003) with very limited success.

<sup>31</sup> Di Bartolomeo and Marchetti (2003), by applying the principal component procedure to the Eijffinger and Geraats' (2002) indexes, find a clear correlation between credibility and transparency.

When considering the debate on central banking in an historical perspective, we can note that in the 1980s, after the oil shocks, the main issue under discussion was CB credibility, with many CBs promptly acting so as to implement it; this discussion was followed, in the 1990s, by that on transparency.<sup>32</sup> The timing of this focus shift is in line with the idea that CBs started to change their policies in terms of transparency *after* they managed to enhance their credibility. That timing is also in opposition with the alternative and common suggestion that transparency supports credibility, even though this is not of course by any means a definitive proof of our claims.

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<sup>32</sup> Fed publications, e.g., report that transparency has indeed substituted for credibility in the internal discussions between the Fed staff.

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