Decision making in the ECB's Governing Council - Should minutes and forecasts be published ?

Gisela Waisman*
IIES, Stockholm University

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Abstract

Governments seem to have some influence on the decisions taken by the Governing Council of the ECB. It has been argued that the publication of forecasts and minutes of the meetings of the Governing Council would have a negative effect due to the influence of governments on their representatives' votes. In my model, the information provided reduces their influence and benefits the Executive Board. Both governments benefit from the publication of minutes, while they sometimes disagree with respect to the publication of forecasts. The model suggests that the current EMU members may want to withhold the publication of forecasts when taking enlargement with a more heterogeneous group of countries into account.

Keywords: European central bank, EMU, Monetary Union, Voting, Transparency
JEL classification: E42, E58, F33.

1 Introduction

The rules of operation of the European System of Central Banks (ESCB) stipulate that "the Community institutions and bodies and the governments of the Member States may not seek to influence the members of the decision-making bodies of the ECB or of the NCBs in the performance of their tasks". Yet, Issing (1999) accepts that even in the absence of published votes, there will be attempts to influence policy-makers. Buiter (1999) goes even further and says that national political authorities and other interested parties will undoubtedly try to put pressure on "their" nationals serving on the ECB Board as well as "their" national central bank governors. The surprise rate cut by the ECB on May 10, 2001 might be an example of such influence. According to *AFX news* (May 10) "Some euro zone finance ministers, led by euro group president Didier Reynders, hinted that they were looking to the ECB for an easing move". Reynders said that the discussions between the ECB and the eurogroup "have had an influence on the bank's decision to lower rates".

Buiter (1999) strongly advocates the publication of the minutes from the meetings of the Governing Council and its relevant committees and sub-committees, the individual voting records of Governing Council members and the inflation forecasts. Issing (1999) instead argues against publication in order to defend a "culture of collective responsibility" and not to "allow national politicians or interest groups to verify whether any pressure applied individually had the intended result". He argues that "publishing forecasts could be misleading if it leads the public to attach more significance to them than they have in the decision making process". Favero, Freixas, Persson, Wyplosz (2000) monitor the ECB and recommend that individual voting records and minutes focusing on individual differences are not published in order to facilitate the building of a collective reputation, but they consider that summary minutes not attributing individual views would be possible and helpful. They recommend that the Council should publish its internal forecasts on euro-wide inflation and output with appropriate qualifications concerning forecast uncertainty.

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The purpose of my paper is to build a model of decision making in the Governing Council of the ECB, where the pressure of the national governments on their representatives affects the decision taken by the Council. Adding uncertainty about either the exact preferences of the Executive Board or its perception of the state of the EMU economy allows me to evaluate one specific aspect of the publication of minutes and forecasts.

Many papers study how the publication of forecasts and votes might influence the private sector, but the fact that publication would affect the pressure of national politicians on their representatives in the Governing Council has not yet been analyzed.[1] Dixit (2001) and Dixit and Jensen (2001) analyze the influence from the different governments on the ECB, but do not consider the issues of uncertainty and publication. They consider a monetary union where the member governments (multiple principals) act non-cooperatively to offer general state-dependent contracts to the common central bank (common agent). My paper instead considers a model with multiple principals and multiple agents, where each government influences his own NCB. Jensen (2000a) uses the principal-agent approach to monetary policy making in a two-country model, but each country has a separate monetary policy chosen by its own central bank which obtains an incentive contract from its government. He shows that optimal outcomes can be achieved using state-independent quadratic contracts.

Helpman and Persson (2001) develop a multiprincipal - multiagent model to analyze how the contribution of lobbies to lawmakers may influence the contents of legislation. They assume that each lobby group only makes contributions to a single lawmaker. This assumption is more appropriate in the present paper as it is easier for a government to influence its own NCB than that of another country. In Helpman and Persson, one lawmaker is randomly selected by nature to be the agenda setter, while in my paper, an Executive Board Member is always the agenda setter and not subject to lobbying by any government.

The economy is represented by a very simple model of monetary policy, with an expectations-augmented short-run Phillips curve, where the ECB can directly choose the inflation rate for the whole EMU area. For simplicity, I will assume that the Governing Council is composed by two national central bankers (NCBs) and one Executive Board Member (EBM). I model the decision-making process in the Governing Council by way of an agenda-setter model where the EBM proposes an inflation rate for the whole EMU area. This is a way of stressing that the EBM seems to have more say in the Governing Council's decisions than the NCBs, maybe as a result of some monopoly on information. I consider this assumption to reflect reality much better than the median-voter model. The proposed rate is only implemented if accepted by at least one NCB, otherwise a default policy representing the status quo of unchanged interest rates is implemented.

I model the national central bankers in the Governing Council as agents of their respective governments, tied by incentive contracts which can become state dependent only if the forecasts and minutes of the Governing Council's meetings are published. Otherwise, the contracts will be based on the governments' expectations about the EBM's preferences and their perceptions about the state of nature (more specifically, the size of a supply shock) in the whole EMU area. These incentive contracts should, of course, not be taken literally; they are a way of modelling the fact that the NCB's future career (both reappointment and future employment opportunities) often depends on pleasing the government.

I present both analytical and numerical results and analyze under which circumstances each of these agents will favor publication. Given the chosen parameters, the EBM is always favorable to the publication of both forecasts and minutes, as this allows him to propose his most preferred inflation rate unconstrained in all states of the world. Non publication introduces noise into the incentive contracts faced by the NCBs.

[1] Other papers combine uncertainty concerning central bank preferences and asymmetric information about the state of the economy. Cukierman and Metzler (1986) show that deliberately not minimizing errors in the monetary control technology could be welfare improving, since it allows the monetary authorities to make better use of surprise inflation in stabilization policy. This model has been extended by both Faust and Svensson (1998, 1999) in an infinite horizon setting, and Jensen (2000b) and Geraats (2001) in a two-period set-up. Faust and Svensson (1998, 1999) find that transparency is almost always preferred by society, but often not by the central bank which prefers discretion to pursue idiosyncratic output goals. Jensen (2000b) reaches different results than Faust and Svensson (1998); in his model, transparency is good for credibility (reducing inflation expectations) but constrains flexibility in the pursuit of output stabilization. Geraats (2001) identifies transparency with the release of central bank forecasts representing a complete summary of the central bank's (private) information on economic shocks. Transparency leads to lower inflation and gives the central bank greater flexibility to respond to shocks in the economy. Other papers, such as Cukierman (2000) and Tarkka and Mayes (1999), analyze forecast publication in the context of models which do not assume uncertainty about central bank objectives. An increased transparency could also be attained by publishing the individual voting records of central bankers, as analyzed by Gersbach and Hahn (2001a,b) and Sibert (1999).

When minutes or forecasts are not published, the incentive constraints of both NCBs bind and the EBM must adapt his proposal in some states, which naturally increases his expected loss. The states where the EBM is constrained are typically those where the supply shocks of both countries have different signs; thus, the pivotal government benefits and the other government loses out.

In four simulated cases of ten the prejudice of not being pivotal in some states more than compensates for the benefit of being pivotal in others, so that both governments agree with the EBM in their preference for publication. In four cases, one government prefers only minutes to be published, while the other government and the EBM still want both minutes and forecasts to be published. In the remaining two cases, both governments prefer that only minutes are published following a boom and both minutes and forecasts published after a recession.

If the group of countries in the EMU is relatively homogeneous, the governments' influence when forecasts are not published does not considerably affect the policies implemented. But the effect of their influence may increase if the group of countries became more heterogeneous, as would be the case with an enlargement of the EMU area. As a last exercise, I use the model to see whether the forthcoming enlargement changes the attitude to publication of the countries currently in the EMU. I assume that the group of countries to be incorporated in the EMU ("new" country) has higher targets for both inflation and employment and faces a supply shock with higher variance.

The government of the "old" country (the group of countries already in the EMU) has the largest influence on the EBM's proposal for both defaults rates, but with opposite effect on the proposed rate. The government of the "new" country only appreciates the influence when the European economy is coming out of a boom, as the proposed rate is then higher than π^*_{EB}. The government of the "old" country always benefits from influencing the EBM's decision and thus, it prefers forecasts not to be published. Suppose that the governments of the countries currently in the EMU would decide on the issue of publication, taking into account that the union could be enlarged in the future. Then, they are likely to favor the publication of minutes but oppose the publication of forecasts in order to increase their influence and reduce their expected losses after enlargement. Heterogeneity exacerbates the conflict of interests and increases the value of the influence on the implemented policy.

Section 2 presents the model under no uncertainty, which also represents the situation when both forecasts and minutes are published. Uncertainty is added in section 3, while section 4 shows the results of the numerical analysis. Section 5 presents the conclusions of the paper.

2 The Model with no Uncertainty

The model of the economy is a further simplification of what Persson and Tabellini (1999) call a simple positive model of monetary policy. The Government Council of the ECB is assumed to consist of the national central bankers (NCBs) of two countries making up the EMU, and one single Executive Board Member (EBM). As the Governing Council consists of the Governors of the national central banks of the 12 EMU countries plus six members of the Executive Board, this simplification captures well the proportion of NCBs and EBMs.

The demand side of the economy is represented by

$$\pi = m,$$

where π is the common inflation rate and m the money growth rate in the whole EMU area.

The supply side of the model assumes that the nominal wage setting in each country aims at implementing an exogenous real wage growth rate, ω_i. Letting π^e denote rationally expected inflation, nominal wage growth w_i in country i then becomes

$$w_i = \omega_i + \pi^e.$$

Employment in country i satisfies

$$y_i = \gamma_i - (w_i - \pi) + \varepsilon_i,$$

where γ_i is a constant and ε_i a supply shock. Combining the last two equations, we obtain an expectations-augmented, short-run Phillips curve

$$y_i = \theta_i + (\pi - \pi^e) + \varepsilon_i,$$

where $\theta_i \equiv \gamma_i - \omega_i$ can be interpreted as the natural rate of employment in country i.

The timing of events is as follows: (a) the private sector forms expectations π^e, given θ_i, in both countries and given the information available to governments, (b) the values of ε_i in both countries are observed, (c) the Governing Council decides on a money growth rate m, which determines the inflation rate π in the whole EMU area. In this section, the governments have complete information; in the next section, I will introduce uncertainty about the EBM's perception of the shock in the whole EMU area and its exact preferences.

The objective function of the government of country i is a loss function defined over inflation and employment:

$$\widetilde{L_{Gi}} = \frac{1}{2}\left[(\pi - \widehat{\pi}_{Gi})^2 + \lambda_{Gi}\ \ (y_i - \widehat{y}_{Gi})^2\right] + C_i^h \equiv L_{Gi} + C_i^h.$$

The government of country i wants to stabilize both inflation and employment around some targeted values, $\widehat{\pi}_{Gi}$ and $\widehat{y}_{Gi}$. λ_{Gi} is the relative weight the government puts on the fluctuations in these two variables. C_i^h is the contribution the government must pay to its NCB when choosing action $h \in \{A, R\}$. Action h can be the approval (A) or the rejection (R) of the agenda setter's proposal. In the following, I refer to the first term of the government's loss function as L_{Gi}. The NCB of country i is assumed to be non-benevolent, he only cares about the contributions he receives from his government. This extreme assumption gives governments the maximum possible influence over their representatives' votes. The NCB thus has the following utility function

$$U_{Ni} = C_i^h\ . \tag{1}$$

The contributions need not be taken literally, they could instead represent the fact that the NCB's future career prospects depend on the government being satisfied with his decisions. For simplicity, I will confine myself to globally truthful contribution schedules satisfying

$$C_i^h = \left[L_{Gi} - K_i^h\right], \tag{2}$$

where K_i^h is a constant the government sets optimally in order convince the NCB to choose the alternative h it prefers. [2] These constants provide the NCB with a non-negative expected contribution if he acts according to the government's wishes, so there is no need to add a participation constraint for the NCB. Besides, the constants K_i^h ensure that the government does not pay a larger contribution than needed to induce the NCB to accept the proposal. These schedules completely align the NCB's preferences with the government's preferences.

The objective function of the EBM is assumed to be

$$L_{EB} = \frac{1}{2}\ \left[(\pi - \widehat{\pi}_{EB})^2 + \lambda_{EB}\ \ (y_U - \widehat{y}_{EB})^2\right],$$

where y_U is the average employment in the EMU area. I assume that the EBM's most preferred rate of employment, $\widehat{y}_{EB}$, always coincides with the natural rate of employment in the EMU area.

The decision process in the Governing Council is assumed to take the form of an agenda-setter model. The EBM is the agenda setter proposing a policy m to both NCBs. If at least one of them accepts his proposal, then policy m is implemented, otherwise a default policy is implemented. The default policy is given and represents the status quo of unchanged interest rates. It is given because it depends on the decision taken in the previous period. In a more complete model, the Governing Council would decide whether to move the interest rate up, down or leave it constant. As $\pi = m$ in this very simplified model, I will describe the decision process as if the EBM made direct proposals over inflation rates, instead of money growth or interest rates. Leaving the interest rate untouched in my simple model, where the only

[2] I assume that the NCB chooses the alternative preferred by the government whenever he is indifferent.

shock is a supply shock, would give a default inflation rate higher than $\widehat{\pi}_{EB}$ following a recession and lower following a boom.[3]

If the EBM were allowed to choose policy without constraint, he would choose an inflation rate according to the standard expression[4]:

$$\pi^*_{EB} = \frac{1}{1+\lambda_{EB}}\ \widehat{\pi}_{EB} + \frac{\lambda_{EB}}{1+\lambda_{EB}}\ \left(\pi^e - \varepsilon_U\right).$$

If the EBM were to propose this rate straightaway for some realizations of the shocks, both NCBs would reject the proposal. The EBM can then adapt his proposal to a rate π^P intermediate between π^*_{EB} and π^d, such that at least one NCB is indifferent between his loss with π^P and his loss with π^d, while the EBM has a lower loss with π^P than with π^d.

The private sector forms its expectations of the inflation rate by computing the probability of being in each state of the world and using these probabilities as weights for the inflation expected to prevail in each state, depending on whether the EBM is constrained. The fact that the EBM proposes a rate π^P different than his most preferred rate in some states of the world affects π^*_{EB} in all other states through the endogenous variable π^e.

If the government of country i was instead allowed to choose an inflation rate unconstrained, for a given π^e, it would choose

$$\pi^*_{Gi} = \frac{1}{1+\lambda_{Gi}}\ \widehat{\pi}_{Gi} + \frac{\lambda_{Gi}}{1+\lambda_{Gi}}\ \left(\pi^e - \varepsilon_i\right).$$

Given the realization of the shocks, the most preferred rates of the two governments and the EBM are often different. In case (a), represented in Figure 1, the EBM's preferred rate lies in between the most

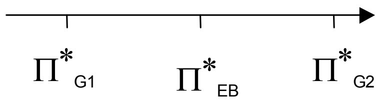

Figure 1:

preferred rates of the two governments; no matter where the default rate is, one NCB is always ready to accept the proposal, π^*_{EB}. The location of the default rate determines which NCB accepts the proposal. For example, if $\pi^d < \pi^*_{EB}$, the NCB of country 2 accepts.In case (b), illustrated in Figure 2, the EBM's

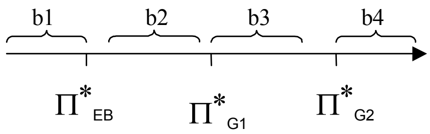

Figure 2:

proposal depends on the location of the default rate:

[3] An alternative way of modeling the decision process would be to assume that the governments can first attempt to influence the EBM's proposal and then buy the votes of the different national central bankers, a situation described as "influencing a legislature with an agenda setter - multiple interest groups" in Grossman and Helpman (2001). In that approach, the agenda setter would choose a proposal maximizing a weighted sum of his own expected utility in the voting stage ($-L_{EB}$) and the contributions he obtains from the two governments, while taking into account whether this proposal has a reasonable chance of succeeding. In some states of the world, we could observe the EBM making proposals that are accepted with some probability. This assumption would make it more difficult to obtain unique results and to analyze the issue of publication of minutes and forecasts, given the non-linearities in my model.

[4] The EBM minimizes
$L_{EB} = \frac{1}{2}\left[\left(\pi - \widehat{\pi}_{EB}\right)^2 + \lambda_{EB}\ \left(\pi - \pi^e + \varepsilon_U\right)^2\right].$

The first-order condition is $\pi - \widehat{\pi}_{EB} + \lambda_{EB}\ \left(\pi - \pi^e + \varepsilon_U\right) = 0 \Rightarrow \pi = \frac{1}{1+\lambda_{EB}}\ \widehat{\pi}_{EB} + \frac{\lambda_{EB}}{1+\lambda_{EB}}\ \left(\pi^e - \varepsilon_U\right).$

(b1) if $\pi^d \leq \pi^*_{EB}$, then the default alternative is worse for both governments than π^*_{EB}, so that the EBM proposes π^*_{EB} and both NCBs accept the proposal.

(b2) if $\pi^*_{EB} < \pi^d < \pi^*_{G1}$, then both governments will prefer π^d to π^*_{EB} and the EBM can propose no rate that is better for both the NCB of country 1 and the EBM than π^d, so π^d will be implemented.

(b3) if $\pi^*_{EB} < \pi^*_{G1} < \pi^d$ and close enough for $L_{G1}\left(\pi^d, \pi^e, R, \varepsilon_1\right) + K_1 < L_{G1}\left(\pi^*_{EB}, \pi^e, A, \varepsilon_1\right)$, where $K_1 \equiv K_1^A - K_1^R$, then the EBM will have to propose a rate π^P intermediate between π^*_{EB} and π^d that makes government 1 indifferent between π^P and π^d, that is a π^P such that $L_{G1}\left(\pi^P, \pi^e, A, \varepsilon_1\right) = L_{G1}\left(\pi^d, \pi^e, R, \varepsilon_1\right) + K_1$.

(b4) if π^d is very far from π^*_{EB} so that $L_{G1}\left(\pi^*_{EB}, \pi^e, A, \varepsilon_1\right) < L_{G1}\left(\pi^d, \pi^e, R, \varepsilon_1\right) + K_1$, then again the EBM proposes π^*_{EB} and at least the NCB of country 1 accepts the proposal.

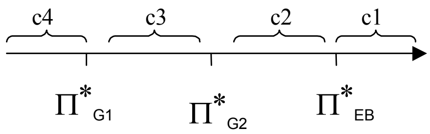

Figure 3:

Case (c), illustrated in Figure 3, is the same as case (b), but with opposite signs and country subindexes. These possible outcomes are characteristic of the agenda-setter model associated with Romer and Rosenthal (1978, 1979), a well known way of modelling collective decision making in a committee.

It may be worth noticing that there is no competition among national central bankers. There is no intrinsic benefit from being the pivotal voter, that is, the one accepting the EBM's proposal. The loss of the NCB (and of the respective government) depends on the rate proposed, no matter who accepts the proposal and the NCB cannot do any better by accepting a worse proposal in order to become pivotal.

In cases (b3) and (c3), governments could use strategic delegation, not to compete among themselves, but to compete against the EBM. Strategic delegation to induce more extreme NCB preferences would help the governments obtain a proposal closer to their preferred rates. Both governments could try to induce NCB preferences that make the EBM indifferent between the limit of the acceptance set and the default rate. This would be a way of shifting power from the EBM to the governments. By confining myself to globally truthful contribution schedules, I am ruling out the possibility of such strategic delegation.

The exact proposal, given the expected inflation π^e, can be obtained by solving the EBM's problem when proposing a policy π in a given state of the world,

$$\min_{\pi} L_{EB} = \frac{1}{2}\left[\left(\pi - \widehat{\pi}_{EB}\right)^2 + \lambda_{EB}\ \left(\pi - \pi^e + \varepsilon_U\right)^2\right] \tag{3}$$

$$s.t. \quad U_{Nj}\left(\pi, \pi^e, A, \varepsilon_j\right) - U_{Nj}\left(\pi^d, \pi^e, R, \varepsilon_j\right) \geq 0,$$

where j is the NCB that is easiest to convince and $\varepsilon_U = \frac{\varepsilon_1 + \varepsilon_2}{2}$. Substituting (2) and (1) into (3) and changing the direction of the inequality (as utilities and losses are defined as non-negative values), the EBM's problem becomes

$$\min_{\pi} L_{EB} = \frac{1}{2}\left[\left(\pi - \widehat{\pi}_{EB}\right)^2 + \lambda_{EB}\ \left(\pi - \pi^e + \varepsilon_U\right)^2\right] \tag{4}$$

$$s.t. \quad L_{Gj}\left(\pi, \pi^e, A, \varepsilon_j\right) - L_{Gj}\left(\pi^d, \pi^e, R, \varepsilon_j\right) - K_j \leq 0,$$

where $K_j \equiv K_j^A - K_j^R$ is a given constant. The constraint implies that indirectly, the EBM must make at least one of the governments better off with his proposal than with the default rate. The incentive contract means that the NCB is given an acceptance set of rates around π^*_{Gi} by his government, where the length of the interval depends on the default rate, the expected inflation, the preferences of the government and the supply shock.

Before making a proposal, the EBM checks if any of the governments is better off with π^*_{EB} than with π^d. Otherwise, he will have to adapt his proposal for it to be accepted by one NCB. The Lagrangean of the problem is:

$$\max_{\pi} L_{EB} = \frac{1}{2}\left[\left(\pi - \widehat{\pi}_{EB}\right)^2 + \lambda_{EB}\ \left(\pi - \pi^e + \varepsilon_U\right)^2\right] + \\ + \delta \left\{ \begin{array}{c} \frac{1}{2}\left[\left(\pi - \widehat{\pi}_{Gj}\right)^2 + \lambda_{Gj}\ \left(\pi - \pi^e + \varepsilon_j - \overline{y}_j\right)^2\right] - \\ \frac{1}{2}\left[\left(\pi^d - \widehat{\pi}_{Gj}\right)^2 + \lambda_{Gj}\ \left(\pi^d - \pi^e + \varepsilon_j - \overline{y}_j\right)^2\right] - K_j \end{array} \right\},$$

where $\overline{y}_j \equiv \widehat{y}_j - \theta_j$ is the difference between the most preferred rate of employment and the natural rate of employment in country j. I assume that country j's government is cheapest to convince and the constraint is binding. The NCB of country j is called pivotal when his incentive constraint is satisfied.

This problem gives the first-order condition:

$$\pi\left[1 + \lambda_{EB} + \delta\ \left(1 + \lambda_{Gj}\right)\right] = \widehat{\pi}_{EB} + \lambda_{EB}\ \left(\pi^e - \varepsilon_U\right) + \delta\, \widehat{\pi}_{Gj} + \delta\, \lambda_{Gj}\ \left(\pi^e - \varepsilon_j + \overline{y}_j\right).$$

The proposed rate π^P, for a given π^e, is

$$\pi^P = \frac{1}{1 + \lambda_{EB} + \delta + \delta\, \lambda_{Gj}} \left[\begin{array}{c} \widehat{\pi}_{EB} + \delta\, \widehat{\pi}_{Gj} + \delta\, \lambda_{Gj}\, \overline{y}_j + \\ \left(\lambda_{EB} + \delta\, \lambda_{Gj}\right) \pi^e - \left(\lambda_{EB}\, \varepsilon_U + \delta\, \lambda_{Gj}\, \varepsilon_j\right) \end{array} \right]. \tag{5}$$

Substituting the inflation rate in (5) into the constraint $L_{Gj}\left(\pi^P, \pi^e, A, \varepsilon_j\right) = L_{Gj}\left(\pi^d, \pi^e, R, \varepsilon_j\right) + K_j$, the value of the multiplier δ can be obtained. We can find the conditions under which π^P and π^*_{EB} coincide:

- If the constraint does not bind, so that $\delta = 0$.
- For a given δ and π^e, assuming that the constraint hypotetically binds, they would coincide if the targeted rates of the EBM and government j coincide, so that they have the same inflation objective $\widehat{\pi}_{EB} = \widehat{\pi}_{Gj}$ and no credibility problem $\overline{y}_j = 0$ and if, at the same time, government j has the same weight on inflation and employment stabilization as the EBM, $\lambda_{Gj} = \lambda_{EB}$, and the same demand for stabilization as the EBM, $\varepsilon_j = \varepsilon_U$.

However, no strict comparison is possible at this point, as π^e is an endogenous variable and the multiplier δ is a non-linear function of all parameters. In a normal Barro-Gordon model, one would follow two further steps to complete the solution : (1) compute the expected inflation π^e by taking expectations of π^P and (2) plug π^e back into the first order condition to solve for π^P. An analytical solution of the model would then be obtained. As the preset model is not recursive, however, I must instead solve both steps jointly. Because of this simultaneity and the associated non-linearity, multiple equilibria are very difficult to rule out, a priori.[5] But I have never encountered multiple equilibria in my numerical examples.

3 The Model with Uncertainty

In this section, the governments face two types of uncertainty. First, they may not be certain of the EBM's exact perception of the average shock in the EMU area. Second, they may not be certain of the exact preferences of the EBM, i.e., they may not be certain of the exact value of parameter $\widehat{\pi}_{EB}$, the inflation rate targeted by the EBM. Introducing both types of uncertainty in the analysis increases the noise faced by the governments when writing the incentive contract and modifies the interval of rates the NCB is induced to accept. The uncertainty about the EBM's preferences also introduces noise into the private sector's inflation expectations.

I will assume that the first type of uncertainty can be eliminated by the publication of the forecasts of the ECB and the second type by the publication of the minutes of the Governing Council meetings. This is obviously a simplification that tries to capture the fact that publication should help reduce both

[5] In this respect, the model reminds me of the escape-clause model of Obstfeld (1997), who stresses multiple equilibria.

types of uncertainty. In the literature, the disclosure of central bank forecasts has been called "economic transparency", while the openness about policy objectives, like explicit inflation targets, has been called "political transparency".[6]

Given the timing of the model, forecasts published in connection with the realization of the shock can be used by the governments in their incentive contracts with their NCBs. But the information is not available and thus, cannot be used by the private sector when forming its inflation expectations. When forecasts are not published, the governments form their expectations about the EBM's perception of the EMU average shock. The private sector expects the error of the governments to equal the average error, namely zero, when forming its inflation expectations. Government i's estimate of the EBM's perception of the average shock in the EMU area $\left(\varepsilon_u^{EB}\right)$ is assumed to take the form:

$$E_{Gi}\left(\varepsilon_U^{EB}\right) = \frac{\varepsilon_i + \varepsilon_j}{2} + \alpha_i \ .$$

Even if government i knows the exact value of ε_i and has some estimate of ε_j, it still needs to estimate $E_{Gi}\left(\varepsilon_U^{EB}\right)$ to figure out which rate the EBM will propose in each state of the world. I will assume that the EBM observes the correct $\varepsilon_U = \frac{\varepsilon_i+\varepsilon_j}{2}$, so that α_i is the error committed by government i when estimating the EBM's perception of the EMU average shock. The errors committed by both governments are uncorrelated and have zero expected value.

The publication of the minutes of the Governing Council meetings over time helps everyone learn about the preferences of the EBM. When minutes are not published, I assume that the private sector in each country shares the government's view of the EBM's targeted inflation and is unaware that it may commit an error, so that this error is incorporated in the private sector's inflation expectations.[7] The government is thus uncertain about the exact inflation rate targeted by the EBM. I will assume that government i believes the inflation rate targeted by the EBM to be

$$E_{Gi}\left(\widehat{\pi}_{EB}\right) = \widehat{\pi}_{EB} + \beta_i,$$

where β_i is the error government i commits when estimating the EBM's targeted rate. I assume once more that the errors committed by both governments are uncorrelated and have zero expected value.

I also analyze what happens if the errors made by the two governments are perfectly positively correlated, that is, if both governments either overestimate or underestimate ε_U^{EB} or $\widehat{\pi}_{EB}$.

When uncertainty is introduced, government i's contribution schedule becomes a function of the errors it commits. Through the contribution schedule, each government provides its NCB with an acceptance set based only on the verifiable information available to the government before the meeting.

When neither minutes nor forecasts are published, government i's estimate of π_{EB}^*, for a given expected inflation, is given by

$$\begin{aligned} E_{Gi}\left(\pi_{EB}^*\right) &= \frac{1}{1+\lambda_{EB}} E_{Gi}\left(\widehat{\pi}_{EB}\right) + \frac{\lambda_{EB}}{1+\lambda_{EB}} \left(\pi_i^e - E_{Gi}\left(\varepsilon_U^{EB}\right)\right) \\ &= \frac{1}{1+\lambda_{EB}} \left(\widehat{\pi}_{EB} + \beta_i\right) + \frac{\lambda_{EB}}{1+\lambda_{EB}} \left[\pi_i^e - \left(\frac{\varepsilon_i+\varepsilon_j}{2} + \alpha_i\right)\right]. \end{aligned}$$

When minutes are published, we instead have

$$E_{Gi}\left(\pi_{EB}^*\right) = \frac{1}{1+\lambda_{EB}} \widehat{\pi}_{EB} + \frac{\lambda_{EB}}{1+\lambda_{EB}} \left[\pi^e - \left(\frac{\varepsilon_i+\varepsilon_j}{2} + \alpha_i\right)\right].$$

And when forecasts are published,

$$E_{Gi}\left(\pi_{EB}^*\right) = \frac{1}{1+\lambda_{EB}} \left(\widehat{\pi}_{EB} + \beta_i\right) + \frac{\lambda_{EB}}{1+\lambda_{EB}} \left(\pi_i^e - \varepsilon_U\right).$$

[6] These names agree with the classification of transparency proposed by Geraats (2001).

[7] As a simplification, I assume that the publication of minutes helps the private sector learn about the EBM's preferences which change over time, while they remain ignorant otherwise. This assumption is valid in a transitional phase, but not in the long run as the private sector would learn how to estimate $\widehat{\pi}_{EB}$ over time. For example, in Faust and Svensson (1998), the Kalman filter provides the optimal solution to the private sector learning problem.

When $L_{Gj}\left(E_{Gi}\left(\pi^*_{EB}\right), \pi^e_j, A, \varepsilon_j\right) > L_{Gj}\left(\pi^d, \pi^e_j, R, \varepsilon_j\right) + K_j$, both constraints are binding and the EBM must make a proposal solving the following problem:

$$\max_{\pi} L_{EB} = \frac{1}{2}\left[\left(\pi - \widehat{\pi}_{EB}\right)^2 + \lambda_{EB}\ \left(\pi - \pi^e + \varepsilon_U\right)^2\right] + \\ + \gamma \left\{ \begin{array}{c} \frac{1}{2}\left[\left(E_{Gi}\left(\pi\right) - \widehat{\pi}_{Gj}\right)^2 + \lambda_{Gj}\ \left(E_{Gi}\left(\pi\right) - \pi^e_j + \varepsilon_j - \overline{y}_j\right)^2\right] \\ -\frac{1}{2}\left[\left(\pi^d - \widehat{\pi}_{Gj}\right)^2 + \lambda_{Gj}\ \left(\pi^d - \pi^e_j + \varepsilon_j - \overline{y}_j\right)^2\right] - K_j \end{array} \right\},$$

where π^e_j is the private sector's expected inflation across all states of the world. The solution to this problem is the proposed rate π^P

$$\pi^P = \frac{1}{1 + \lambda_{EB} + \gamma + \gamma\,\lambda_{Gj}} \left[\begin{array}{c} \widehat{\pi}_{EB} + \gamma\,\widehat{\pi}_{Gj} + \gamma\,\lambda_{Gj}\,\overline{y}_j + \\ \left(\lambda_{EB} + \gamma\,\lambda_{Gj}\right)\pi^e_j - \left(\lambda_{EB}\,\varepsilon_u + \gamma\,\lambda_{Gj}\,\varepsilon_j\right) \end{array} \right]. \tag{6}$$

This proposed rate looks just like (5), except for the multiplier being different. The new multiplier γ can be obtained by substituting the inflation rate in (6) into the constraint.

The consequence of publication can be seen in a numerical example with specific parameter values and a given realization of shocks and errors presented in Appendix 1. In the example, when either minutes or forecasts are not published, the most preferred rates of all agents and the estimated most preferred rate of the EBM are ordered as follows:

$$\pi^*_{G1} < E_{G2}\left(\pi^*_{EB}\right) < \pi^d < E_{G1}\left(\pi^*_{EB}\right) < \pi^*_{G2}.$$

Both governments believe that they prefer the default rate rather than $E_{Gi}\left(\pi^*_{EB}\right)$ and determine an acceptance set around π^*_{Gi}.

When neither forecasts nor minutes are published, the interval of rates the NCBs are induced to accept is all rates such that $L_{G1} \leq 1536$ for the NCB of country 1 (NCB1) and $L_{G2} \leq 1032$ for NCB2. In this particular case, the EBM prefers the default rate of 0.015 to all rates in the two intervals, so that he either directly proposes π^d or proposes π^*_{EB} but both NCBs reject this proposal. When only minutes are published, the corresponding intervals are all rates such that $L_{G1} \leq 2125$ and $L_{G2} \leq 1525$. The constraints are less binding and the EBM can now satisfy NCB1 by proposing the rate $\pi^P = 0.0063$, an intermediate rate between π^*_{G1} and π^*_{EB}. When only forecasts are published, the intervals are $L_{G1} \leq 1530$ and $L_{G2} \leq 1030$ and the EBM again prefers the default rate to all rates in the two intervals.

When both minutes and forecasts are published, both governments understand that the most preferred rates of all agents are ordered as follows:

$$\pi^*_{G1} < \pi^*_{EB} < \pi^d < \pi^*_{G2}.$$

This corresponds to case (a) in the previous section. Government 1 prefers π^*_{EB} to π^d so the EBM can propose his most preferred rate and NCB1 will accept his proposal.

In the states of the world where the EBM is not unconstrained (the ones that are interesting for analyzing the issue of publication), introducing uncertainty reduces the acceptance interval of both NCBs. This makes it more unlikely that the EBM's most preferred rate is accepted, more often constraining him when he proposes an inflation rate.

Because the constraints faced by the EBM are most binding when minutes and forecasts are unpublished, the governments' influence on the proposed rate is strongest in this regime, while publication reduces their influence. One might thus think that publication is bad for governments, since they lose power, but that is not necessarily true. The example in this section dealt with just one possible realization of the shocks and errors. To find out whether publication is good or bad ex ante, it is necessary to consider the full equilibrium decisions and economic outcomes in the different states of the world. This is done by numerical examples in the next section.

4 Numerical Analysis

As explained before, I can only fully describe the voting process and compare the expected losses of all agents in a numerical analysis. I call the set of parameters in the example of the previous section the benchmark case. This symmetric case is a good starting point for the analysis, but it is not realistic. Governments with different preferences or distribution of errors and whose countries have different distributions of supply shocks may have different preferences with respect to publication. So I look at the effect of differences in the parameters by changing them, first one at a time and then simultaneously, trying to analyze the effect of the enlargement of the EMU.

The parameters in the benchmark case are: $\lambda_{EB} = \lambda_{G1} = \lambda_{G2} = 1$; $\widehat{\pi}_{EB} = \widehat{\pi}_{G1} = \widehat{\pi}_{G2} = 0.01$; $\overline{y}_1 = \overline{y}_2 = 0$. The deviations I study are: high λ_{G2} ($\lambda_{G2} = 2$); high λ_{G1} and λ_{G2} ($\lambda_{G1} = \lambda_{G2} = 2$); high $\widehat{\pi}_{G2}$ ($\widehat{\pi}_{G2} = 0.02$); high $\widehat{\pi}_{G1}$ and $\widehat{\pi}_{G2}$ ($\widehat{\pi}_{G1} = \widehat{\pi}_{G2} = 0.02$); high $\overline{y}_2$ ($\overline{y}_2 = 0.02$) and high $\overline{y}_1$ and $\overline{y}_2$ $(\overline{y}_1 = \overline{y}_2 = 0.02)$.

With respect to the shocks and errors, I assume that they can either take on a high or a low value, with equal absolute value but different signs. These occur with equal probability, so that their expected value is zero. The supply shock ε_i can take on the values $-e_i$ and $+e_i$, the error government i commits when estimating the EBM's perception of the EMU average shock, α_i, takes on values $-a_i$ and $+a_i$ and the error committed by government i when estimating the EBM's targeted inflation rate, β_i, takes on the values $-b_i$ and $+b_i$. In the benchmark and other cases described above, I have assumed that $e_1 = e_2 = 0.06$, $a_1 = a_2 = 0.02$, $b_1 = b_2 = 0.01$. I look at three further cases: low e_2 $(e_2 = 0.03)$, low b_2 $(b_2 = 0.0075)$ and low a_2 $(a_2 = 0.01)$. Initially, I assume that the errors committed by both governments are independent. But I also describe how the results are affected by assuming errors to be perfectly positively correlated. For the supply shocks, I look at five alternative correlation patterns.

When both forecasts and minutes are published, there are four states of the world: four combinations of the two possible supply shocks in each country. Figure 6 in Appendix 2 shows the probabilities of these states of the world under the alternative correlation assumptions. When either minutes or forecasts are published, there are 16 states of the world and when neither minutes nor shocks are published, there are 64 states of the world. Figures 4 and 5 give numbers to all these states, so that I can refer to them in the following tables.

The last parameter that needs to be given a numerical value is the default rate, π^d, supposed to represent the status quo outcome under unchanged policy. I will look at three values: $\pi^d = 1.5\%$ corresponding to a period following a recession (a low default interest rate), $\pi^d = 1\%$, and $\pi^d = 0.5\%$ corresponding to a period following a boom.

I present most results corresponding to the assumption of independent supply shocks, since assuming correlation between the supply shocks does not change the preference ordering of the agents. Figure 7 in Appendix 2 presents the development of the decision process and the expected losses of all agents for the different correlation assumptions in the benchmark case. Figures 8 to 10 present the expected losses of all agents under different publication alternatives and default rates. I show how the voting process is resolved, namely in which cases the EBM is allowed to propose his most preferred rate unrestricted and which NCB is pivotal in the different states of the world.

The table in Figure 11 summarizes the preferred publication alternatives of all agents corresponding to the different default rates. MF refers to the publication of both minutes and forecasts and M to the publication of minutes only. For all parameter values in the ten cases analyzed, the incentive constraints are never binding when both minutes and forecasts are published, so that the EBM can simply propose his most preferred rate in all states of the world. This is not necessarily the case, I could choose parameters such that both incentive constraints bind even when minutes and forecasts are published. It would still be the case, however, that the constraints are more binding and governments have more influence under non publication. The EBM's expected losses are always lowest when the constraints are less binding, so that he will always prefer minutes and forecasts to be published.

The EBM is mostly constrained in states of the world where the supply shocks have different signs in both countries, so that the governments have opposite interests and most often benefit if their own NCB is pivotal but lose otherwise.

When the economy is coming out of a recession or boom, the ten cases analyzed can be divided into three groups.

- Both NCBs agree with the publication preferences of the EBM: in the benchmark case, when one or both governments put a high relative weight on the fluctuation of output (high λ_{Gi}) and when one government commits a smaller error when estimating the EBM's inflation target (low β_i), the prejudice of not being pivotal in some states more than compensates for the benefit of being pivotal in some other states, so that both governments agree with the EBM in their preference for publication.

- One NCB agrees with the EBM while the other is opposed to the publication of forecasts: when one government has a higher target for inflation or employment than the other and the EBM (high $\widehat{\pi}_{G2}$ and $\overline{y}_2$), when one country has a smaller variance of the supply shock (low e_2) and when one government commits a smaller error when estimating the EBM's perception of the EMU average shock (low a_2), the uncertainty benefits one government (the one with a higher target for inflation or employment, a smaller variance in the supply shock and a higher error when estimating the EBM's perception of the EMU average shock) but hurts the other.

- Both NCBs prefer that only minutes are published in the period following a boom (a low default inflation rate corresponding to a high default interest rate) and that both minutes and forecasts are published after a recession: when both governments have a higher target for inflation or employment than the EBM, they have a stronger preference for inflation than the EBM. The stimulation of the economy provided by higher inflation is more valuable following a recession than a boom. But the NCBs are pivotal in states where they want lower inflation than the EBM following a recession (higher after a boom), so the governments prefer not to influence the proposed rate.

The publication of minutes is always beneficial as it corrects the error committed by the private sector when estimating the EBM's targeted inflation rate. In general, the publication of forecasts makes no difference when the cycle is rapidly changing, that is, when the default rate is very far from the rate targeted by the governments; when the default rate coincides with the most preferred rate of the EBM and when the supply shocks are strongly positively correlated in the EMU area, as all agents then have more aligned interests. When there was neither a recession nor a boom in the previous period, the EBM is most often unconstrained even if only minutes are published, and the three agents agree on their preference for either minutes or both minutes and forecasts to be published.[8]

One might think that both governments have an incentive to make their NCBs attractive as the pivotal agent to get a proposed rate closer to their most preferred rate. Both governments would then compete in accepting rates increasingly closer to the EBM's most preferred rate. The result of this competition would be that the EBM is never constrained, notwithstanding the level of uncertainty. But this cannot occur, given my assumptions. When each government writes the incentive contract, it is unaware of committing an error with respect to the EBM's preferences and perception of the EMU shock, so it acts as if there were no uncertainty. In this case, there is no benefit from competing to become pivotal as already explained in section 2.

I assume that the errors committed by both governments when estimating the EBM's perception of the EMU average shock (α_i) are perfectly positively correlated in the benchmark case. This does not significantly affect the expected losses of the agents when forecasts are not published. When the errors committed by both governments in estimating the EBM's targeted inflation rate (β_i) are perfectly positively correlated, it hurts the EBM, but there is no significant effect on the governments' expected losses because they win in some states and lose in others.

If the group of countries in the EMU is relatively homogeneous, the governments' influence when forecasts are not published does not have a considerable effect on the implemented policies. But the effect of their influence may increase if the group of countries became more heterogeneous, as would be the case with an enlargement of the EMU area. An interesting application of the model is to ask whether the countries' preferences with respect to publication would change in case the EMU area were enlarged. To do that, I identify one country in the model (called "old") with the current EMU area and the other

[8] The reason for this is that the EBM is often constrained when supply shocks have different signs in both countries, but in this particular alternative, a zero average EMU supply shock means that $\pi^*_{EB} = \pi^d = 0.01$, so that the governments are indifferent between the default rate and the EBM's most preferred rate. Note, however, that a small change in the EMU average shock and the EBM's most preferred rate as in the case with low e_2 means that the EBM is constrained in some states of the world.

country (called "new") with the group of countries that would be included in an enlarged EMU. For obvious reasons, I assume that the government of the "new" country has a higher target for inflation and a preferred employment rate exceeding the natural rate. Furthermore, the "new" country's supply shock has a higher variance. All three parameter perturbations are included in the second group distinguished above, that is, one NCB agrees with the EBM while the other is in favor of the publication of minutes but opposed to the publication of forecasts. However, as shown before, the effect of a higher variance of the supply shock is opposite to the effect of higher targets for inflation and employment. Thus, the consequence of such an enlargement is not straightforward. Once more, I can only fully describe the voting process and compare the expected losses of all agents in a numerical analysis.

The specific parameter values I assume are: $\lambda_{EB} = \lambda_{GO} = \lambda_{GN} = 1$; $\widehat{\pi}_{EB} = \widehat{\pi}_{GO} = 0.01$; $\widehat{\pi}_{GN} = 0.03$; $\overline{y}_O = 0$; $\overline{y}_N = 0.02$; $e_O = 0.03$; $e_N = 0.06$; $a_O = a_N = 0.02$ and $b_O = b_N = 0.01$. The table in Figure 12 in Appendix 2 presents the expected losses of all agents under different publication alternatives and default rates and how the voting process is resolved. As was the case before, the EBM is always in favor of publishing both minutes and forecasts as this allows it to propose its more preferred rate in all states of the world and the governments of both countries favor the publication of minutes to correct the error committed by the private sector when estimating the EBM's targeted inflation rate.

The government of the "old" country influences most the EBM's proposal for both defaults rates, but with opposite effect on the proposed rate. The government of the "new" country only appreciates the influence when the European economy is coming out of a boom, as the proposed rate is then higher than π^*_{EB}. The government of the "old" country always benefits from influencing the EBM's decision, so it prefers forecasts not to be published.

Suppose that the governments of the countries currently in the EMU were to decide on the issue of publication taking into account that the union might be enlarged in the future. Then, they are likely to favor the publication of minutes but oppose the publication of forecasts to increase their influence and reduce their expected losses after the enlargement. Heterogeneity exacerbates the conflict of interests and increases the value of the influence on the implemented policies.

5 Conclusions

Despite the stringent rules of operation of the European System of Central Banks (ESCB), governments seem to have some influence in the decisions taken by the Governing Council of the ECB. I have modelled the governments' influence by help of a multiprincipal-multiagent model, where each national central banker tries to satisfy his own government in order to ensure a better career in the future. This way of modelling the relationship gives the governments considerable influence; before any meeting of the Governing Council, the governments induce their national central banker to accept rates within a certain acceptance set and reject any other proposal.

As a counterweight to this high level of national influence, I assume that the voting process takes the form of an agenda-setter model, where the Executive Board member proposes a policy (an inflation rate). This voting process gives more power to the agenda setter who only needs to make one national central banker (called pivotal) indifferent between his proposal and the default rate.

I use this model to analyze the publication of forecasts and minutes of the Governing Council meetings. It has been argued that publication would have a negative effect due to the influence of governments on their national central bankers' votes. In my model, the published information is incorporated in the incentive contracts governments offer to their agents, which actually makes the contracts less binding. This reduces the governments' influence on the proposed rate instead of increasing it and thus benefits the EBM.

In four of the ten parameter constellations that I analyze, one government benefits from the influence and prefers forecasts not to be published, while the other agrees with the EBM. In four cases, both governments agree with the EBM in their preference for the publication of forecasts. Only in two cases do both governments prefer forecasts not to be published. The publication of the minutes further eliminates the error committed by the private sector when estimating the EBM's targeted inflation rate, which is always beneficial for all agents.

Should the minutes of the meetings and forecasts be published? My numerical analysis does not give a definitive answer to the normative question, but it gives some insights into how the decision might be taken. Suppose that the Governing Council itself has to decide on the issue of publication. The decision to be taken should depend on the procedure for making the decision. If the median voter is allowed to decide or the EBM is allowed to make a proposal (as an agenda setter), the Council would decide in favor of the publication of both forecasts and minutes for most parameter values. If the decision must instead be taken with unanimity, the Council would have a harder time agreeing on the publication of forecasts. The same would be true if the publication had to be decided by a direct agreement among governments and the Executive Board members.

These predictions do not seem to match reality: the Executive Board appears to prefer secrecy and no government seems to be in favor of the publication of minutes. This does not necessarily mean that the previous analysis is incorrect, as I have only studied one specific effect of publication. Publication is likely to affect financial markets, might make it harder for the Governing Council to build a collective reputation, etc. All these additional effects may explain why minutes and forecasts are not published. The contribution of this paper is to analyze - and maybe refute - one common argument against publication, namely that it would have a negative impact on their national representatives through the influence of governments.

As a last exercise, I use the model to see if the forthcoming enlargement changes the attitude to publication of the countries currently in the EMU. I assume that the group of countries to be incorporated in the EMU has higher targets for both inflation and employment and faces a supply shock with higher variance. The higher level of heterogeneity exacerbates the conflict of interests. The model suggests that the current EMU members may want to withhold the publication of forecasts when taking enlargement with a more heterogeneous group of countries into account.

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A Appendix 1

The parameters I will look at are: $\lambda_{EB} = \lambda_{G1} = \lambda_{G2} = 1$; $\widehat{\pi}_{EB} = \widehat{\pi}_{G1} = \widehat{\pi}_{G2} = 0.01$; $\overline{y}_1 = \overline{y}_2 = 0$ and $\pi^d = 0.015$. The realization of the shocks and errors are: $\varepsilon_1 = 0.06$; $\varepsilon_2 = -0.06$; $\alpha_1 = -0.02$; $\alpha_2 = +0.02$; $\beta_1 = +0.01$ and $\beta_2 = -0.01$.

In this particular case, when neither minutes nor forecasts are published, the expected inflation rates (average of the inflation expectations in all states of the world given $\beta_1$and β_2) are $\pi_1^e = 0.0198$ and $\pi_2^e = 0.00015$. The governments estimate the EBM's most preferred rate as $E_{G1}(\pi^*_{EB}) = 0.0299$ and $E_{G2}(\pi^*_{EB}) = -0.0099$. The expected losses[9] of the two governments at $E_{Gi}(\pi^*_{EB})$ are $L_{G1}(E_{G1}(\pi^*_{EB}), A, \varepsilon_1) = 2657$ and $L_{G2}(E_{G2}(\pi^*_{EB}), A, \varepsilon_2) = 2654$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 1536$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1032$. This means that even for the minimal $K_i = 0$, the EBM cannot propose his most preferred rate unrestricted as $2657 > 1536$ and $2654 > 1032$, he must instead adapt his proposal to such a rate that at least one NCB accepts it.

In this example, the interval of rates the NCBs are induced to accept are all rates such that $L_{G1}(E_{G1}(\pi), A, \varepsilon_1) \leq 1536$ for NCB1 and all rates such that $L_{G2}(E_{G2}(\pi), A, \varepsilon_2) \leq 1032$ for NCB2. The most preferred rate for government 1 in this particular case is $\pi^*_{G1} = -0.01$, so that the EBM would have to propose a lower rate than $\pi^*_{EB} = 0.01$ to convince NCB1 to accept his proposal. The multiplier turns out to be $\gamma_1 = 0.3278$ and the corresponding proposed rate would be $\pi^P = 0,00258$.This rate is worse for the EBM than the default rate, so the EBM instead proposes $\pi^P = 0.015$.

When only minutes are published, the governments estimate the EBM's most preferred rate as $E_{G1}(\pi^*_{EB}) = 0.02$ and $E_{G2}(\pi^*_{EB}) = 0$. The private sector's expected inflation in both countries equals 0.01 and the expected losses of the two governments at $E_{Gi}(\pi^*_{EB})$ are $L_{G1}(E_{G1}(\pi^*_{EB}), A, \varepsilon_1) = 2500$ and $L_{G2}(E_{G2}(\pi^*_{EB}), A, \varepsilon_2) = 2500$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 2125$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1525$. Even for $K_i = 0$, the EBM cannot propose his most preferred rate unrestricted as $2500 > 2125$. Therefore, he will have to adapt his proposal to a rate in the acceptance set of at least one NCB. The EBM is still constrained when proposing an inflation rate, but the constraints are less binding, so that the EBM can propose a rate closer to $\pi^*_{EB} = 0.01$ than before. The EBM can now satisfy NCB1 by proposing the rate $\pi^P = 0.0063$ and the corresponding multiplier is $\gamma_2 = 0.1429$. The publication of minutes reduces the noise in the incentive contracts written by the governments, i.e., makes the acceptance sets of both NCBs wider, which translates into a smaller multiplier.

When only forecasts are published, the endogenous value of the expected inflation in country 1 when β_1 is positive is $\pi_1^e = 0.0195$ and the expected inflation in country 2 when β_2 is negative is $\pi_2^e = 0.0006$, so both governments will estimate the EBM's most expected rate as $E_{G1}(\pi^*_{EB}) = 0.01995$ and $E_{G2}(\pi^*_{EB}) = 0.00007$. The expected losses of the two governments at $E_{Gi}(\pi^*_{EB})$ are $L_{G1}(E_{G1}(\pi^*_{EB}), A, \varepsilon_1) = 1852$ and $L_{G2}(E_{G2}(\pi^*_{EB}), A, \varepsilon_2) = 1854$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 1536$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1030$. The EBM is once more constrained and must adapt his proposal to please NCB1. The most preferred rate for government 1 in this particular case is $\pi^*_{G1} = -0.01$, so that the EBM would have to propose a lower rate than $\pi^*_{EB} = 0.01$ to convince NCB1 to accept his proposal. Such a rate is worse for the EBM than the default rate, so the EBM instead proposes $\pi^P = 0.015$.

When both minutes and forecasts are published, both governments estimate the EBM's most preferred rate as $\pi^*_{EB} = 0.01$ since $\pi^e = 0.01$ and $\varepsilon_U = 0$. The private sector's inflation expectation in both countries $E_{Pi}(\pi^*_{EB})$ also equals 0.01, so that the expected losses of the two governments at π^*_{EB} are $L_{G1}(\pi^*_{EB}, A, \varepsilon_1) = 1800$ and $L_{G2}(\pi^*_{EB}, A, \varepsilon_2) = 1800$. The losses of both governments under the default rate are $L_{G1}(\pi^d, R, \varepsilon_1) = 2125$ and $L_{G2}(\pi^d, R, \varepsilon_2) = 1525$. As $1800 < 0.002125$, the EBM can choose his most preferred rate unrestricted and the NCB1 will accept his proposal.

[9] Losses multiplied by 1000000 to facilitate comparisons.

A Appendix 2

No uncertainty (minutes and forecasts published)

	-e1	+e1
-e2	1	3
+e2	2	4

Uncertainty about the preferences of the EBM (forecasts published)

	-b1,-b2	-b1,+b2	+b1,-b2	+b1,+b2
-e1, -e2	1	2	3	4
-e1, +e2	5	6	7	8
+e1, -e2	9	10	11	12
+e1, +e2	13	14	15	16

Uncertainty about the perception of the EMU shock by the EBM (minutes published)

	-a1,-a2	-a1,+a2	+a1,-a2	+a1,+a2
-e1, -e2	1	2	3	4
-e1, +e2	5	6	7	8
+e1, -e2	9	10	11	12
+e1, +e2	13	14	15	16

Figure 4:

Uncertainty about both the preferences and the perception of the EMU shock by the EBM				
		-e1, -e2		
	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1,-b2	1	2	3	4
-b1,+b2	5	6	7	8
+b1,-b2	9	10	11	12
+b1,+b2	13	14	15	16
		-e1,+e2		
	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1,-b2	17	18	19	20
-b1,+b2	21	22	23	24
+b1,-b2	25	26	27	28
+b1,+b2	29	30	31	32
		+e1, -e2		
	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1,-b2	33	34	35	36
-b1,+b2	37	38	39	40
+b1,-b2	41	42	43	44
+b1,+b2	45	46	47	48
		+e1,+e2		
	-a1, -a2	-a1, +a2	+a1, -a2	+a1, +a2
-b1,-b2	49	50	51	52
-b1,+b2	53	54	55	56
+b1,-b2	57	58	59	60
+b1,+b2	61	62	63	64

Figure 5:

Probab. of shock combinations under diff. correlation assumptions				
Correlation Assumptions	Shock combinations			
	-e1, -e2	+e1, -e2	-e1, +e2	+e1, +e2
Independence	25%	25%	25%	25%
Partial positive correlation	35%	15%	15%	35%
Total positive correlation	50%	0%	0%	50%
Partial negative correlation	15%	35%	35%	15%
Total negative correlation	0%	50%	50%	0%

Figure 6:

Losses of all agents for alternative correlations of the supply shocks												
Benchmark Case - π^d=0.5%												
Correlation between	Min. and For. Pub.			Minutes Published			Forecasts Published			Min and For not Pub.		
supply shocks	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
No correlation	1350	1350	450	1352	1352	452	1402	1402	478	1399	1399	475
Partial **+** correlation	1170	1170	630	1171	1171	631	1221	1221	657	1219	1219	655
Total **+** correlation	900	900	900	900	900	900	949	949	925	948	948	924
Partial **-** correlation	1530	1530	270	1533	1533	272	1583	1583	299	1579	1579	296
Total - correlation	1800	1800	0	1804	1804	4	1855	1855	31	1850	1850	26
Losses multiplied by 1000000		***1 NCB1 in states 23,34,44 ; NCB2 in states 19,24,42										

Figure 7:

Losses of all agents for no correlation of the supply shocks - Default rate = 0.5%													
Case		Min. and For. Pub.			Minutes Published			Forecasts Published			Min and For not Pub.		
		LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Bench-	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
mark	Losses	1350	1350	450	1352	1352	452	1402	1402	478	1399	1399	475
High	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***2		
λ_{G2}	Losses	1350	2475	450	1353	2476	452	1402	2553	478	1399	2549	475
High	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
λ_{G1}, λ_{G2}	Losses	2475	2475	450	2478	2478	452	2553	2553	478	2550	475	475
High	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
π_{G2}	Losses	1350	1400	450	1352	1397	452	1403	1459	478	1399	1450	475
High	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
π_{G1}, π_{G2}	Losses	1400	1400	450	1396	1396	452	1459	1458	478	1449	1449	475
High	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
y_2	Losses	1350	1550	450	1357	1539	452	1403	1615	478	1398	1604	475
High	Pivotal NCB	EBM not constrained			NCB1st7, 2 st10,16			NCB1st6, NCB2st11			***3		
y_1. y_2	Losses	1550	1550	450	1542	1542	453	1616	1615	478	1616	1612	498
Low	Pivotal NCB	EBM not constrained			NCB1 in st 10			NCB1 in st 11			***4		
e_2	Losses	1181	506	281	1189	500	282	1236	550	306	1262	551	320
Low	Pivotal NCB	EBM not constrained			NCB1st7, NCB2st10			NCB1st6, NCB2st11			***1		
b_2	Losses	1350	1350	450	1352	1352	452	1383	1399	472	1384	1392	470
Low	Pivotal NCB	EBM not constrained			NCB1 in st 7			NCB1st6, NCB2st11			***1		
a_2	Losses	1350	1350	450	1337	1365	451	1402	1402	478	1399	1399	475
Losses multiplied by 1000000			***1 NCB1 in states 23,34,44 ; NCB2 in states 19,24,42										
***2 NCB1 in st.23,34,42,44;NCB2 in st.19,24						***3 NCB1 st.34,42,44,60 ; NCB2 st.19,23,24,52,56,64							
***4 NCB1 st.19,23,42,58,62;NCB2 st.24,41,46,61													

Figure 8:

Losses of all agents for no correlation of the supply shocks - Default rate = 1%

Case		Min. and For. Pub.			Minutes Published			Forecasts Published			Min and For not Pub.		
		LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Bench-	Pivotal NCB	EBM not constrained			EBM not constrained			NCB1st6, NCB2st11			***1		
mark	Losses	1350	1350	450	1350	1350	450	1398	1398	474	1398	1398	474
High	Pivotal NCB	EBM not constrained			EBM not constrained			NCB1 in st 6, 11			***2		
λ_{G2}	Losses	1350	2475	450	1350	2475	450	1398	2546	474	1398	2549	474
High	Pivotal NCB	EBM not constrained			EBM not constrained			NCB1st6, NCB2st11			***3		
$\lambda_{G1}, \lambda_{G2}$	Losses	2475	2475	450	2475	2475	450	2547	2547	474	2550	2550	474
High	Pivotal NCB	EBM not constrained			EBM not constrained			NCB2st6, NCB1st11			***4		
π_{G2}	Losses	1350	1400	450	1350	1400	450	1397	1446	474	1397	1447	474
High	Pivotal NCB	EBM not constrained			EBM not constrained			NCB2st6, NCB1st11			***5		
π_{G1}, π_{G2}	Losses	1400	1400	450	1400	1400	450	1446	1446	474	1446	1446	474
High	Pivotal NCB	EBM not constrained			EBM not constrained			NCB2st6, NCB1st11			***6		
y_2	Losses	1350	1550	450	1350	1550	450	1397	1599	474	1417	1582	475
High	Pivotal NCB	EBM not constrained			EBM not constrained			NCB2st6, NCB1st11			***7		
y_1. y_2	Losses	1550	1550	450	1550	1550	450	1606	1603	474	1613	1613	506
Low	Pivotal NCB	EBM not constrained			NCB1 in st 7, 10			NCB2 in st 6, 11			***8		
e_2	Losses	1181	506	281	1172	516	282	1270	529	313	1246	545	309
Low	Pivotal NCB	EBM not constrained			EBM not constrained			NCB2 in st 6, 11			***9		
b_2	Losses	1350	1350	450	1350	1350	450	1379	1395	469	1388	1385	469
Low	Pivotal NCB	EBM not constrained			EBM not constrained			NCB1st6, NCB2st11			***10		
a_2	Losses	1350	1350	450	1350	1350	450	1398	1398	474	1435	1361	474

Losses multiplied by 1000000 ***1 NCB1 st 23,27,31,34 ; NCB2 st 19,38,42,46

***2 NCB1 st 23,27,31,34,38,42 ; 2 st 19,46 ***3 NCB1 st 23,27,31,34 ; 2 st 19,38,42,46

***4 NCB1 st 27,31,34,42 ; 2 st 19,23,38,46 ***5 NCB1 st 27,31,34,42,46 ; 2 st 19,23,38

***6 NCB1 st 31,34,42 ; 2 st 19,23,24,27,32 ***7 NCB1 st 34,42,44,60 ; 2 st 19,23,24,52,56,64

***8 NCB1 st 23,42 ; 2 st 19,24,41,46 ***9 NCB1 st 27,31,34,38 ; 2 st 19,23,42,46

***10 NCB1 st 31-34 ; 2 st 23,24,41,42

Figure 9:

Losses of all agents for no correlation of the supply shocks - Default rate = 1.5%

Case		Min. and For. Pub.			Minutes Published			Forecasts Published			Min and For not Pub.		
		LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB	LoG1	LoG2	LoEB
Bench-	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
mark	Losses	1350	1350	450	1352	1352	452	1402	1402	478	1399	1399	475
High	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***2		
λ_{G2}	Losses	1350	2475	450	1353	2476	452	1402	2553	478	1399	2551	475
High	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
$\lambda_{G1}, \lambda_{G2}$	Losses	2475	2475	450	2478	2478	452	2553	2553	478	2550	2550	475
High	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
π_{G2}	Losses	1350	1400	450	1349	1408	451	1402	1446	478	1399	1447	475
High	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
π_{G1}, π_{G2}	Losses	1400	1400	450	1405	1405	451	1446	1446	478	1447	1447	475
High	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
y_2	Losses	1350	1550	450	1347	1564	451	1402	1590	478	1399	1597	475
High	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
y_1. y_2	Losses	1550	1550	450	1559	1559	451	1591	1590	478	1600	1599	475
Low	Pivotal NCB	EBM not constrained			NCB1 in st 7			NCB1 in st 6			***3		
e_2	Losses	1181	506	281	1189	500	282	1237	551	306	1262	551	320
Low	Pivotal NCB	EBM not constrained			NCB1st10, NCB2st7			NCB2st6, NCB1st11			***1		
b_2	Losses	1350	1350	450	1352	1352	452	1383	1399	472	1384	1392	470
Low	Pivotal NCB	EBM not constrained			NCB1 in st 10			NCB2st6, NCB1st11			***1		
a_2	Losses	1350	1350	450	1337	1365	451	1402	1402	478	1399	1399	475

Losses multiplied by 1000000 ***1 NCB1 in states 21,31,42 ; NCB2 in states 23,41,46

***2 NCB1 in st.21,23,31,42;NCB2 in st.41,46 ***3 NCB1 st 3,7,23,42,46; 2 st. 4,19,24,41

Figure 10:

Most preferred publicaton alternatives									
Case	Def. = 0.5%			Default rate = 1%			Def. = 1.5%		
	Gov 1	Gov 2	EBM	Gov 1	Gov 2	EBM	Gov 1	Gov 2	EBM
Benchmark	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
High λ_{G2}	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
High λ_{G1}, λ_{G2}	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
High π_2	MF	M	MF	MF / M	MF / M	MF / M	M	MF	MF
High π_1, π_2	M	M	MF	MF / M	MF / M	MF / M	MF	MF	MF
High y_2	MF	M	MF	MF / M	MF / M	MF / M	M	MF	MF
High y_1, y_2	M	M	MF	MF / M	MF / M	MF / M	MF	MF	MF
Low e_2	MF	M	MF	M	MF	MF	MF	M	MF
Low b_2	MF	MF	MF	MF / M	MF / M	MF / M	MF	MF	MF
Low a_2	M	MF	MF	MF / M	MF / M	MF / M	M	MF	MF

Figure 11:

Losses of all agents for no correlation of the supply shocks Enlargement of the EMU													
Default rate		Min. and For. Pub.			Minutes Published			Forecasts Published			Min and For not Pub.		
		LoGO	LoGN	LoEB	LoGO	LoGN	LoEB	LoGO	LoGN	LoEB	LoGO	LoGN	LoEB
After recession	Pivotal NCB	EBM not constrained			NCB1 in st 10			NCB1 in st 11			***1		
	Losses	506	1581	281	500	1595	282	549	1645	306	551	1665	320
After boom	Pivotal NCB	EBM not constrained			NCB1st16, NCB2st8			NCB2 in st 6			***2		
	Losses	506	1581	281	505	1577	282	550	1629	306	553	1665	339

***1 NCB1 in states 2,4,34,42,44 ; NCB2 in states 10,21,23,31

***2 NCB1 in states 21,31,34,44,52,56,58,60,62,64 ; NCB2 in st 18,20,22-24,28,32,42,55,61,63

Figure 12: