Voting Transparency and the Optimal Remuneration of Central Bankers in a Monetary Union[*]

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Abstract

We examine whether the central bank council of a monetary union should publish its voting records when members are appointed by national politicians. We show that the publication of voting records lowers overall welfare if the private benefits of holding office are not too high. High wages of central bankers lower overall welfare under opacity, as they induce European central bankers to care more about being re-appointed than about beneficial policy outcomes. We show that opacity and low wages jointly guarantee the optimal welfare level. Moreover, we suggest that wage setting for central bankers should be centralized on a European level.

Keywords: Central Banks, Transparency, Voting.

JEL: E58, D70.

1 Introduction

Many central banks have decided to publish voting records during the last years. Among them are the Bank of England, the Fed and the Bank of Japan. However, the European Central Bank has always insisted on keeping the details of the decision-making process secret. In this paper we argue that the European Central Bank has rightly done so.

We present a model to examine the desirability of voting transparency if central bankers in a monetary union are appointed by national politicians. The publication of voting records in a monetary union may have two detrimental effects. First, it may induce central bankers to vote in the interest of their countries as opposed to the interest of the monetary union as a whole. Second, national governments are better able to distinguish nationalist from European central bankers and thus can re-appoint nationalist central banker only which also lowers European welfare.

We also examine the optimal level of remuneration for central bankers. We show that, under opacity, high wages destroy incentives for central bankers to behave optimally from a European perspective, as central bankers become too focused on holding office. It is then optimal to set wages for central bankers on a European level, because national governments are interested in paying them too much in order to influence their behavior. This, however, is not desirable for aggregate welfare.

One important assumption is that central bankers may sometimes be more interested in outcomes in their own countries than in the overall outcome for the monetary union. The importance of regional bias on the part of monetary policy committee members has recently been confirmed for the US by Meade and Sheets (2003). If US central bankers exert a regional bias, then it seems highly plausible that a national bias cannot be excluded for central bankers in the European Monetary Union. Heinemann and Hüfner (2002) find some first empirical evidence that ECB council members take divergences of national data from Eurozone averages into account. Von Hagen 2000 has identified and studied a regional bias in a voting game. On the drawbacks of external influence on committees see also Felgenhauer and Grüner (2003).

Our paper continues the line of research on the transparency of voting records initiated by Sibert (2003), Gersbach and Hahn (2001), and Gersbach and Hahn (2004). While these papers deal with transparency for a national central bank, we consider a monetary union with conflicting national interests. We also contribute to the broader issue of the optimal degree of central bank transparency as surveyed by Goodfriend (1986), Geraats (2002) and Hahn (2002).

Our paper also contributes to an emerging theoretical literature on the optimal design

of independent central bank boards with several members appointed by the government. Waller and Walsh (1996) provide a comprehensive account of how central bank independence can be characterized in terms of competitiveness, partisanship, and term length. Waller (2000) shows that a group of politically appointed central bankers can produce substantial policy smoothing and low policy uncertainty. Our paper is complementary to this literature as we focus on whether the votes of individual central bankers for a given design of the board should be made transparent to the political authorities that appoint central bankers.

The paper is organized as follows: In the next section, we present our model. In section 3, we analyze the results under opacity. We consider transparency in section 4. In section 5, we argue that the proposed re-appointment scheme is optimal. We proceed in section 6 by deriving the optimal wage and disclosure policy for a central bank in a monetary union. Section 7 concludes.

2   The Model

In this section we present a two-period model of decision-making in a monetary union where central bankers are appointed by national governments. Suppose that there are two types of central bankers: nationalist central bankers who desire monetary policy that is optimal only for their home country and European central bankers who prefer policy that is optimal for Euroland as a whole.

We consider N (N odd) countries of sizes α_j ($\alpha_j > 0$, $j = 1..N$) forming a monetary union ($\sum_{j=1}^{N} \alpha_j = 1$). There are two potential choices for monetary policy $i^{(t)} \in \{-1; +1\}$ in each period $t = 1, 2$. The optimal choice of monetary policy for an individual country i_j^* is randomly drawn from the set $\{-1; +1\}$ and is commonly known. For simplicity we assume that the optimal choice of monetary policy is constant over time for each country.[1] Welfare in country j for period t is given by:

$$W_j^{(t)} = \begin{cases} 1 & \text{if } i^{(t)} = i_j^* \\ 0 & \text{if } i^{(t)} \neq i_j^* \end{cases} \tag{1}$$

where we have normalized the social gains from monetary policy to 1 (0) if monetary policy is beneficial (detrimental) for country j.

Why might the optimal monetary policy differ across countries? First, national preferences may differ. For example, in some countries price stability may be regarded

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[1]Note that in general i_j^* will not be constant over time. However, the strategic effects in the first period do not depend on this assumption. Hence, introducing non-constant optimal interest rates would not affect our results qualitatively.

as much more important than in other countries. Second, economic development and shocks may be different across countries. Thus, a tightening of monetary policy may be optimal for one country, while at the same time a monetary easing may be optimal for another. This case seems of particular relevance for the EMU since there are substantial differences in national inflation rates. E.g., in August 2004, the annual inflation rate measured by the HICP amounted to 0.3% in Finland and 3.3% and 3.6% in Luxembourg and Spain respectively.[2]

Aggregate welfare for the monetary union is given by:

$$W^{(t)} = \sum_{j=1}^{N} \alpha_j W_j^{(t)} \tag{2}$$

It is obvious that the monetary policy that maximizes the monetary union's welfare amounts to:[3]

$$i^* = \begin{cases} -1 & \text{if } \sum_{j=1}^{N} \alpha_j i_j^* < 0 \\ +1 & \text{if } \sum_{j=1}^{N} \alpha_j i_j^* > 0 \end{cases} \tag{3}$$

It is useful to define $\mathbf{C}$ as the set of countries where $i_j^* \neq i^*$. In these countries a conflict arises between nationally optimal and overall optimal policy. In all countries that are not in $\mathbf{C}$, no conflict between nationally optimal and European goals arises. We use n to denote the number of countries in $\mathbf{C}$. Note that n is common knowledge in the central bank council.

It will prove advantageous to introduce the following definition. Let w be per-period European welfare if i^* is adopted.

$$w := \sum_{j \notin \mathbf{C}} \alpha_j \tag{4}$$

This implies that $1 - w$ equals per-period European welfare if i^* is not adopted.

$$1 - w = \sum_{j \in \mathbf{C}} \alpha_j$$

It follows that $w > \frac{1}{2}$.

We next specify the preferences of central bankers. European central bankers have the following utility:

$$U_j^E = W^{(1)} + B + \delta W^{(2)} + \delta \cdot \begin{cases} B & \text{when holding office in period 2} \\ 0 & \text{when not holding office in period 2} \end{cases} \tag{5}$$

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[2]See http://europa.eu.int/rapid.

[3]In addition, we assume that no partition of countries exists such that the sum of the respective sizes α_j is 1/2. This assumption is not essential for our results but guarantees that the monetary policy decision which is optimal for the monetary union is unique.

B ($B \geq 0$) denotes the private benefits from holding office. These benefits may stem from the wage paid to central bankers, they may also result from the satisfaction and prestige involved with holding such a position. Finally, they may represent enhanced career opportunities of individuals serving as central bankers. The variable δ ($0 < \delta < 1$) denotes the discount factor.

Nationalist central bankers also derive utility from holding office. In addition, they are interested in national welfare:

$$U_j^N = W_j^{(1)} + B + \delta W_j^{(2)} + \delta \cdot \begin{cases} B & \text{when holding office in period 2} \\ 0 & \text{when not holding office in period 2} \end{cases} \quad (6)$$

Each central banker is appointed by a selfish national government only interested in a large value of national welfare W_j. The government is not aware of the type of candidate central bankers when it makes its appointment decision. Its prior probability of a central banker being a nationalist amounts to $1/2$.

At the beginning of the second period, the government can dismiss its member of the central bank council or re-appoint him.

The sequence of events is given as follows:

- **1st Period:**

  - In the beginning of the first period, the original council with N central bankers is formed ($N \geq 1$, N odd). Each member is either a nationalist or a European with equal probability. Each member's preferences are private information.

  - Members simultaneously vote on monetary policy i.

  - The interest rate preferred by the majority is set by the central bank.

  - Voting records are published under the transparency requirement or remain secret for all outsiders under opacity.

- **2nd Period:**

  - At the beginning of the second period, the re-appointment of the members of the central-bank council takes place. Each government can dismiss its central banker and replace him by another central banker from a pool of candidates. Newly appointed central bankers will be of either type with equal probability.

  - Members simultaneously vote on monetary policy i.

– The alternative preferred by the majority is set by the central bank.

We introduce two special equilibrium constellations:

- European equilibrium: All European central bankers in $\mathbf{C}$ vote for i^* in the first period.

- Nationalist equilibrium: All European central bankers in $\mathbf{C}$ vote for the nationally optimal interest rate in the first period.

3   Opacity

Let us analyze the scenario with opacity. First, we discuss the governments' re-appointment procedure. Of course, the optimal re-appointment procedure and the monetary policy proposed by the two types of central bankers interact and must be formulated as equilibrium strategies in the overall game. However, we simplify the analysis at this stage by assuming certain government re-appointment schemes. In section 5 we will justify these assumptions as equilibrium strategies.

Without transparency, the government can only condition its decision on the observed outcome of the election:

Re-Appointment Scheme O:

$$
\text{member } j \text{ is } \begin{cases} \text{re-appointed} & \text{if } j \notin \mathbf{C} \\ \text{re-appointed} & \text{if } i^{(1)} = i_j^* \text{ and } j \in \mathbf{C} \\ \text{dismissed} & \text{if } i^{(1)} \neq i_j^* \text{ and } j \in \mathbf{C} \end{cases} \tag{7}
$$

The re-appointment scheme implies that it may be optimal for governments in $\mathbf{C}$ to dismiss their central bankers, if, due to an undesirable outcome, it seems likely that these central bankers do not pursue national interests.

Note that, in the second period, central bankers wish to maximize $W_j^{(2)}$ or $W^{(2)}$ respectively. Thus, European central bankers will vote for i^* while nationalist central bankers will vote for the respective nationally optimal monetary policy in the second period.

In the first period, it is obvious that central bankers who are not in $\mathbf{C}$ will always vote for i^*. Nationalist central bankers in $\mathbf{C}$ vote for i_j^*. This increases the likelihood of nationally optimal policy and also enhances their chances of being re-appointed. If $n < (N+1)/2$, then the voting behavior of European central bankers in $\mathbf{C}$ does not affect the election outcome or their probability of being re-appointed. They can be

assumed to vote for i^*. The case with $n \geq (N+1)/2$ is more subtle and is considered in the following.

We look for symmetric equilibria in which all European central bankers follow the same equilibrium strategies. If all other European central bankers in $\mathbf{C}$ vote for i^* with probability q in the first period of the game, then it is advantageous for a European central banker j in $\mathbf{C}$ to also vote for i^* if:

$$Q\left(\frac{1}{2}q\right)(w - (1 - w))$$
$$\geq \delta Q\left(\frac{1}{2}q\right)\left(P\left(\frac{1}{2}\right)(w - (1 - w)) + B\right) \tag{8}$$

where:

$$Q(x) := \binom{n-1}{\frac{N-1}{2}}(1 - x)^{\frac{N-1}{2}} x^{n-1-\frac{N-1}{2}} \tag{9}$$

Note that $Q(x)$ is the probability that among the central bankers in $\mathbf{C}\backslash\{j\}$ exactly $(N-1)/2$ vote for i_j^* if each central banker votes for i^* with probability x. This constellation is crucial because it is the only case where the vote of the central banker under consideration matters.

We have also introduced:

$$P(x) := \sum_{j=(N+1)/2-(N-n)}^{n} \binom{n}{j} x^j (1 - x)^{n-j} \tag{10}$$

which represents the probability of a European outcome if each central banker in $\mathbf{C}$ casts a European vote with probability x.

$1/2 \cdot q$ is the likelihood of an individual central banker in $\mathbf{C}\backslash\{j\}$ casting a European vote. Therefore $Q(1/2 \cdot q)$ is the probability of exactly $(N-1)/2$ in $\mathbf{C}\backslash\{j\}$ voting for i_j^*. If there are exactly $(N-1)/2$ central bankers in $\mathbf{C}\backslash\{j\}$ voting for i_j^*, the central banker under consideration can improve the outcome of the election in the first period. Thus he can ensure that European welfare amounts to w instead of $1 - w$. He can also vote for the respective nationally optimal monetary policy, which enables him to be re-appointed. Then he can reap the personal benefits B in the second period as well as prevent bad policy which would have occurred with probability $P(1/2)$ if he had voted for i^* in the first period.

Let us define the critical value for B:

$$B^{(O)}(q) = \left(\frac{1}{\delta} - P(1/2)\right)(2w - 1) \tag{11}$$

For $B \leq B^{(O)}(q)$ it is always optimal for a European central banker in $\mathbf{C}$ to vote for i^* given that all European central bankers in $\mathbf{C}$ vote for i^* with probability q, i.e., voting

for i^* is a dominant strategy. Note that $B^{(O)}(q)$ is always positive. Since $B^{(O)}(q)$ does not depend on q, we will omit the argument q in the following.

We obtain the following proposition:

Proposition 1
If $B \leq B^{(O)}$, then the following perfect Bayesian Nash equilibrium exists. In both periods, all nationalist central bankers vote for their preferred policy i_j^*, whilst all European central bankers vote for i^*. Each government follows the re-appointment procedure O.

We can now compute ex ante European welfare:

$$
\begin{aligned}
W_{OE} = &\, P\left(1/2\right)w + \left(1 - P\left(1/2\right)\right)\left(1 - w\right) \\
&+ \delta\left[\left(P\left(1/2\right)\right)^2 w + \left(1 - \left(P\left(1/2\right)\right)^2\right)\left(1 - w\right)\right]
\end{aligned}
\tag{12}
$$

We have introduced the subscript E, because the equilibrium is a European equilibrium. In the first period, all Europeans in **C** vote for the interest rates optimal from a European perspective.

If B is large, Europeans in **C** do not vote for i^* in the first period. Thus, we obtain:

Proposition 2
If $B \geq B^{(O)}$, then the following perfect Bayesian Nash equilibrium exists. In both periods, all nationalist central bankers vote for their preferred policy i_j^*. European central bankers vote for i^*, except for those in **C** in the first period. They vote for i_j^*. Each government follows the re-appointment procedure O.

This equilibrium is a nationalist equilibrium, since all European central bankers in **C** vote for the nationally optimal interest rates in the first period.

Ex ante European welfare amounts to:

$$
W_{ON} = 1 - w + \delta\left[P\left(\frac{1}{2}\right)w + \left(1 - P\left(\frac{1}{2}\right)\right)\left(1 - w\right)\right]
\tag{13}
$$

The difference in welfare can be readily computed as:

$$
W_{OE} - W_{ON} = P\left(1/2\right)\left(1 - \delta\left(1 - P\left(1/2\right)\right)\right)\left(2w - 1\right)
\tag{14}
$$

The difference in welfare can be split into two components. In the European equilibrium, there is a welfare gain of $P\left(1/2\right)\left(2w - 1\right)$ in the first period compared to the nationalist equilibrium. However, in the second period, there arises a welfare loss of $-\delta P(1/2)(1 - P(1/2))(2w - 1)$. Intuitively, a nationalist equilibrium is detrimental in

the first period, because of the increased likelihood of a nationalist outcome in the first period. In the second period, however, because national governments cannot identify a majority of European central bankers in the first period and replace them, welfare is higher because of higher chances of European monetary policy.

Overall, welfare is always higher under a European equilibrium for any value of the discount factor δ. This can be easily seen by applying $w > 1/2$. We summarize this important finding by the following proposition:

Proposition 3
Under opacity, welfare is always higher under a European equilibrium, i.e., for $B \leq B^{(O)}$, than under a nationalist equilibrium, i.e., for $B \geq B^{(O)}$.

Hence, we obtain the interesting result that high wages of committee members may be detrimental, because high wages make the members care too much about being re-appointed and less about overall welfare. To state it differently, high wages may destroy socially desirable behavior.

4 Transparency

Again, we first propose the re-appointment procedure. In section 5, we will show that this scheme is in fact optimal.

The re-appointment scheme has the important feature that governments make their re-appointment decision dependent on the vote of their council members.

Re-Appointment Scheme T:

$$\text{central banker } j \text{ is } \begin{cases} \text{re-appointed} & \text{if } i_j^{(1)} = i_j^* \\ \text{dismissed} & \text{if } i_j^{(1)} \neq i_j^* \end{cases} \tag{15}$$

Note that, in the second period, all nationalist central bankers will vote for i_j^*, whereas all European central bankers will vote for i^*. Now we turn to the optimal behavior of central bankers in the first period. All central bankers in $\mathbf{C}$ who are nationalists will always vote for i_j^* as this is their preferred policy and this choice will also enhance their re-election chances. It remains to be shown how the Europeans in $\mathbf{C}$ behave.

If $n < (N+1)/2$, then European central bankers in $\mathbf{C}$ cannot influence the outcome of the election in the first period. Therefore, they will always vote for i_j^*, which will guarantee re-appointment. In the following, we consider the more interesting case $n \geq (N+1)/2$.

It is optimal for a European central banker j in $\mathbf{C}$ to vote for i^* when all other Europeans in $\mathbf{C}$ vote for i^* with probability q if:[4]

$$Q\left(\frac{1}{2}q\right) \geq \delta B + \frac{1}{2}\delta Q\left(\frac{1}{2}(1-q) + \frac{1}{2} \cdot q \cdot \frac{1}{2}\right) \tag{16}$$

The left side of the inequality describes the advantage of voting for i^*. By voting for i^*, the central banker may enhance the outcome of the election. Since the other central bankers in $\mathbf{C}$ vote for European monetary policy with probability $\frac{1}{2}q$, this will happen with probability $Q\left(\frac{1}{2} \cdot q\right)$.

The right side of the inequality captures the disadvantages of voting for i^* for the central banker under consideration. First, the central banker loses office and thus forgoes the benefits from holding office in the second period. Voting for a nationalist policy and in turn being re-appointed would also enable the central banker to affect the election outcome in period 2. The central banker would cast the pivotal vote with probability $Q\left(\frac{1}{2}(1-q) + \frac{1}{2} \cdot q \cdot \frac{1}{2}\right)$. Note that $\frac{1}{2}(1-q) + \frac{1}{2} \cdot q \cdot \frac{1}{2}$ is the likelihood of a central banker in $\mathbf{C} \backslash \{j\}$ voting for i^* in the second period. $\frac{1}{2}(1-q)$ is the probability of a member being a European from the start and $\frac{1}{2} \cdot q \cdot \frac{1}{2}$ is the probability of the central banker being a European who votes for i^* and is replaced by another European. The additional $\frac{1}{2}$ before δ is introduced to take into account the fact that the successor of the respective central banker would be a nationalist only with probability $\frac{1}{2}$.

Let us define the critical value of B as:

$$B^{(T)}(q) := \frac{1}{\delta}Q\left(\frac{q}{2}\right) - \frac{1}{2}Q\left(\frac{1}{2} - \frac{q}{4}\right) \tag{17}$$

If $B \leq B^{(T)}(q)$, then it is optimal for a European central banker in $\mathbf{C}$ to cast a European vote when all European central bankers in $\mathbf{C}$ cast a European vote with probability q. If $B \geq B^{(T)}(q)$, it is optimal to cast a nationalist vote for a European central banker in $\mathbf{C}$.

Thus, there may be three types of symmetric equilibria. First, if $B \geq B^{(T)}(0)$, then an equilibrium exists where all European central bankers in $\mathbf{C}$ vote for the nationally optimal monetary policy.

Proposition 4
If $B \geq B^{(T)}(0)$, then a nationalist equilibrium exists.

Interestingly, it can easily be shown that $B^{(T)}(0) < 0$ for $n > (N+1)/2$ and $B^{(T)}(0) > 0$ for $n = (N+1)/2$. This follows from $Q(0) = 1$ for $n = (N+1)/2$ and $Q(0) = 0$ for

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[4]Note that we only consider symmetric equilibria, i.e., those equilibria where all European central bankers behave identically.

$n > (N + 1)/2$. Hence, these equilibria exist for any value of private benefits B if $n > (N + 1)/2$. For $n = (N + 1)/2$, these equilibria exist only for sufficiently large values of B.

Intuitively, if $n > (N+1)/2$, a central banker can never affect the outcome of the election if all other central bankers in $\mathbf{C}$ vote for a nationalist policy. Thus it is beneficial not to vote for i^* from a European's perspective, because this would not increase the probability of a European monetary policy in the first period but would merely cause the respective central banker to be dismissed. Under opacity, these equilibria do not exist, because voting for i^* would not be detected (and thus would not cause dismissal). Hence the central banker would be indifferent between both choices. Note that we have assumed that any central banker votes for his preferred alternative if he is indifferent between both options. Thus, we obtain multiple equilibria under transparency but none under opacity. By contrast, if $n = (N+1)/2$ and $q = 0$, then any central banker in $\mathbf{C}$ could change the outcome of the election and would do so unless B were very large.

Second, if $B \leq B^{(T)}(1)$, then an equilibrium exists where all European central bankers in $\mathbf{C}$ vote for i^*.

Proposition 5
If $B \leq B^{(T)}(1)$, then a European equilibrium exists.

Third, equilibria in mixed strategies may exist. These can be computed by solving $B = B^{(T)}(q)$ for q. In these equilibria, European central bankers in $\mathbf{C}$ are indifferent between both votes and therefore randomize between i^* with probability q and i_j^* with probability $1-q$. In general, it is not possible to compute the solutions of $B = B^{(T)}(q)$ analytically, since $B^{(T)}(q)$ is a polynomial of order $n-1$.

It seems plausible to exclude those equilibria in mixed strategies where $\frac{\partial B^{(T)}(q)}{\partial q} > 0$ as unstable. These equilibria imply that a marginal increase in q, which implies that it is slightly more likely that other European central bankers in $\mathbf{C}$ vote for i^*, makes voting for i^* more beneficial for a European central banker in $\mathbf{C}$. However, even if we apply this refinement, multiple equilibria usually exist under transparency for low values of B. It is important to note that $B^{(T)}(1)$ may be smaller than $B^{(T)}(0)$ which implies that an equilibrium in pure strategies does not always exist.

If European central bankers in $\mathbf{C}$ vote for the respective European interest rate with probability q in the first period, then ex ante welfare under transparency is given by:

$$
\begin{aligned}
W_T(q) = {}& P\big(1/2 \cdot q\big)w + \Big(1 - P\big(1/2 \cdot q\big)\Big)(1 - w) \\
& + \delta\bigg[P\Big(1/2 - q/4\Big)w + \Big(1 - P\Big(1/2 - q/4\Big)\Big)(1 - w)\bigg]
\end{aligned}
\tag{18}
$$

where we have used that the probability of a central banker in **C** voting for European policy in the second period amounts to $1/2(1-q) + 1/2 \cdot q \cdot 1/2 = 1/2 - q/4$.

It is easy to see that $W_T(1) > W_T(0)$. This implies that a pure European equilibrium is always preferable to a pure nationalist equilibrium. Numerical analyses show that interior welfare optima exist in some cases. Hence it is not clear that $q = 1$ always represent the socially desirable equilibrium.

This illustrates a subtle advantage of transparency. If n is rather large, some European central bankers in **C** can survive the first period of the game, if they randomize with $q < 1$. This enables some Europeans to reach the second period although i^* may have been chosen in the first period. Under opacity, all central bankers in **C** are dismissed if i^* is chosen. However, this potential advantage of transparency may only be substantial if n is rather large and if, by chance, the number of European central bankers is very high in the first period. Overall this effect is not strong enough to affect the ex ante comparison of transparency and opacity. It is nevertheless interesting to note that transparency may enable some European central bankers to hide their true type and thus reach the second period of the game, while under opacity this is impossible.

5   Optimality of Re-Appointment Schemes

Now we argue that the proposed re-appointment schemes represent the optimal behavior of national governments given the behavior of central bankers. Under transparency, it is optimal for a government in **C** to dismiss its central banker if, by voting for i^*, he has disclosed himself as European. This increases expected national welfare for the second period, because expected national welfare is always increasing in the likelihood of the respective central banker being a nationalist.[5]

Under opacity, consider the case where a European policy has been adopted in the first period of the game. Then the probability of a central banker in **C** being European is at least as large as the probability of him being a nationalist.[6] Hence, a newly chosen candidate is more likely to be a nationalist central banker than the incumbent. This, in turn, implies that it is optimal for a government in **C** to dismiss its central banker.

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[5]When the respective central banker's vote will turn out to be not pivotal, the probability of him voting for a nationalist policy is irrelevant. By contrast, if the respective central banker's vote happens to be pivotal, a nationalist outcome is more likely, if it is more likely that he votes for a nationalist policy.

[6]If $n < (N+1)/2$, then both probabilities are identical. Thus national governments are indifferent between dismissing or re-appointing its central banker. Our assumption that governments replace their central bankers in this case is not essential and merely serves to simplify the exposition. If $n \geq (N+1)/2$, then the probability of a central banker in **C** being European is strictly larger than the probability of him being a nationalist.

6 Optimal Remuneration and Optimal Disclosure Policy

Let us now discuss the optimal remuneration under opacity. From what has been said before, it is clear that $B \leq B^{(O)}$ guarantees the highest welfare under opacity, as a very high remuneration would make European central bankers focus too much on individual re-appointment compared to welfare.

Proposition 6

Under opacity, welfare is optimal for $B \leq B^{(O)}$.

Let us now discuss the impact of the size of B on welfare under transparency. Note that $B^{(T)}(q)$ is a polynomial and thus $B_{max} = \max_{q \in [0;1]} B^{(T)}(q)$ is well-defined. Thus, if $B \geq B_{max}$, only equilibria exist where all European central bankers in **C** vote for the respective nationally optimal monetary policy. If $B < B_{max}$, then it is unclear how a change in B would impact on welfare. If multiple equilibria exist, then a change in B may affect which equilibrium is chosen.

It is interesting to ask whether the European equilibrium under opacity is superior to any equilibrium that can be achieved under transparency. It is straightforward to show that this amounts to verifying whether the inequality $P(1/2 \cdot q) + \delta P(1/2 - q/4) < P(1/2) + \delta(P(1/2))^2$ is always satisfied. As $P(x)$ is increasing in x, $P(1/2) \geq P(1/2 \cdot q)$. Thus, the inequality holds for any $0 < \delta \leq 1$ if it holds for $\delta = 1$. It is therefore sufficient to show

$$P\left(\frac{1}{2} \cdot q\right) + P\left(\frac{1}{2} - \frac{q}{4}\right) < P\left(\frac{1}{2}\right) + \left(P\left(\frac{1}{2}\right)\right)^2 \tag{19}$$

This inequality holds if

$$P(1/3) < (P(1/2))^2 \tag{20}$$

This can be seen as follows. First, consider the case $q \leq 2/3$. Then $P(q/2) \leq P(1/3) < (P(1/2))^2$ and $P(1/2 - q/4) < P(1/2)$. Second, for $q > 2/3$ we can conclude that $P(1/2 - q/4) < P(1/3) < (P(1/2))^2$ and $P(q/2) < P(1/2)$.

The above condition (20) is quite rather complex. Thus we will proceed in two ways. For the cases $n = (N+1)/2$, $n = (N+1)/2 + 1$, for symmetric equilibria in pure strategies as well as for very large n we show analytically that opacity is generally preferable to transparency. For other circumstances, we rely on numerical computations.

Proposition 7

For all symmetric equilibria in pure strategies opacity is always superior to transparency.

The proof is given the appendix. Note that this proposition and (19) imply $P(1/4) < (P(1/2))^2$. As a corollary, we immediately obtain

Corollary 1
Any symmetric equilibrium under transparency with $q \leq 1/2$ is inferior to any symmetric equilibrium under opacity.

Now we consider the special case where the members in **C** represent only a rather narrow majority of all central bankers.

Proposition 8
Suppose $n = (N + 1)/2$ or $n = (N + 1)/2 + 1$. Then opacity is always superior to transparency.

The proof is given in the appendix. These cases are of particular relevance, since monetary policy that is optimal for the monetary union is unlikely to be detrimental to a very large number of countries.

For $N = 3$, the only relevant case is $n = 2$. For $n < 2$, there is no conflict between European welfare and national welfare for a majority of countries and thus the policy optimal from a European perspective would always be adopted. The case $n = 3$ and $N = 3$ is impossible, because the policy which is optimal for the monetary union cannot be detrimental for all individual countries. Equivalently, for $N = 5$, the only relevant cases are $n = 3$ and $n = 4$. Hence, from proposition 8 we immediately obtain the following corollary

Corollary 2
Suppose $N = 3$ or $N = 5$. Then opacity is always superior to transparency.

In the next proposition we consider large committees and obtain

Proposition 9
Suppose $n = (N + 1)/2 + k$ where $k \geq 0$ is an integer that is fixed. If n (and N) is sufficiently large, opacity is superior to transparency.

The proof is given in the appendix. For the remaining cases, we rely on numerical computations. They show that inequality (20) holds for all parameters $N \leq 100$ and $(N + 1)/2 \leq n \leq N - 1$. A numerical check of (20) yields

Proposition 10
For $N \leq 100$, opacity is always superior to transparency.

Hence, the combination of low wages and opacity is beneficial as it induces European central bankers to focus on policy outcomes as opposed to individual re-appointment

and simultaneously protects European central bankers from being replaced by governments focusing on national welfare.

We have shown that high wages for central bankers under opacity may destroy their incentives to opt for European policy as holding office becomes very desirable. Is it then desirable for each country to pay low wages? The opposite is true. By paying its central banker a high wage, the country can discipline its central banker and can induce him to vote in the national interest of the country. Choosing the wages of central bankers thus has the features of a prisoner's dilemma. Although all countries would be better off when paying moderate wages to central bankers, each country has an incentive to pay a high wage to its central banker given the wages of the other central bankers. Consequently, it is desirable to agree on wages for central bankers on a European level (as opposed to national levels).

7 Discussion and Conclusions

While a great deal of attention has been paid to the remuneration of chief executives and recently also of politicians (cf. Gersbach (2004)), we identify a new detrimental effect of high wages for central bankers in the context of a monetary union and national re-appointment decisions. High wages make re-appointment highly valuable which induces European central bankers to vote for the respective nationally optimal monetary policy in order to secure re-appointment. High wages in our model can be thought to comprise not only the actual remuneration of central bankers but also, e.g., the size of the national central bank. It seems plausible that a national central banker's utility positively depends on the size of his institution, because a large national central bank implies more prestige and power. Thus, our model might also shed some light on the fact that the some national central banks in the EMU still seem excessively large.

Our result is a subtle counter-example to the idea that paying agents better will improve their performance. In the context of a monetary union, increasing the remuneration of central bankers improves the performance from the perspective of a single nation but not from a European perspective.

It is interesting to ask whether given a certain amount of remuneration, opacity or transparency are preferable. While for sufficiently low remuneration ($B \leq B^{(O)}$), transparency is always detrimental and opacity should be chosen, one cannot obtain such a clear-cut result if remuneration is high.[7]

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[7]Our numerical calculations show that opacity or transparency may be advantageous, depending on the parameter values and on the equilibrium chosen under transparency.

However, we obtain the result that low wages and opacity act in a complementary manner in increasing welfare. Both measures increase jointly the incentive of European central bankers to act as European statesmen, while at the same time protecting them from national governments. While low wages are always beneficial under opacity, the same is not necessarily true under transparency.

Since opacity and a low wage, or a low value of office in general, jointly increase welfare, we suggest that confidentiality of individual voting behavior should be accompanied by a centralized determination of remuneration for central bankers which applies to all countries. The latter requirement curbs the incentive to pay national central bank governors high wages to secure that they vote nationalistic. It would be even better if all central bankers were accountable to a European authority. However, this solution may not be politically feasible.

However, low wages may also have detrimental affects not captured by our model such as attracting only less able candidates. Thus the beneficial effect of low wages identified in our paper needs to be balanced against these disadvantages.

The Governing Council has recently accepted a reform proposal. In this proposal, the principle of one-country-one-vote is kept. However the number of governors with voting rights will be restrained through a complicated rotation scheme (for a discussion see e.g. Gros (2002) or Wyplosz (2003)). This new scheme does not eliminate the underrepresentation of large countries or the over-representation of small countries in the political weight. Thus, one of our implicit assumptions remains valid, namely that the stronger relative influence of small countries implies that monetary policy chosen by the council may not be optimal from an overall European perspective.[8]

One implication of our model that could be tested empirically is that under opacity either no central banker or a large group of central bankers is dismissed, while under transparency, the dismissal of only a few central bankers should be comparably frequent.

Our analysis may have applications for other committees where re-appointment or re-election and political pressure play an important role. E.g., one may conjecture that secret voting in the German "Bundesrat", where representatives of the "Länder" vote on national policy issues, would lead to more efficient policy-making.[9]

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[8]Note we would always obtain socially optimal results if $\alpha_j = 1/N$ for $j = 1...N$, i.e., if each country's weight in the decision-making equalled its weight in the welfare function.

[9]A similar effect might also play a role for courts where opacity may protect judges from socially detrimental influence. Judges, however, are usually appointed only once. However, they may nevertheless find it embarrassing or expect career disadvantages when voting against the interests of those politicians who have appointed them if voting is public.

A   Proof of Proposition 7

We have to verify only two cases.

1. $q = 0$. Inserting $q = 0$ into (19) yields $P(0) + P(1/2) < P(1/2) + (P(1/2))^2$. Since $P(0) = 0$ and $P(1/2) > 0$, the inequality holds.

2. $q = 1$. This is the case where all Europeans in $\mathbf{C}$ vote for i^* in the first period. It turns out to be easier not to evaluate (19) but to argue along the following line of reasoning. Note that, in the first period, welfare is identical under transparency and opacity, since the central bankers behave identically under both regimes. Hence it is sufficient to focus on welfare in the second period.

   Let us assume for the moment that there are k nationalists in $\mathbf{C}$ in the first period. If $k \geq (N + 1)/2$, then we obtain the same results under transparency and opacity. In both periods i^* is not implemented. Thus we have to analyze $k < (N+1)/2$. Under transparency, the nationalist central bankers in $\mathbf{C}$ remain in office while they are replaced under opacity in the second period. It is intuitively clear that this makes i^* less likely under transparency. However, we will also give a formal proof. We have to show that, under transparency, the likelihood that a detrimental monetary policy is implemented is higher than the respective probability under opacity. Formally, this can be stated as

$$\sum_{j=\frac{N+1}{2}-k}^{n-k} \binom{n-k}{j} \frac{1}{2^{n-k}} > \sum_{j=\frac{N+1}{2}}^{n} \binom{n}{j} \frac{1}{2^n}$$

   The left hand side gives the probability that at least $(N + 1)/2 - k$ nationalist central bankers are appointed in addition to the k nationalist incumbents. The right hand side gives the probability of at least $(N + 1)/2$ central bankers in $\mathbf{C}$ being nationalists if all central bankers in $\mathbf{C}$ are replaced.

   If we define the left hand of the inequality as $\kappa(k)$, it is sufficient to show that $\kappa(k + 1) > \kappa(k)$. This is equivalent to

$$\sum_{j=\frac{N+1}{2}-k-1}^{n-k-1} \binom{n-k-1}{j} \frac{1}{2^{n-k-1}} > \sum_{j=\frac{N+1}{2}-k}^{n-k} \binom{n-k}{j} \frac{1}{2^{n-k}}$$

   Using the well-known formula for binomial coefficients, $\binom{n}{k} = \binom{n-1}{k} + \binom{n-1}{k-1}$, this

can be manipulated as follows

$$2 \sum_{j=\frac{N+1}{2}}^{n} \binom{n-k-1}{j-k-1} > \sum_{j=\frac{N+1}{2}}^{n} \binom{n-k}{j-k}$$

$$2 \sum_{j=\frac{N+1}{2}}^{n} \binom{n-k-1}{j-k-1} > \sum_{j=\frac{N+1}{2}}^{n} \left(\binom{n-k-1}{j-k} + \binom{n-k-1}{j-k-1} \right)$$

$$2 \sum_{j=\frac{N+1}{2}}^{n} \binom{n-k-1}{j-k-1} > \sum_{j=\frac{N+1}{2}}^{n} \binom{n-k-1}{j-k} + \sum_{j=\frac{N+1}{2}+1}^{n+1} \binom{n-k-1}{j-k-1}$$

$$\binom{n-k-1}{(N+1)/2-k-1} > 0$$

Hence, transparency implies a lower probability of i^* being implemented in the second period. Since opacity and transparency imply the same welfare in the first period, opacity is always desirable for $q = 1$.

$\square$

B   Proof of Proposition 8

First, we consider the case with $n = (N+1)/2$. Then the expression for $P(x)$ simplifies to:

$$P(x) = 1 - (1-x)^n$$

Intuitively, a European monetary policy is adopted unless all central bankers in $\mathbf{C}$ vote for a national monetary policy, which happens with probability $(1-x)^n$. Inequality (20) can now be written as

$$1 - \left(1 - \frac{1}{3}\right)^n < \left(1 - \left(\frac{1}{2}\right)^n\right)^2$$

This is equivalent to

$$2 < \left(\frac{4}{3}\right)^n + \frac{1}{2^n}$$

Note that the smallest value of n is $n = 2$.[10] For $n = 2$, it is straightforward to verify that this inequality is satisfied. For $n > 2$, we note that $\left(\frac{4}{3}\right)^n > 2$, which also implies that the inequality holds.

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[10]The only relevant cases are $n \geq (N+1)/2$. $N = 3$ is represents the smallest council (except for $N = 1$, which implies that transparency and opacity are equivalent.)

Second, we consider $n = (N+1)/2 + 1$. For $n = (N+1)/2 + 1$, the expression for $P(x)$ simplifies to

$$P(x) = 1 - (1-x)^n - n(1-x)^{n-1}x$$

This implies

$$
\begin{aligned}
P(1/2) &= 1 - (n+1)\frac{1}{2^n} \\
(P(1/2))^2 &= 1 - \frac{2(n+1)}{2^n} + \frac{(n+1)^2}{2^{2n}} \\
P(1/3) &= 1 - \left(1 + \frac{n}{2}\right)\left(\frac{2}{3}\right)^n
\end{aligned}
$$

Inequality (20) can now be written as

$$2 < \frac{1+n/2}{1+n}\left(\frac{4}{3}\right)^n + \frac{1+n}{2^n}$$

Note that the smallest value of n is $n = 4$.[11] The inequality is readily verified in this case. For $n \geq 5$, $(4/3)^n > 4$ and $(1+n/2)/(1+n) > 1/2$, which implies that the inequality also holds. Hence, opacity is always socially desirable from a European perspective if $n = (N+1)/2 + 1$.

$\square$

C   Proof of Proposition 9

Note that $P(x)$ can be written as

$$P(x) = 1 - \sum_{j=0}^{k}\binom{n}{j}(1-x)^j x^{n-j}$$

where $k = n - (N+1)/2$. Then (20) is equivalent to

$$2\frac{1}{2^n}\sum_{j=0}^{k}\binom{n}{j} < \left(\frac{2}{3}\right)^n \sum_{j=0}^{k}\binom{n}{j}\frac{1}{2^j} + \left(\frac{1}{2^n}\sum_{j=0}^{k}\binom{n}{j}\right)^2$$

This inequality is satisfied if

$$\frac{\sum_{j=0}^{k}\binom{n}{j}\frac{1}{2^j}}{\sum_{j=0}^{k}\binom{n}{j}} > 2\left(\frac{3}{4}\right)^n$$

---

[11]The value of $n = 4$ corresponds to $N = 5$ and $n = (N+1)/2 + 1$.

Note that the left hand side of the inequality is always larger than $\frac{1}{2^k}$, since it is a weighted average of $1, 1/2, 1/4, ..., 1/(2^{k-1}), 1/(2^k)$. For an increasing value of n and a fixed value of k, the right hand side of the inequality is becoming arbitrarily small. Hence, there exists an n^* such that (20) holds for all $n \geq n^*$.

$\square$

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