How should large and small countries be represented in a currency union?

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Abstract We present a simple model of optimal representation in a federal central bank that balances two opposing forces: the wish to insulate common monetary policy from changing preferences at the national level, and the attempt to avoid an overly active or passive reaction to idiosyncratic national economic shocks. A perfect match between economic size and voting rights is rarely optimal, and neither is the "one country, one vote principle". There are indications that the pattern of over- and under-representation of member countries in the ECB Council might be extreme.

Keywords Central bank · Federal central bank · Currency union · Optimal representation · Voting · ECB

JEL Classification D72 · E52 · E58 · F33

1 Introduction

The likely extension of the Economic and Monetary Union (EMU) has triggered a lively debate on the organization of monetary policy in the euro area. Following a suggestion by the European Central Bank (ECB), current EMU member governments have agreed on a plan to reform the ECB's organizational structure with a view to better match the economic and political weights of member countries in the ECB Council and limit the overall size of the Council.[1]

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[1] Studies discussing these and related arguments include, among others, Baldwin et al. (2001), Hefeker (2002), Gros et al. (2002), Fitoussi and Creel (2002), de Grauwe (2003), and Meade (2003). Bindseil (2001) discusses the "one country, one vote" rule in the ECB Council.

An extended version of the paper is available in Berger and Mueller (2004).

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Table 1 Misrepresentation in Federal Central Banks, 1959–2001

	Fed		Buba		ECB		
	1977	2001	1959	1992	2001	EMU24	EMU24 (R)
STD	4.46	5.54	8.48	5.70	11.26	12.47	11.34
STD (B)	0.41	0.66	2.65	0.91	4.60	7.88	5.99

Sources: Bureau of Economic Analysis; US Federal Reserve; Statistisches Bundesamt; IFS; and own calculations

Notes: "(R)" marks the post-reform case. "STD" measures the sum of the squared difference between national or regional vote shares in the overall decision-making committee and the relevant GDP or GSP share of the given year. "STD (B)" assumes that the Board votes with each region or country in line with its GDP or GSP share. Berger (2002, Appendix I) discusses the effect of EMU enlargement on misrepresentation indicators under different assumptions on Board behavior. See Berger (2006) for further details

It is probably fair to say that most academic observers agree that limiting the overall size of the ECB Council is a crucial step to ensure efficiency in monetary policymaking in the euro area[1]—there is less agreement, however, on whether (or to what degree) correcting the existing lack of correlation between the member countries' economic size and their voting power is sound policy. The current ECB structure, by following the "one country, one vote" principle, gives economically smaller countries a disproportional large vote, possibly introducing a bias into the ECB's decision-making. The Maastricht treaty would have the ECB stabilize inflation within the euro area using the Harmonized Consumer Price Index.[2] This encourages the ECB to take a European perspective by evaluating the potential impact of national economic developments on euro area inflation based on the respective relative economic size of a member country. If national central bank governors put at least some weight on national economic developments, their over-representation could distort this perspective by directing monetary policy toward national issues.

To provide some perspective, it is interesting to relate the degree of misrepresentation in today's ECB, as well as in the hypothetical expanded ECB with 24 members, to the example of other federal central banks—namely the US Federal Reserve System and the German Bundesbank before the advent of the euro. Table 1 shows two indicators of misrepresentation based on the sum of the squared deviation of the voting rights held by a country or region in the decision-making Council or committee and its GDP share. Strikingly, the misrepresentation of economic size in the ECB Council is about an order of magnitude more severe than in the Fed or, after the post-unification reform of 1992, the Bundesbank. This is true if the misrepresentation indicator ignores or takes into account the role of the Board, if we look at an EMU with 12 or 24 members, or if we look at the situation before or after the planned ECB reform.

So is the comparatively stark pattern of misrepresentation of size in the ECB excessive? The answer is far from clear. While reducing the degree of over-representation will ensure that the decision-making process within the ECB Council will be more likely to resemble the perspective of a benevolent European social planner, there are a number of arguments that caution against a too mechanistic match of economic size and representation. For instance, Gros and Hefeker (2002) and Benigno (2004) point out that over- and under-representation of member countries in the planner's target function or, equivalently, in the distribution of

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[2]Euro area inflation is computed by Eurostat using a weighted average of (harmonized) current euro area member inflation rates, where the weights are based on relative expenditure on final private domestic consumption. The distribution of relative consumption very closely mirrors that of relative GDP.

voting rights within the actual ECB Council, could be optimal if transmission mechanisms differ. How important these differences might be is, however, mostly an empirical question.[3] Another argument is made by Casella (1992), who points out that over-representation could be a necessary condition for smaller countries to join a currency union. Sibert (2006) and Berger (2006) provide recent surveys on the discussion on optimal central bank design.

The present paper adds central bank independence as a potentially crucial argument to this debate.[4] We show that optimal representation weights two opposing forces: the wish to reduce the impact of national preference shocks on union-wide policymaking, and the attempt to minimize misrepresentation of any one country's relative economic size.

In what follows, Sect. 2 will briefly review recent related literature. Section 3 describes the model, the first-best benchmark policy, and actual policy-making in a federal central bank. Section 4 derives the conditions for optimal representation of national interests within a currency union. Finally, Sect. 5 draws some conclusions.

2 Relation to recent literature

Our contribution is related to three intertwined strands in the economic literature on central bank design. One, including von Hagen and Süppel (1994) and Lohmann (1997, 1998), asks whether a central bank with a centralized or a decentralized structure is better suited to cope with partisan preference shocks at the national level. The argument is involved, but in general strong national representation in the joint central bank Council leads to inefficiencies at the union level.

This contrasts with a somewhat more recent body of papers discussing the efficiency of alternative decision-making structures (Gerling et al. 2005). Gerlach-Kristen (2006), for instance, argues that committees with multiple members might be better suited than single individuals to process information, fostering efficient decision-making—a theoretical result supported by experimental evidence produced by Blinder and Morgan (2005).[5] Since much of the information that federal central banks are processing is regional, this can be taken to suggest that regional or national representation in the Council has advantages (Maier et al. 2003).[6] Thus, full centralization would not be desirable.

A third group of papers takes the influence of national interest on central bank Council policies as given and asks how to deal with shocks to national preferences. Waller and Walsh (1996) suggest long and overlapping contracts for Council members to moderate national preference shocks (see also Lindner 2000), an idea already reflected, for example, in the term structure of ECB Council members. Other recent proposals remain largely theoretical to date. For instance, Gersbach and Pachl (2004) suggest to raise the majority requirements in line with the size of the desired interest rate change to moderate idiosyncratic national policy demands. Heisenberg (2003) argues that increasing the transparency of Council decision-making would help constraining the problem at its source. Finally, Bullard and Waller (2004) discuss the advantages of alternative decision-making arrangements, including simple majority voting, bargaining, and a supermajority design, in a general equilibrium framework.

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[3]Ciccarelli and Rebucci (2002) present evidence that suggests that transmission mechanisms have become fairly similar among current EMU members already during the 1990s.

[4]Advantages of the "one country, one vote" principle based on considerations of political economy are also discussed in Berger (2002) and Berger et al. (2004).

[5]Gersbach and Hahn (2001) explore similar issues from a transparency perspective.

[6]Also see Goodfriend (2000) and Greenspan (2000).

Finally, our work is broadly related to the political-economic literature that deals more generally with country representation in decision-making bodies of the European Union (EU).[7] For instance, Laruelle and Widgren (1998) show that large countries are under-represented and small countries are over-represented in the Council of Ministers compared to a benchmark that takes into account relative population size (see also Felsenthal and Machover 2001 and Sutter 2000). Barbera and Jackson (2006) study the optimal design of voting rules in the Council from a utilitarian perspective.

3 The model

3.1 The economy and the first-best benchmark

The output gap in each member country of the currency union i, defined as the percentage deviation of the actual output level from the level of natural output y_i^n, is given by a standard Lucas supply function

$$y_i = \pi - \pi^e + \theta_i; \quad \theta_i \sim \left(0, \sigma_{\theta_i}^2\right). \tag{1}$$

Inflation, π, is assumed to be similar across the currency union, that is, $\pi = \pi_i = \pi_{\neq i}$, and under the full control of the common central bank. Inflation expectations, denoted by π^e, are set rationally, so that $\pi^e = E\pi$. The last term in (1), θ_i, is a country-specific economic shock with zero mean and known (positive) variance.

A reasonable assumption—one that seems to be broadly in line with the spirit of the Maastricht treaty in the example of the ECB or the policy targets pursued by the US Federal Reserve—is that the first-best policy minimizes a standard quadratic loss function based on the deviations of inflation and the aggregate output gap, y, from their commonly (currency union-wide) agreed target levels:

$$L^* = (\pi - \pi^*)^2 + \lambda y^2.$$

The term $\pi^* > 0$ is an exogenous inflation target, say 2 percent. While we will later allow stochastic deviations of national inflation targets from the first-best inflation target, we assume that π^* remains constant. One interpretation (in line, for instance, with the institutional setup of the ECB) is that currency union members agree on the common inflation target ex ante.[8] The coefficient λ measures the relative weight attached to output stabilization, with $0 < \lambda < \infty$. The target level for the aggregate output gap has been set to zero, ensuring that the first-best policy does not suffer from a time inconsistency problem. The aggregate output gap is the weighted sum of the respective national output gaps, that is, $y = \sum \chi_i y_i$, where we can define the economic weights of each country as the expected share in aggregate union output: $\chi_i \equiv y_i^n / \sum y_i^n$. This allows us to express L^* as

$$L^* = (\pi - \pi^*)^2 + \lambda \left(\sum \chi_i y_i\right)^2,$$

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[7]See Hix (2005) for a general description of political decision-making in the EU.

[8]For example, assume that currency union member countries' inflation targets are $\pi_i^* = \hat{\pi}_i^* + \varepsilon_i; \varepsilon_i \sim (0, \sigma_{\varepsilon_i}^2)$ and that members bargain over the common central bank's inflation target. Then the expected value of the outcome would be $\pi^* = \sum w_i \hat{\pi}_i^*$, where w_i is an arbitrary bargaining weight. To simplify, we will assume $\hat{\pi}_i^* = \pi^*$ in what follows.

or, in the two-country case,

$$L^* = (\pi - \pi^*)^2 + \lambda\big(\chi y_1 + (1 - \chi)y_2\big)^2, \tag{2}$$

where χ and $(1 - \chi)$ denote the relative economic weight of country 1 and country 2, respectively. In what follows, we will focus on the two-country case for simplicity.

In order to derive a benchmark for actual decision-making, we solve a standard social planner's optimization problem. The planner sets inflation by minimizing (2) with respect to π, taking into account (1). Under rational expectations the expected welfare (loss) under a first-best policy is

$$EL^*(\pi_{FB}, y_{1_{FB}}, y_{2_{FB}}) = \frac{\lambda(\chi^2\sigma_{\theta_1}^2 + (1 - \chi)^2\sigma_{\theta_2}^2 + 2\chi(1 - \chi)\varphi_{\theta_1,\theta_2}\sigma_{\theta_1}\sigma_{\theta_2})}{1 + \lambda},$$

where π_{FB}, $y_{1_{FB}}$, and $y_{2_{FB}}$ mark the equilibrium outcomes in the first best and $\varphi_{\theta_1,\theta_2}$ is the coefficient of correlation (and $\varphi_{\theta_1,\theta_2}\sigma_{\theta_1}\sigma_{\theta_2}$ the covariance) between economic shocks in countries 1 and 2. The covariance term appears in EL^* because, while the central bank "leans against the wind" with its stabilization policy, it never fully compensates economic shocks in either country as long as the relative weight of the real term in the underlying loss function L^* is not infinitely high.

3.2 Actual decision-making

The purely union-wide perspective employed to derive the benchmark solution might not be a good description of actual decision-making in a federal central bank. While, for instance, the ECB (1999, p. 55) rightfully stresses that "members of the [Council] do not act as national representatives, but in a fully independent personal capacity," there is reason to assume that national economic considerations play at least some role in the voting behavior of governors in the Council.[9] This is supported by evidence of national (or regional) influences in other federal central bank systems. Berger and de Haan (2002) show that regional differences in growth and inflation influenced voting behavior in the pre-1999 Bundesbank Council; Meade and Sheets (2002) find that Federal Reserve FOMC members do take into account developments in regional unemployment when deciding monetary policy; and Heinemann and Huefner (2004) and Meade and Sheets (2002) argue that there might even be indications of regional voting behavior in actual ECB policy.

A simple, yet plausible, description of actual decision-making within the common central bank is a weighted voting approach or a form of Nash-bargaining in which voting weights are the fall-back positions.[10] In this case, decisions will be based on a loss function of the form

$$L_A = \sum \alpha_i L_i, \tag{3}$$

where α_i denotes the political weight of country i's representative or governor in the Council, with $\sum \alpha_i = 1$. In other words, the loss function underlying actual central bank decisions

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[9]This assumption is fairly wide-spread in the academic literature. See, among others, the contributions by von Hagen and Süppel (1994), Lindner (2000), Aksoy et al. (2002), Gros and Hefeker (2002), Hefeker (2003), Gersbach and Pachl (2004), and Frey (2005).

[10]This representation of decision-making abstracts from possible strategic interaction between Council members. For an analysis of coalition forming in the Council in light of EMU enlargement see, for instance, Baldwin et al. (2001).

is seen as a weighted sum of the individual loss functions of the member countries, L_i, where the political weights can differ from the economic weights, that is, $\alpha_i \gtreqless \chi_i$.

The description of decision making abstracts, without loss of generality, from the role of the Board. Board members may share the regional perspective of the country representatives in the Council or the perspective of the social planner. In both cases, however, the analysis of possible deviations of ECB behavior from the Maastricht norm should focus on the behavior of national representatives as described in (3).[11]

But how will national representatives act in the Council? As already discussed, we assume that they base their decisions on a loss function thought to measure country i's welfare:

$$L_i = (\pi - \pi_i^*)^2 + \lambda y_i^2, \tag{4}$$

where π_i^* is the national target level for inflation, y_i is the national output gap, and $0 < \lambda < \infty$ is the relative weight of the output target.

The loss function specified in (4) incorporates elements in line with the social planner's benchmark as well as idiosyncratic national motives. As in (2), the loss function of country i includes a real target compatible with the level of natural output (i.e., there is no inflation bias), and we assume that the relative weight of the real argument in (4), λ, is the same as in the first-best benchmark. But national central bank governors deviate from the benchmark in two crucial areas. First, governors focus on the level of the output gap in country i. Second, national inflation targets may be subject to idiosyncratic shocks.

In particular, following the approach by Faust and Svensson (2001), we introduce preference uncertainty at the national level by defining the national inflation target as

$$\pi_i^* = \pi^* + \varepsilon_i; \quad \varepsilon_i \sim \left(0, \sigma_{\varepsilon_i}^2\right). \tag{5}$$

Equation (5) states that country i's inflation target might deviate from the assumed benchmark value, π^*, by a country-specific preference shock ε_i with zero mean and known variance $\sigma_{\varepsilon_i}^2$. We will argue below that, while targeted inflation is not the only modeling choice for the discord between different national Council members, it is a very plausible one. Moreover, our results do not depend on introducing preference uncertainty through the inflation target. Allowing the output target to fluctuate around zero at the national level produces similar results. And the same holds, broadly speaking, for uncertainty regarding the relative weight of the real and nominal targets in (4).[12]

Preference uncertainty in the form of shocks to the national inflation target can occur for various reasons. One interpretation is shifts in the way the central bank aggregates heterogeneous preferences in the society at large into policy targets (Faust and Svensson 2001).[13] Bullard and Waller (2004) argue that changing preferences concerning inflation might reflect random changes in the political dominance of agents losing or gaining from high inflation. Finally, Hibbs (1977), Alesina (1987), and Alesina and Rosenthal (1995) argue that policymakers have different objective functions, so that shocks to the composition of government can lead to unexpected changes in national inflation preferences.

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[11]The EU Treaty specifies that the Board is appointed by "common accord" at the European government level (EU 1997, Article 112 2. (b)). Arguably, this selects Board members with a euro area-wide perspective. See also Frey (2005).

[12]The working paper version of the present paper (Berger and Mueller 2004, Sect. 5) provides a formal discussion of relative output weight shocks following Beetsma and Jensen (1998).

[13]It can be argued that, at the European level, this aggregation was organized at the constitutional stage, resulting in a time-invariant target level of π^*.

To compute actual central bank policy in the two-country case, we substitute (4) into (3) to get

$$L_A = \alpha\big((\pi - \pi_1^*)^2 + \lambda y_1^2\big) + (1 - \alpha)\big((\pi - \pi_2^*)^2 + \lambda y_2^2\big). \tag{6}$$

Minimizing (6) with regard to inflation while taking into account (1) and assuming rational expectations yields the following actual equilibrium values for inflation and output:

$$\pi = \pi^* + \frac{1}{1+\lambda}\big[\alpha\varepsilon_1 + (1-\alpha)\varepsilon_2 - \lambda\big(\alpha\theta_1 + (1-\alpha)\theta_2\big)\big] \equiv \pi_A,$$

$$y_1 = \frac{1}{1+\lambda}\big[\alpha\varepsilon_1 + (1-\alpha)\varepsilon_2 - \lambda(1-\alpha)\theta_2 + \big(1+\lambda(1-\alpha)\big)\theta_1\big] \equiv y_{1_A},$$

$$y_2 = \frac{1}{1+\lambda}\big[\alpha\varepsilon_1 + (1-\alpha)\varepsilon_2 - \lambda\alpha\theta_1 + (1+\lambda\alpha)\theta_2\big] \equiv y_{2_A}.$$

4 Optimal representation

Substituting π_A, y_{1_A}, and y_{2_A} in (2) and taking expectations, we can compute the expected welfare loss associated with the actual monetary policy, $EL^*(\pi_A, y_{1_A}, y_{2_A})$. The optimal representation of country 1, α^*, is then

$$\alpha^* \Leftrightarrow \arg\min EL^*(\pi_A, y_{1_A}, y_{2_A}).$$

Country 2's optimal weight is, equivalently, $1 - \alpha^*$.

The optimal weight of country 1 in the general case depends not only on the weight of the real argument in the loss function, λ, and the economic weight, χ, but also on both countries' economic and preference shocks and their possible interaction terms (see Berger and Mueller 2004). In the next section we will take a closer look at what defines optimal representation, with a focus on its relation to a country's economic weight. To facilitate the analysis, we will start with the assumption that all shocks are independent.

4.1 The baseline case with independent shocks

Assuming that $\varphi_{\varepsilon_1,\varepsilon_2} = \varphi_{\theta_1,\theta_2} = \varphi_{\varepsilon_i,\theta_i} = \varphi_{\varepsilon_i,\theta_{\neq i}} = 0$ for $i = 1, 2$, the optimal weight of country 1 is

$$\alpha^* = \frac{\sigma_{\varepsilon_2}^2 + \chi\lambda^2(\sigma_{\theta_1}^2 + \sigma_{\theta_2}^2)}{\sigma_{\varepsilon_1}^2 + \sigma_{\varepsilon_2}^2 + \lambda^2(\sigma_{\theta_1}^2 + \sigma_{\theta_2}^2)}, \tag{7}$$

which obviously satisfies $0 < \alpha^* < 1$ because $\chi < 1$ and $\sigma_{\varepsilon_1}^2 > 0$.

4.1.1 Over- and under-representation

Equation (7) has a straightforward implication for the relation between economic size and a country's optimal voting weight. In particular, we find that

$$\alpha^* \gtreqless \chi \Leftrightarrow \chi\sigma_{\varepsilon_1}^2 \lesseqgtr (1 - \chi)\sigma_{\varepsilon_2}^2. \tag{8}$$

Broadly speaking, (8) states that over-representation in the Council in relation to a country's economic size is more likely to be optimal for smaller countries with relatively stable
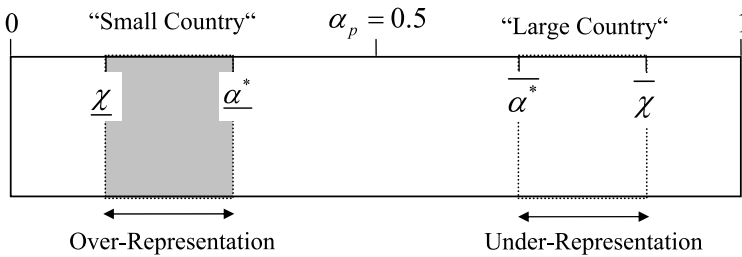
Fig. 1 Optimal representation

preferences. Under-representation, on the other hand, is more likely to be optimal for larger countries with relatively volatile preferences. This becomes even clearer if we rewrite (8) to highlight the tension between economic size and relative preference stability:

$$\alpha^* \gtreqqless \chi \Leftrightarrow \chi \lesseqqgtr \frac{\sigma_{\varepsilon_2}^2}{\sigma_{\varepsilon 1}^2 + \sigma_{\varepsilon 2}^2} \equiv \alpha_P. \tag{9}$$

Obviously, over-representation is optimal if a country's share in the currency union's GDP is lower than a critical threshold value, α_P, measuring the other country's relative contribution to overall preference volatility. Vice versa, under-representation is optimal when a country is large relative to the other currency union member's contribution to preference volatility.

The threshold value α_P has an interesting interpretation. Note that according to (7) and (9), $\alpha^* \to \alpha_P$ as $\sigma_{\theta_1}^2, \sigma_{\theta_2}^2 \to 0$, that is, α_P can be interpreted as the optimal political voting weight that results purely from trading off differences in the volatility of preferences between countries in the absence of economic shocks.

Equivalently, in the absence of preference shocks, the optimal political weight, α^*, converges with a country's relative economic weight, χ, which, according to (2), is the weight it should receive under the first-best scenario: $\alpha^* \to \chi$ as $\sigma_{\varepsilon 1}^2, \sigma_{\varepsilon 2}^2 \to 0$.

This suggests the following general observation.

Remark 1 Optimal representation balances two forces: the wish to reduce the impact of preference shocks on monetary policy (by bringing α^* as close as possible to α_P), and the attempt to limit misrepresentation of a country's relative economic size to avoid an overly active or passive reaction to national economic shocks (by keeping α^* as closely as possible to χ).

As a consequence, a country's optimal representation in the Council, α^*, will always be in an interval defined by χ on the one hand and α_P on the other. Figure 1 illustrates two possible scenarios, depicting a small country with a relative size $\underline{\chi} < 1/2$ and a large country with relative size $\overline{\chi} > 1/2$, respectively, assuming that both countries have preference shocks of similar volatility ($\alpha_P = 1/2$). Under these assumptions, in the large-country case the optimal weight $\bar{\alpha}^*$ will be located to the left of $\overline{\chi}$ and to the right of α_P, indicating optimal under-representation. In the small-country case, the optimal weight $\underline{\alpha}^*$ will be located to the right of $\underline{\chi}$ and to the left of α_P, which suggests optimal over-representation. Thus, whether a country should be over- or under-represented depends on the relative size of the country and the characteristics of both countries' preference shocks.
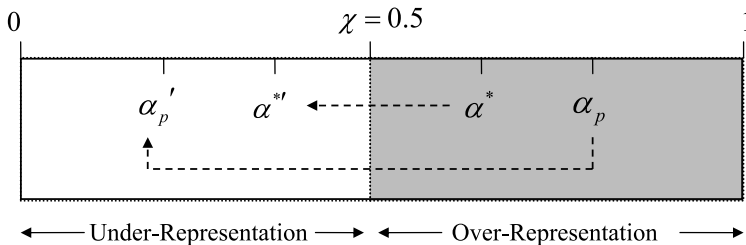
Fig. 2 Mis-representation among equals

Intuitively, we would expect small countries to be optimally over-represented and large countries to be under-represented, but this is not necessarily the case. However, the intuitive scenario is the outcome if preferences are similar across the currency union:[14]

Remark 2 If preference shocks were sufficiently similar, it would always be optimal to over-represent small countries and to under-represent large countries.

On the other hand, if differences in preference shocks are stark, there is room for a counterintuitive result:

Remark 3 Under-representation of a small country can be optimal if its inflation preferences are relatively volatile. By the same token, over-representation of a large country can be optimal if its inflation preferences are stable in comparison. Size continues to be important, however, as these outcomes are less likely for very small or very large countries, respectively.

Proof Equation (9) requires $\chi < \sigma_{\varepsilon_2}^2/(\sigma_{\varepsilon 1}^2 + \sigma_{\varepsilon_2}^2)$ for $\alpha^* > \chi$. Thus, a large country with $\chi > 1/2$ can only be over-represented if $\sigma_{\varepsilon 1}^2 < \sigma_{\varepsilon_2}^2$. By the same logic, $\alpha^* < \chi$ requires $\sigma_{\varepsilon 1}^2 > \sigma_{\varepsilon_2}^2$ for a small country with $\chi < 1/2$. The inequalities for over- and under-representation are both more likely to be fulfilled if $|\chi - 1/2| \to 0$.   □

The above analysis suggests that the counterintuitive case of, for instance, a large country being over-represented, is most relevant when the actual overall difference in country sizes within the union is small. In the extreme case of a monetary union of economic equals, asymmetry in representation would always be optimal if there were asymmetries in preference shocks.

Figure 2 illustrates the result for $\chi = 1/2$ and the case of a country seeing the relative stability of its inflation preferences decline. As its preferences become relatively more volatile, with the ratio $\sigma_{\varepsilon_2}^2/(\sigma_{\varepsilon 1}^2 + \sigma_{\varepsilon_2}^2)$ declining from a value $\alpha_P > 1/2$ to $\alpha'_p < 1/2$, its optimal representation in the joint central bank Council declines from over-representation (α^*) to under-representation ($\alpha^{*\prime}$).

Finally, (8) sheds light on the "one country, one vote" principle featured so prominently in the debate on ECB reform. It shows that:

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[14]Equation (8) reduces to $\alpha^* \gtreqless \chi \Leftrightarrow \chi \lesseqgtr (1 - \chi)$ when $\sigma_{\varepsilon_1}^2 = \sigma_{\varepsilon_2}^2$. Obviously, similar outcomes can be found for asymmetrical preference shocks as long as the differences in preferences remain small compared to the differences in economic size.

Remark 4 In the absence of economic shocks and if preference shocks are symmetrical, optimal representation in the Council follows the "one country, one vote" principle no matter the distribution of economic size.

While this does not quite rule out "one country, one vote", it marks it as a rather special case: (7) and (9) imply $\alpha^* = 1 - \alpha^* = \alpha_P = 1/2$ when economic shocks are absent (i.e. $\sigma_{\theta_1}^2, \sigma_{\theta_2}^2 = 0$) *and* when preference shocks are perfectly symmetrical $\sigma_{\varepsilon 1}^2 = \sigma_{\varepsilon 2}^2$.

4.1.2 Comparative statics

How does optimal representation change with the characteristics of economic and preference shocks? As one would expect, inspection of (7) reveals a clear-cut relation between representation and preference stability.

Remark 5 An increase in the volatility of preference shocks reduces the optimal weight a country should receive in the Council.

The finding is independent of the initial degree of over- or under-representation. In contrast, the impact of a marginal increase in economic volatility depends on a country's initial status.

Remark 6 An increase in economic volatility in a country reduces the gap between economic weight and optimal representation. Over-represented countries will see their optimal voting weight reduced, while under-represented countries will see their optimal voting right increased.

Proof Taking the partial derivative of (7) and rearranging yields $\partial \alpha^* / \partial \sigma_{\theta_1} \gtreqless 0 \Leftrightarrow \chi \sigma_{\varepsilon 1}^2 \gtreqless (1 - \chi) \sigma_{\varepsilon 2}^2$, which, by (8), implies the result.   □

For given country size, neglecting economic shocks in favor of moderating preference shocks becomes more expensive (in welfare terms) as economic volatility increases.

4.2 Integration and optimal representation

It is often argued that a common currency leads to more aligned business cycles, including through increasing trade intensities and the absence of the exchange rate mechanism, but a currency union might also bring about closer integration in the political sphere. The question is whether integration along these lines will change the trade off underlying optimal representation.[15]

A first insight is that the baseline results on optimal representation hardly change when we allow for either cross-country correlation of economic shocks ($\varphi_{\theta_1,\theta_2} \neq 0$) or cross-country correlation of preference shocks ($\varphi_{\varepsilon_1,\varepsilon_2} \neq 0$). It is straightforward to show that the baseline results discussed above generalize to these cases (see Berger and Mueller 2004).

A second finding can be summarized as follows:

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[15]The formal details for the results summarized in this section are provided in Berger and Mueller (2004).

Remark 7 Integration has opposing effects on optimal representation. As economic shocks become more similar, size matters less, and countries with relatively stable preferences are likely to see their optimal voting weight increase. On the other hand, with more similar preference shocks, economically large countries are likely to see their optimal voting weight increase and small countries are likely to see their optimal voting weights decrease.

The rationale is—in line with the discussion of (9) earlier—that increased business cycle synchronization reduces the cost of moderating the impact of preference shocks on monetary policy. Similarly, greater likeness of preference shocks reduces the potential gains from moderating these shocks by letting optimal voting weights deviate from economic size. As a consequence, the overall impact of increasing integration on optimal representation is ambiguous.[16] There is, in other words, no natural argument why a federal central bank that was founded on the "one country, one vote" principle should eventually converge to representation based on economic size alone or vice versa.

4.3 Correlation between economic and preference shocks

If preference shocks are, at least in part, a consequence of changes in government, and if changes in government are influenced by economic conditions, preference and economic shocks might not be independent. In fact, there is room for something akin to a "political business cycle". For instance, one can imagine that voters elect a government that is more tolerant to inflation when economic activity is in decline, giving rise to a negative correlation between economic and preference shocks.[17]

As with cross-country correlations, allowing preference shocks to be correlated with economic shocks within country 1 (i.e., $\varphi_{\varepsilon_1,\theta_1} \neq 0$) changes optimal representation and the conditions for over- or under-representations compared to the baseline—albeit not fundamentally. Interestingly, however, under certain conditions a strong political business cycle in the sense just discussed might make it optimal to decrease a country's voting weight below its relative economic size.

Remark 8 A negative correlation between preference and economic shocks (a "political business cycle") amplifies country 1's policy demands after economic shocks—making optimal under-representation more likely.

The rationale behind this finding is that a negative correlation of output and preference shocks in country 1 increases the cost of over-representing a country in the Council. To see this, note that the preferred inflation rate of country 1 is:

$$\pi_1 = \frac{1}{1+\lambda}(\pi^* + \varepsilon_1) + \frac{\lambda}{1+\lambda}(\pi^e - \theta_1).$$

Over-representation of country 1 would mean that, for instance, a negative shock to the output gap ($\theta_1 < 0$) would trigger a too expansionary monetary policy at the union level, as country 1's preferred policy reaction ($-\theta_1\lambda/(1+\lambda) > 0$) would receive greater influence on Council decisions than suggested by its economic weight. This policy request would be

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further amplified if country 1 is, in addition, subject to an inflation preference shock pointed in the opposite direction as the output shock ($\varepsilon_1 > 0$ in this example), increasing the distance to the first-best policy.

5 Concluding remarks

We present a simple model of optimal representation in a federal central bank in which optimal voting weights reflect two opposing forces: the wish to insulate common monetary policy from changing preferences at the national level, and the attempt to avoid an overly active or passive reaction to idiosyncratic national economic shocks.

An important result is that a perfect match between economic size and voting rights is rarely optimal, and neither is the "one country, one vote principle". Whether a country should be over- or under-represented compared to its relative economic size depends on a number of forces, including relative size, the relative weight of the real target, and the stochastic properties of economic and preference shocks. For instance, it might be optimal to over-represent a large country if its policy preferences are very stable relative to other union members. Deepening integration in the sense of more similar economic and preference shocks has an ambiguous effect on optimal representation. The existence of a link between economic and preference shocks within a country (a "political business cycle") tends to reduce the optimal country weight.

Empirically, there are indications that misrepresentation of member countries in the ECB Council might be too extreme and hard to reconcile with the theoretical arguments made above. This gap that is destined to increase further despite recent ECB reform efforts after euro area enlargement. At the same time, the prevailing pattern of political stability within current and future euro area member countries does suggest that small countries are not significantly more politically stable than larger member countries (see Berger and Mueller 2004). This suggests further room for discussion of the representation of economic size in the ECB's Governing Council.

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