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Monetary Committee Size and Special Interest Influence

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Abstract

In this paper we view monetary policy as the equilibrium outcome of a game between a central bank's monetary policy committee (MPC) and two special interest groups (a financial sector and a political sector) who attempt to bias policy in their favor by offering contribution schedules contingent on policy outcomes, which is a standard approach to model influence, and has also been considered in monetary policy studies by other scholars. Under this framework, we show that equilibrium inflation rate and output are an average of the ones preferred by the committee and the special interest groups; thus, size of a monetary committee may play a role in the design of independent central banks (i.e. banks isolated from political pressures). The reason is that special interest group's weights on equilibrium inflation rate under influence is lower the higher the size of the committee. We test the following implications of the model: i) societies with a higher concern on a low and stable inflation rate will appoint a larger committee; ii) larger committees deliver lower and more stable inflation rates.

Keywords: Monetary Policy Committees, Special Interest Politics, Inflation, Welfare.
JEL Classification: E58-D71-D78

1 Introduction

In this paper we offer a novel motivation for committee decision making in monetary policy: a committee can improve social welfare by making monetary policy more independent from the pressure of interest groups. We do this by studying a game between members of a monetary policy committee (MPC) and lobbies. Lobbies attempt to bias policy in their favor by offering each MPC member a contribution schedule, contingent on inflation proposals. In line with several studies on central bank independence, a central premise in this paper is that interests as well as institutions matter in monetary policy choices. Monetary policy is affected by both central bank's own preferences and the current institutional framework (which places a constraint on the set of feasible policies), but it is also influenced by interest groups.

We show that equilibrium inflation rate and output are the same as the ones chosen by a single central banker who averages preferences of lobbies and MPC members. This result allows us to revisit and extend Rogoff's (1985) seminal argument in favor of the appointment of a conservative central banker to the more realistic case of committee policymaking under the influence of lobbies. In particular, an implication of our model is that a society may be better off appointing a committee with conservative members (rather than a single conservative central banker).

Several authors have stressed that special interest groups exert considerable influence on monetary policy outcomes. Also, there exists a considerable body of literature which models this influence and studies its consequences on central bank independence.

Gabillon and Martimort (2004) analyze the impact of granting independence to a central banker who is subject to the influence of elected politicians and of interest groups attempting to bias policy in their favor. They conclude that independence increases delegation costs but also stabilizes political business cycles, improving welfare. They view the financial sector as a powerful anti-inflationist group, because its profits come from borrowing short and lending long, and thus, it is hurt by surprise inflation.

Posen (1995) constructs a measure of central bank independence and of financial sector's opposition to inflation, and finds that financial sector's opposition to inflation is a good predictor of central bank independence and inflation. This result suggests that the financial sector's influence on monetary policy decisions is effective. In a later paper he suggests that the modern generations of central bankers are characterized by great politicization and may be unable to constrain the destabilizing behavior of politicians and financiers (Posen, 2004). He also argues that the financial sector, which benefits from low and stable inflation, politically supports central bank independence, and suggests that in the long run, the possibility of endogenous institutional change should also be taken into account when explaining monetary policy decisions, because in heterogeneous societies, a particular monetary policy decision comes at some group's expense, weakening political support for a certain monetary regime or institution.

Eijffinger and De Haan (1996) also argue that another important determinant of central-bank independence is public's opposition to inflation, which may arise after extremely high inflation or even hyperinflation episodes. For example, Lohmann (2006) observes that in developed countries, older people may become a group particularly sensible to monetary policy decisions, as long as they hold assets denominated in nominal currency and not indexed by inflation. She refers to a special interest gridlock resulting from the high social costs of reneging on the promises made to older people, which will constitute a powerful voting bloc. Supporting the argument, she mentions that the American Association of Retired Persons is one of the most powerful lobbies in Washington D. C. This power translates into a desire of politicians with reelection prospects to exert influence on monetary authorities, which is closely related to the time inconsistency problem: a discretionary central bank would be under political pressure to boost output and employment, only to create higher inflation in the long run, because output cannot exceed its potential (Kydland and Prescott, 1977; Barro and Gordon, 1983b,a). Solutions to this problem are at the root of the recent reforms undertaken by several banks around the world (Crowe and Meade, 2007).

Dixit and Jensen (2003) and Ruta (2008) extend the common agency model of Bernheim and Whinston (1986) and Grossman and Helpman (1994) to include agent's expectations of future monetary policy, in order to model monetary policymaking in a monetary union where members influence the policy of the common central bank through incentive schemes. They show that political influence on the common central bank is relatively harmless. This is due to the properties of the equilibrium contribution schedules, which resemble the principals' utility functions. The authors call these equilibrium contingent schedules *compensating*, because changes in the reward due to a change in the elected policy by the agent are exactly compensated by a change in the utility function of the principal. When these contributions are all that matters to the common agent, the equilibrium monetary policy is a weighted average of the most preferred policies of the members of the union. In their words, "when politicization is 'maximal', policy outcomes turn out to be Pareto efficient."

In the present paper we generalize the common agency approaches to monetary policymaking of Dixit and Jensen (2003) and Ruta (2008) modeling political and financial sector's influence as a contribution game between multiple principals and multiple agents, using the theoretical framework of Prat and Rustichini (2003), which is an extension of the common agency games in Bernheim and Whinston (1986) and Dixit et al. (1997). This framework allows us to show that: if MPC's decision mechanism can be considered as averaging proposals of each committee member, and each committee member is effectively influenced by interest groups when making her proposal, then equilibrium policies are a simple average of preferred policies of interest groups and of each member of the monetary policy committee. As a consequence, larger and homogeneous committees are more isolated from the influence of the interest groups, because their preferred policy has a larger weight on the equilibrium one.

A suggestive example is United Kingdom's central bank, the Bank of England. Prior to 1998 (since 1993) interest rate decisions were made solely by Eddie George (the governor), and prior to that, monetary policy was determined directly by the Chancellor of the Exchequer. It may be the case that during 1993-1998, the bank transitioned from a politicized regime in which governor implemented the orders of the chancellor, to an independent one. Laws granting legal independence came into force in 1993, but real independence was enhanced with the introduction of MPC decision making in 1998.

In the next section we describe the general setup and we find the equilibrium policy chosen by a single benevolent central banker who shares the preferences of society and decides monetary policy discretionally and without the influence of interest groups (our benchmark); in section 3 we characterize the equilibrium policy that arises when L exogenously determined lobbies offer simultaneously and non-cooperatively contingent contributions to each member of a monetary policy committee, and we derive testable predictions of the model. In section 4 we present empirical findings. We conclude in section 5. Proofs are relegated to the appendix.

2 MODEL

Monetary policy is determined by a monetary policy committee (MPC) comprised of $N \geq 2$ members. There are also L interest groups (lobbies), who attempt to influence the MPC decision by offering a contribution schedule to each member of the MPC. We let L and N denote both the sets and cardinality. Finally, there is another group, named *society*. We assume that the size of each lobby is negligible relative to the size of society who is unable to get politically organized.

Every actor in this economy (members of the MPC, lobbies and society) prefers price and output stability. The MPC sets the policy instrument in order to stabilize the economy when it is hit by a stochastic shock that moves it away from a desired target. Thus, we propose the following general loss function (gross of contributions) for agent i (an MPC member, a lobby, or society), which is standard in the academic literature on monetary policy:

$$L_i = \frac{1}{2}\left[\left(\pi - \pi_i\right)^2 + b_i\left(y - y_i\right)^2\right],$$

where $\pi - \pi_i$ denotes deviations of inflation (π) around preferred target level π_i, y denotes deviation of real output from potential output around preferred target levels y_i. We let $y_i \geq 0$. Preference parameter b_i is a relative weight that the agent i places on output stabilization. A strictly positive value for y_i reflects the desire to stabilize output above the equilibrium level, which leads to the well known inflation bias: a discretional central bank would be under political pressure to boost the economy and increase employment; however, rational agents anticipate that in spite of an expansionary policy, output cannot exceed its potential value; this kind of policy would only lead to higher inflation (Barro and Gordon, 1983b,a; Kydland and Prescott, 1977). Solutions to the problem are delegating monetary policy to individuals with a high degree of inflation aversion (Rogoff, 1985) or giving incentives to the central banker to control inflation (Walsh, 1995). Recent reforms to central bank governance seem to be an effort of countries to put into practice these proposals. Crowe and Meade (2007) survey and quantify these trends, with a particular focus on independence and transparency.

Utility for member n of the MPC is

$$W_n = \sum_{l \in L} C_{l,n} - L_n .$$

where L_n is member n's loss function and $C_{l,n}$ is a monetary contribution that lobby l gives to member n. Contributions are offered simultaneously and non cooperatively. An objective function that is linear in monetary contributions is also used by Walsh (1995), who considers a principal-agent relation between the government and a central banker, by Gabillon and Martimort (2004), who study the relation between central bank's independence and the influence of private interest groups, by Dixit and Jensen (2003) and Ruta (2008), who view policy in a monetary union as the equilibrium result of a common agency game in which several principals –national governments– exert political pressures (i.e. offer incentive contracts) to a central banker –the common agent, and by Hefeker and Zimmer (2010) and Eijffinger and Hoeberichts (2008), who consider a central bank that faces pressures from the government.

Utility for lobby l is

$$W_l = -L_l - \sum_{n \in N} C_{l,n} ,$$

where $\sum_{n\in N} C_{l,n}$ is the total contribution paid by lobby *l*.

We define the following general measure of aggregate social loss:

$$L_S = \frac{1}{2}\left[\left(\pi-\pi_S\right)^2 + b_S\left(y-y_S\right)^2\right].$$

Output is determined by an expectations augmented Phillips curve:

$$y = \pi - \pi^e + s,$$

where π^e is rationally expected inflation rate and s is a random shock with distribution function F, mean $E(s)=0$ and variance $E(s^2)=\sigma^2$. We assume that the policy instrument (interest rate or the rate of growth of money supply) controls the inflation rate perfectly; that is, we abstract from errors in the policy transmission mechanism, so we can consider π to be directly the policy instrument.

The output shock s is only observed by the committee, so policy can be made contingent on the value of the shock, but lobbies and society cannot use the shock to form inflation expectations. It follows that rationally expected inflation rate is

$$\pi^e = E\left[\pi(s)\right] = \int \pi(s)\,dF(s).$$

MPC uses a weighting rule to aggregate individual proposals. That is, if $(\pi_n)_{n\in N}$ is a proposal profile, the inflation rate chosen by the MPC is $z = \sum_{n=1}^{N} \eta_n \pi_n$, where η_n are positive weights such that $\sum_{n=1}^{N} \eta_n = 1$.

2.1 Benchmark

As a benchmark, we consider the case in which monetary policy is decided by a single central banker who shares the preferences of society and decides monetary policy discretionally and without the influence of interest groups. The policymaker solves

$$\min_{\pi,y} \frac{1}{2}\left[\left(\pi-\pi_S\right)^2 + b_S\left(y-y_S\right)^2\right]$$

s. t.

$$y = \pi - \pi^e + s \quad \text{given } \pi^e.$$

The following lemma characterizes our benchmark case.

Lemma 1

i) Inflation and output are respectively

$$\pi^B = \pi_S + b_S y_S - \frac{b_S}{1+b_S}s,$$

and

$$y^B = \frac{s}{1+b_S};$$

ii) Inflation bias, inflation variance, output variance and expected social loss are respectively

(1) $$bias_B = b_S y_S \ ,$$

(2) $$VAR\left(\pi^B\right) = \left(\frac{b_S}{1+b_S}\right)^2 \sigma^2,$$

(3) $$VAR\left(y^*\right) = \left(\frac{1}{1+b_S}\right)^2 \sigma^2,$$

and

(4) $$EL_S = \frac{1}{2}\left[bias_B^2 + VAR\left(\pi^B\right) + b_S VAR\left(y^B\right) + b_S y_S^2\right] .$$

Note that $E\left(y^B\right)=0$ and $E\left(\pi^B\right)=\pi_S + b_S y_S$; on an expected basis, inflation is higher than the target, but expected output is at the equilibrium level. This is the familiar inflation bias, which arises when the monetary authority is unable to commit to a rule and chooses to boost output above the potential (Barro and Gordon, 1983b, a; Kydland and Prescott, 1977).

Expected loss rises with inflation bias, with inflation variance and with output variance. The coefficient b_s measures the relative importance that society gives to the effect of output variability on welfare. Expected welfare rises with reductions in inflation bias, and in variability of inflation and output; that is, society benefits from a low and stable inflation and from a stable output. Indeed, if $y_s = 0$ (if society does not care about keeping output above the potential) we get the more intuitive expression

$$EL_s = \frac{1}{2}\left[VAR(\pi) + b_s VAR(y)\right].$$

2.2 The model with lobby pressure

We focus now on a non-cooperative game in which in the first stage, L exogenously determined lobbies offer simultaneously and non-cooperatively contingent contributions to each MPC member. Prat and Rustichini (2003) introduce this kind of games and characterize contributions and agents' choices in equilibrium.

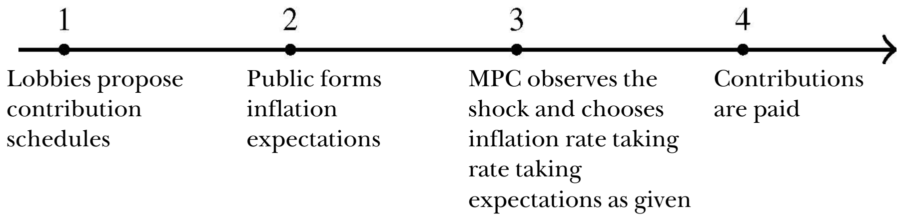
There is a set L of principals (lobbies) and a set N of agents (committee members), with l and n their typical elements. We also denote their cardinality with L and N. The extensive form game is as follows: In the first stage, principals move simultaneously and non-cooperatively, choosing a contribution schedule, *contingent on agent n's proposal*,[1] to be offered to each agent. In the second

[1] We follow Prat and Rustichini (2003) in considering action-contingent contracts. With outcome-contingent contracts, Theorem 1 in Prat and Rustichini (2003) –which is used to prove the main proposition of this paper– does not hold. Outcome contingent contracts would specify a contribution schedule contingent on the value of the inflation rate chosen by the committee. With action-contingent contracts, the incentive compatibility condition that characterizes an equilibrium policy can be written in a simple form, because lobby l knows exactly how much money it takes to convince committee member n to deviate from equilibrium proposal π_n. But with outcome-contingent contracts, whatever committee member n expects other committee members to propose must also be taken into

stage, agents move simultaneously, choosing an action $\pi_n \in \mathbb{R}$ (the inflation proposal of agent *n*). The final outcome $z \in \mathbb{R}$ (committee's choice of the inflation rate) is given by the weighting rule *f* defined above. Thus, f: $\mathbb{R}^N \to \mathbb{R}$ maps each action profile $(\pi_l,\ldots,\pi_N)$ to a value in $\mathbb{R}$.

Figure 1

Timing of the game



We let $C_{1,n}(\pi_n) \geq 0$ denote the contribution of principal l to agent n conditional on n's proposal being π_n. Committee member n receives a reward only for her proposal, but she may receive rewards from more than a principal. For tractability, we assume that contribution schedules are differentiable. [2]

Definition 1

A contribution schedule offered by principal l to agent n is a differentiable function $C_{l,n}: \mathbb{R} \to \mathbb{R}_+$ that assigns a monetary contribution to each inflation proposal of committee member n, $\pi_n \in \mathbb{R}$.

We let B denote the set of differentiable real functions. The strategy set of principal l is B, and a strategy for l is an element of B. A strategy for agent n is a mapping $\sigma_n : B^L \to \mathbb{R}$, that is, a strategy for agent n specifies an inflation proposal π_n for each L–tuple of contribution schedules $(C_{l,n})_{l \in L} \in B^L$.

$L_i(z)$ denotes the loss function gross of contributions for decision maker i (principal or agent), when inflation outcome is z. For notational brevity, we omit preference parameters π_i^*, b_i and y_i^*. We also omit inflation expectations π^e and supply shock s, which also enter in the loss function but are taken as given by committee members.

An equilibrium with lobby pressure is a sub-game perfect equilibrium of the two stage game. Formally,

Definition 2

An equilibrium with lobby pressure is a pair $(\hat{C},\hat{\sigma})$, where

account when writing the incentive compatibility condition. As far as we know, no characterization of the equilibrium outcomes of the game is available. In their model of lobbying and fiscal federalism, Bordignon et al. (2008) assume action-contingent contracts for the same reason.

[2] This assumption is also made by Fredriksson and Millimet (2007) in a model in which firms and environmentalists lobby the legislatures to get a favorable pollution taxation policy, and by Damania and Fredriksson (2007), in a model of lobbying and trade policy.

$$\hat{C} := \left(C_{l,n}\right)_{l\in L, n\in N}, \quad z \in \mathbb{R}$$

and

$$\hat{\sigma} := \left(\hat{\sigma}_n\right)_{n\in N},$$

such that:

1) for every $n \in$ N, and every $C \in B^L$, given $\left(\hat{\sigma}_j\right)_{j\neq n}$,

$$\hat{\sigma}_n \in \arg\max_{\pi_n} - L_n\left(f\left(\pi_n, \hat{\sigma}_{-n}\right)\right) + \sum_{l\in L} C_{l,n}\left(\pi_n\right)$$

2) for every $l \in$ L, given $\left(\hat{C}_k\right)_{k\neq l}, \hat{C}_l$ solves

$$\min_{C_l\in B} L_l\left(f\left(\hat{\sigma}\left(C_l, \hat{C}_{-l}\right)\right)\right) + \sum_{n\in N} C_{l,n}\left(\hat{\sigma}\left(C_l, \hat{C}_{-l}\right)\right).$$

2.3 Equilibrium with lobby pressure

The following proposition establishes that we can characterize the equilibrium policy under lobby pressure as the one chosen by a single central banker assigning relative weight β to output stabilization (which is the average of relative weights b_i of lobbies and committee members) and having preferred targets $\overline{\pi}$ (which is the average of preferred inflation targets of lobbies and committee members) and $\overline{y}$ (the weighted average of preferred output targets).

Proposition 1

If $\left(\pi^*, y^*\right)$ is an equilibrium policy under lobby pressure which entails positive contributions, then it solves

$$\min_{\pi,y} \frac{1}{2}\left[\left(\pi - \overline{\pi}\right)^2 + \beta\left(y - \overline{y}\right)^2\right]$$

s. t.

$$y = \pi - \pi^e + s, \text{ given } \pi^e$$

where

$$\beta = \frac{\sum_{i\in N\cup L} b_i}{L+N}, \; \overline{\pi} = \frac{\sum_{i\in N\cup L} \pi_i}{L+N}, \; \overline{y} = \sum_{i\in N\cup L} w_i y_i \quad \text{and} \quad w_i = \frac{b_i}{\sum_{j\in N\cup L} b_j}.$$

The intuition is the following. In the lineal-quadratic framework that is commonly used in the monetary policy literature, equilibrium policy results as a weighted average of the preferred policies of the actors that have a say in monetary policy, either because they are part of the MPC or because they are able to exert influence on the MPC.

3 Predictions

In this section we show the empirical predictions that can be obtained from the proposition above.

The following lemma gives an expression for inflation, output, inflation bias, inflation and output variance, and expected loss in an equilibrium with lobby pressure:

Lemma 2

i) Equilibrium inflation and output are respectively

$$\pi^{*} - \bar{\pi} + \beta\bar{y} - \frac{\beta}{1+\beta^{S}} ,$$

and

$$y^{*} = \frac{s}{1+\beta} ,$$

ii) Inflation bias, inflation variance, output variance and expected social loss are respectively

(5) $$bias^{*} = \beta\,\bar{y} ,$$

(6) $$VAR\left(\pi^{*}\right) = \left(\frac{\beta}{1+\beta}\right)^{2} \sigma^{2} ,$$

(7) $$VAR\left(y^{*}\right) = \left(\frac{1}{1+\beta}\right)^{2} \sigma^{2} ,$$

and

(8) $$EL_{L} = \frac{1}{2}\left[\left(\bar{\pi} + \beta\bar{y}\right)^{2} + \pi_{S}^{2} - 2\pi_{S}\beta\bar{y} - 2\bar{\pi}\pi_{S} + VAR\left(\pi^{*}\right)\right] + \frac{1}{2}b_{S}\left[VAR\left(y^{*}\right) + y_{S}^{2}\right] ,$$

where expressions for β, $\bar{\pi}$ and $\bar{y}$ have been established in proposition 1.

To study the relation between committee size on inflation and welfare, we consider identical committee members that is, we assume $b_n \equiv \tilde{b}_{MPC}, y_n \equiv y_{MPC}$ and $\pi_n \equiv \pi_{MPC}$ for all $n \in N$, and we denote with $\tilde{b}_L$ the average of relative weights across lobbies and $\tilde{b}$ denotes the average of committee members' and lobbies' weights: $\tilde{b}_L = \left(\sum_{l\in L} b_l\right) / L$ and $\tilde{b} = \left(\sum_{i\in N\cup L} b_i\right) / \left(L+N\right)$ This notation along with the assumption of identical committee members allows us to express β in the following weighted average form:

$$\beta = \left(\frac{N}{N+L}\right)\tilde{b}_{MPC} + \left(\frac{L}{N+L}\right)\tilde{b}_{L} .$$

Proposition 2

i) If lobbies' average preference parameter is lower than MPC's preference parameter, (that is, if $\tilde{b}_L < \tilde{b}_{MPC}$ then $\tilde{b}_L < \beta < \tilde{b}_{MPC}$) and if lobbies' average preference parameter is higher than MPC's preference parameter $\left(\tilde{b}_L > \tilde{b}_{MPC}\right)$ then $\tilde{b}_L > \beta > \tilde{b}_{MPC}$; ;

ii) β (N) converges to $\tilde{b}_{MPC}$ as N goes to infinity;

iii) if $\tilde{b}_{MPC} > \tilde{b}_L, \beta$ increases with *N*, and if $\tilde{b}_{MPC} < \tilde{b}_L, \beta$ decreases with *N*.

The intuition of part *i)* of proposition 2 is that the effect of contribution schedules given by the lobbies is to bias policy towards the one preferred by the average lobbyist; the implication of part *ii)* is that this policy bias is weaker the larger the monetary policy committee is.

Inflation variance increases with β, and output variance decreases with β; it follows from part *iii)* of proposition 2 that the effect of an additional committee member on inflation bias and stabilization is different whether $\tilde{b}_{MPC} < \tilde{b}$ .or $\tilde{b}_{MPC} > \tilde{b}$. If ˜ $\tilde{b}_{MPC} < \tilde{b}_L, \beta$ decreases with the size of the monetary policy committee, so inflation bias and inflation variability also decrease with a rise in the size of the monetary policy committee. Intuitively, larger monetary policy committees are more isolated from the pressure of lobbies, which on average put a higher weight on output stabilization objectives than the MPC. If $\tilde{b}_{MPC} > \tilde{b}$, the reverse reasoning goes through: more conservative lobbies will exert pressure on monetary authorities in order to make them deliver a lower and more stable inflation rate. This pressure is less effective the larger the monetary policy is.

The effect of a rise in the MPC size on society's expected welfare is ambiguous. If MPC is more conservative than the average lobby, then a larger MPC results in a lower and more stable inflation rate, but also in more output variability. Whether the first or the second effect dominates depends on the relative weight that society puts on output stabilization objectives (b_S).

In order to analyze with more detail the effect of a rise in the MPC size on society's expected welfare we assume that there are two lobbies. The first lobby is the financial sector (indexed with *F*), which is typically an anti-inflationist group. The second lobby is the political sector (indexed with *P*), who is more concerned about output and employment. Let $0 \leq b_F < b_P$ be the relative weights of respectively the financial lobby and the political lobby, so $\tilde{b}_L \equiv (b_F + b_P)/2$. Society and MPC members preferences $\left(b_s \text{ and } \tilde{b}_{MPC}\right)$ are somewhere between these two values. We also assume that society appoint a conservative committee, which seems to be the case in most countries that introduced legal reforms to enhance independence of central bankers in the last two decades. Then, preference parameters are ordered as follows:

$$b_F \leq \tilde{b}_{MPC} < b_S \leq b_P$$

Although a more elaborate analysis should allow for possible differences in preferred inflation and output targets, these values are difficult to observe, so we are going to assume that the only source of heterogeneity among the different actors is the relative weight put on output stabilization. Thus, we let $\pi_F = \pi_P = \pi_S = \pi_{MPC}$ and we define $y_L = y_P = y_S = y_{MPC} \equiv k$. Substitution in (8) leads to the following expression of social welfare evaluated in equilibrium policies:

$$EL_s = \psi(\beta) + b_s \phi(\beta).$$

Where $\psi(\beta) = \frac{1}{2}\left[(\beta k)^2 + VAR\left(\pi^*\right)\right]$ is expected loss due to a high and unstable inflation, and $\phi(\beta) = \frac{1}{2}\left[VAR\left(y^*\right) + k^2\right]$ is expected loss due to an unstable output. $\psi(\beta)$ rises with β and $\phi(\beta)$ diminishes with β

If $\tilde{b}_{MPC} < \tilde{b}_L$ (that is, MPC is more conservative than the average lobby) then by proposition 2, a larger MPC leads to a lower β, which in turn leads to a lower and stable inflation (a lower $\psi(\beta)$) but to higher output variability (a higher $\phi(\beta)$). At low values of b_S, the first effect would dominate over the second effect, so highly inflation averse societies would be better off appointing a larger MPC. For example, hyperinflations or even high inflationary episodes may strengthen public's opposition to inflation (Eijffinger and De Haan, 1996) and detonate reforms of central banks. In the following section we test the following hypotheses: *i)* a larger MPC leads to a lower and more stable inflation; *ii)* countries having experienced important inflationary episodes will appoint larger MPC when introducing legal reforms to monetary policy institutions.

4 EMPIRICAL RESULTS

4.1 Data description and sources

We use a sample of 59 countries that introduced substantial reforms to its central bank's statue or revoked an old statue to introduce a completely new one at some moment between 1980 and 2010, and are currently making policy decisions by committee. All of these statues are currently in force. In all of these countries, the modified statue specifies that a committee, board or council is responsible for monetary policy decisions. In most cases, old statue is not available at the central bank's website, and information on whether decisions were made by a committee or by an individual prior to the statue reform, is not readily available. It may be the case that some banks were already deciding monetary policy by committee before the introduction of the actual statue. However, Blinder (2004) notes that there is a clear trend toward making monetary policy decisions by committee, and that "decision making by committees used to be the exception in monetary policy ... (while) it has now become the rule". Also, in its guide to *Central Bank Watching* for 2000, JP Morgan (2000) observed that "one of the most notable developments of the past few years has been the shift of monetary policy decision-making to meetings of central bank policy boards". Thus, we take the year of statue reform to be the year when the central bank of the sample introduced committees in monetary policy decisions.

To build a panel dataset, we surveyed the websites listed in the central bank hub of the Bank of International Settlement (BIS).[3] This list includes the central bank website of 172 countries. Of these countries, we selected those satisfying the following conditions: *i)* a substantial reform of central bank statue was introduced after 1980. *ii)* The reformed statue clearly specifies that a committee is responsible for monetary policy decisions, and specifies the size of the committee. We discarded banks with a single individual responsible for monetary policy decisions, countries for which macroeconomic data before reform were not available (inflation, GDP, public debt or current account deficit) and countries with central banks not involved in monetary policy, like most European countries in the euro zone, the West African and East African states, and countries of the Organization of the Eastern Caribbean States. We did not consider central banks of common currency zones for the same reason as before: macroeconomic data is not available for the common currency area before its formation. This selection left us with a sample of 59 central banks. Sizes range from 3 to 15 members, with an average of 8 members. Table 1 and

[3] http://www.bis.org/cbanks.htm.

figure 2 show the frequency of sizes. See the appendix for the list of countries in the sample, their MPC size and the date of reform of statutes.

Table 1

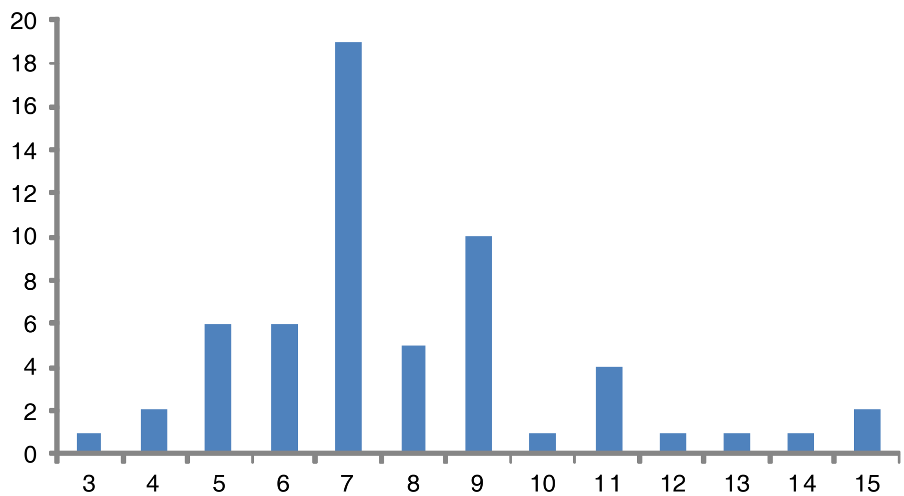
MPC sizes of the sample

MPC size	3	4	5	6	7	8	9	10	11	12	13	14	15
Central banks	1	2	6	6	19	5	10	1	4	1	1	1	2

Source: Central Bank's websites

Figure 2

MPC sizes of the sample



We used macroeconomic indices as the main controls for the estimations shown below. They were taken from the World Economic Outlook database (GDP growth and public debt and current account, both as % of GDP, annual averages of years 1980 to 2010) and from International Financial Statistics database (monthly inflation rate).

4.2 Estimations

Table 2 shows pre and post reform sample averages.

Table 2

Changes in macroeconomic performance due to central bank reforms

Index	Pre-reform	Post	Relative change (versus Pre) (%)
GPD growth	2.46	4.46	↑ 81
Inflation rate	158.25	10.13	↓ 94

Stdev inflation rate	343.39	11.46	↓ 97
Current account deficit	4.41	3.64	↓ 40
Public debt	70.05	55.39	↓ 21

Note that these values are a clear evidence of a considerable improvement in general macroeconomic performance of reforming countries. For example, GDP growth almost doubled (2.46 before reform versus 4.46 after the reform, an 81% increase) and average inflation rate fell 94% (pre-reform average was 1463% higher than post-reform average: 343.39 versus 11.46). Inflation volatility also plummeted, and current account deficit and public debt fell significantly. We interpret these figures as evidence of a strong correlation between central bank reforms and macroeconomic performance. We corroborated this correlation with a fixed effects estimation using the original panel structured dataset, setting MPC size of country *i* at year *t* equal to one for pre-reform years, and equal to the de jure size (as specified in the reformed statue) for post-reform years. Table 3 shows estimation results of the following model:

$$SIZE_{it} = \beta_0 + \beta PI_{it} + \gamma GDP_{it} + \delta DEBT_{it} + \lambda CCAA_{it} + \eta ITT_{it} + \alpha_i + u_{it} ,$$

where $SIZE_{it}$ is a measure of MPC size of country *i* in year *t*, and PI, GDP, GDEBT and CCAA are respectively annual inflation rate, annual GDP growth, debt as percentage of GDP and current account as percentage of GDP and ITT is a dummy for an inflation targeting regime. We estimated both the model with the ITT dummy and without it. We used three measures for committee size: the number of members, *mpcsize;* and two transformations of it: *weight* = *mpcsize/(1+mpcsize)* and *logmpcsize* = *ln(mpcsize)*.

Size coefficients have the correct sign and are significant at 1% level. Except current account (which is weakly significant –10% level in the ITT model), all macro variables are significant, specially public debt which has a positive sign, possibly indicating the need to inflate in order to finance deficit. There is a negative correlation between GDP and inflation, possibly indicating that stability is beneficial for growth. Coefficients for ITT dummy are not at all surprising and similar results have been obtained by several other researchers studying the relation of inflation targeting regimes and macroeconomic outcomes.[4]

Table 3

Inflation rate and committee size, fixed effects estimation

	I	II	III	IV	V	VI
mpcsize	−0.551^{c}	−0.364^{c}				
	(0.162)	(0.169)				
weight			−11.731^{c}	−7.516^{b}		
			(3.189)	(3.410)		
logmpcsize					−2.135^{c}	−1.376^{c}
					(0.590)	(0.627)
gdebt	0.103^{c}	0.106^{c}	0.103^{c}	0.106^{c}	0.103^{c}	0.106^{c}
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
ccaa	0.079^{a}	0.080^{a}	0.080^{a}	0.080^{a}	0.080^{a}	0.080^{a}
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)

[4] The reader may find a recent survey of this literature and empirical evidence indicative of the endogeneity of inflation targeting, in de Roux and Hofstetter (2011)

gdp	−0.269[c]	−0.279[c]	−0.269[c]	−0.279[c]	−0.269[c]	−0.279[c]
	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)
itter		−6.509[c]		−6.222[c]		−6.290[c]
		(1.786)		(1.825)		(1.815)
Observations	1632	1632	1632	1632	1632	1632

Yet, implementation of committee decision making is only an aspect of the reforms, and the results showed in table 3 may not be considered as meaning that bigger committees deliver lower inflation rates, or even that committee decision making (versus individual decision making) causes lower inflation rates. There are two reasons to be careful: the first one is that, as we noted earlier, committee decision making may pre-exist to the statue reform; and the second reason is that we are considering de jure sizes, so data do not exhibit variability of committee size within a post-reform period (although there is variability among countries in post-reform MPC size). SIZE may work as a dummy indicating that a central bank's reform has taken place, so this panel data estimation only points to a strong correlation between reforms and macroeconomic outcomes.

To corroborate whether there exists a correlation between MPC size and inflation rate, we estimate the following model using the pooled dataset:

$$\Delta_i = \beta_0 + \beta SIZE_i + \lambda GDPPRE_i + \delta DEBTPRE_i + \lambda CCAAPRE_i + \eta DISCR_i + u_i \, ,$$

where Δ_i is a relative measure of inflation drop or inflation volatility drop. We use two measures of inflation volatility: standard deviation of inflation –*SD(π)*– and the following transformation: $VOL(\pi) = l\,\mathrm{n}\left(1 + SD(\pi)\right)$, to down-weight the impact of extraordinary inflation shocks and inflationary episodes (Erhart et al., 2007) and to avoid the disadvantage of the log form which overweights observations close to zero (Bowdler and Malik, 2005). We estimate the models for the following three measures:

$$\Delta_i = \left(PRE(\pi)_{1i} - POST(\pi)_i\right) / \; POST(\pi)_i)$$

$$\Delta_{2i} = \left(PRE\left(SD(\pi)\right)_i - POST\left(SD(\pi)\right)_i\right) / \; POST\left(SD(\pi)\right)_i)$$

$$\Delta_{3i} = \left(PRE\left(VOL(\pi)\right)_i - POST\left(VOL(\pi)\right)_i\right) / \; POST\left(VOL(\pi)\right)_i)$$

Controls are committee size (*mpcsize*), average of macroeconomic indices (GDP, DEBT and CCAA) prior to reform, and a measure of central bank's discretion, taken from Fry et al. (2000) dataset, who construct an index based on scores related to central bank's regime (exchange rate targeting, money targeting and inflation targeting).[5] This control is included because political pressure to boost the economy should be more effective the more discretional is the central bank (Crowe and Meade, 2007). On the contrary, a rule (adequately enforced), makes sterile any attempt of politicians to intervene on monetary policy. We estimate the model both with this measure and without it. The model with Discretion was estimated over the subsample of 36 countries for which a measure of it was available.[6] Table 4 shows the results of the estimation.

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[5] It is calculated as twice the maximum of these scores minus the sum of the other two. It is converted to an index between zero and 100, where a high score implies more discretion.

[6] We also estimated the model using directly the averages of inflation rates and inflation volatility in the post-reform period (that is, without relating it to the pre-reform values) but the estimators were not significant.

Table 4

Committee size versus inflation drop pre and post reform

	Dep Vars: pidrop	pivldrop	pivldrop3	pidrop	pivldrop	pivldrop3
mpcsize	6.485[b]	45.448[a]	0.028	10.454[b]	70.839[b]	0.041[a]
	(2.980)	(22.962)	(0.018)	(4.182)	(31.229)	(0.022)
caapre	−3.374[a]	−17.672	−0.008	−5.127[b]	−27.718[a]	−0.004
	(1.465)	(11.287	(0.009)	(2.052)	(15.326)	(0.011)
gdppre	−1.361	8.381	−0.012	−0.658	9.600	−0.006
	(1.995)	(15.372)	(0.012)	(2.423)	(18.092)	(0.013)
gdebtpre	−0.329[b]	−1.671	−0.001	−0.575	−2.396	0.000
	(0.162)	(1.246)	(0.001)	(0.395)	(2.948)	(0.002)
discretion				−0.478	−3.467	−0.003
				(0.454)	(3.390)	(0.002)
R^2	0.178	0.106	0.078	0.278	0.190	0.128
N	59	59	59	36	36	36

In the model without controlling for the level of discretion, MPC size has a positive and significant effect (at 5% level) on the size of inflation reduction due to the introduction of central bank reforms. Inflation volatility (measured by the standard deviation) reduction is also positive and significant at 10% level. Controlling for discretion rises the effect of committee size in both inflation and inflation volatility drop, and it also rises significantiveness of the effect on volatility (from 10% to 5% percent). This evidence indicates that stabilization effect of central bank reforms are positively related to MPC size posterior to reform, but it also suggests the possible presence of endogeneity between pre-reform inflation rate and committee size. Countries with higher inflation rates or even inflationary episodes have more to gain from a stabilization process, driving inflation rates to international standards. The design of a larger committee secures the achievement of the stabilization process by isolating monetary policy decisions from the influence of politicians.

To obtain further evidence we regress MPC size against inflation and inflation volatility prior to reform, expecting a positive sign on the effect of pre-reform inflation rate on MPC size. Table 5 shows estimation results of the following model:

$$SIZE_i = \beta_0 + \beta PRE_i + \gamma GDPPRE_i + \delta DEBTPRE_i + \lambda CCAAPRE_i + \eta DISCR_i + u_i ,$$

where PRE is average inflation rate prior to reform, in the first model, average standard deviation of inflation rate in the second model, and average volatility of inflation rate in the third model. We estimate the models both including and excluding discretion variable. We also include averages of macroeconomic variables prior to reform (GDP growth, public debt as a percentage of GDP, and current account as a percentage of GDP).

Prior inflation rate and at least one of inflation variability measures are significant, and every one of them has the expected sign. Countries having higher inflation rates or inflation volatility are prone to appoint larger committees when they introduce reforms to its central bank. Discretion coefficient is positive and significant. Central banks operating with a higher discretionary level also appoint larger committees, because political influence is an issue in such cases.

5 Concluding remarks

In this paper we considered monetary policy as the equilibrium result of the interaction between members of a MPC and organized groups (lobbies) who attempt to bias policy in their favor, by offering contingent contribution schedules to each MPC member. We showed that equilibrium inflation rate and output can be interpreted as those chosen by a single central banker who averages preferences of lobbies and committee members. We introduced another larger group that is unable to get politically organized (the rest of the society) and we analyzed the effect of rising the size of the MPC on society's welfare. While in general, the effect is ambiguous, we showed that under plausible assumptions (homogeneous and conservative MPC) a larger MPC leads to a lower and stable inflation. We also support the model with evidence based on a sample of 59 countries that reformed their central bank statues at some moment in the last 30 years, incorporating decision making by committees in the reformed statues. We find that: *i)* reforms are strongly related to general improvements in macroeconomic performance; *ii)* stabilization episodes due to the introduction of reforms (inflation and inflation volatility falls) are related to committee size post-reform with a possible two way causality; *iii)* countries having higher average inflation rates or inflation volatilities prior to the adoption of reforms, appointed larger committees when they reformed their central banks.

Table 5

Committee size versus inflation rate previous to central bank's reform

mpcsize	I	II	III	IV	V	VI
pipre	0.002[a]			0.003[b]		
	(0.001)			(0.001)		
pivlpre		0.000			0.001[a]	
		(0.000)			(0.000)	
pivlpre 1			0.308[a]			0.517[b]
			(0.181)			(0.209)
discretion				0.042[b]	0.047[c]	0.045[c]
				(0.016)	(0.016)	(0.016)
ccaapre	0.128[a]	0.116[a]	0.130[b]	0.198[c]	0.177[b]	0.184[c]
	(0.066)	(0.068)	(0.060)	(0.068)	(0.069)	(0.054)
gdebtpre	0.005	0.004	0.005	0.018	0.011	0.015
	(0.007)	(0.007)	(0.007)	(0.016)	(0.017)	(0.016)
gdppre	0.074	0.030	0.072	0.086	0.001	0.074
	(0.089)	(0.097)	(0.098)	(0.094)	(0.093)	(0.091)
R^2	0.087	0.073	0.097	0.310	0.293	0.331
N	59	59	59	36	36	36

An issue not considered in the present paper is the optimal size of a monetary policy committee. We argued that a larger MPC is more independent from the influence of organized interest groups. But larger committees may suffer from the free rider problem if gathering information is costly. Also, it may take more time and effort to reach a consensus on the monetary policy action.[7]

[7] This argument is formalized and tested by Erhart and Vasquez-Paz (2008). Their main conclusions are that optimal size varies according the uncertainty of MPC members' information and is also influenced by the size of the monetary zone and the overall activity. Erhart et al. (2007) find a non linear relation between MPC size and inflation volatility: countries with less than five MPC members tend to have larger inflation volatilities, while raising the number above five does not contribute to further reduction in volatility. Berger and Nitsch (2008) analyze the relationship between the number of monetary policy decision-makers and monetary policy outcomes, using data in groups of countries and in several sub-periods between 1960 and 2000. They find a U-shaped relation between the size and inflation, inflation variability and output growth, with a minimum at 7-10 members.

Appendix

5.1 List of countries with committee size and year of reform

Table A 1.

List of countries

Country	Reform year	mpcsize	Country	Reform year	mpcsize
Iceland	2001	3	Armenia	2006	7
Cape Verde	2001	4	Bahrain	2007	7
Serbia	2004	4	Mauritania	2007	7
Chile	1989	5	Ethiopia	2008	7
Mexico	1994	5	Brazil	1996	8
Paraguay	1995	5	Guatemala	2002	8
Moldova	1996	5	Kenya	2008	8
Guyana	1998	5	Burundi	2009	8
Republic of Yemen	2000	5	Angola	2010	8
Bolivia	1995	6	Kazakhstan	1996	9
Uruguay	1995	6	Albania	1998	9
Poland	1998	6	Japan	1998	9
Vietnam	1998	6	UK	1998	9
Sweden	1999	6	Botswana	1999	9
Canada	2001	6	Sudan	2002	9
Malawi	1989	7	Dominican Republic	2003	9
Colombia	1992	7	Pakistan	2003	9
Philippines	1994	7	Morocco	2006	9
Costa Rica	1996	7	Mauritius	2007	9
Barbados	1997	7	Malaysia	2010	10
Bulgaria	1997	7	Ukraine	1999	11
Korea	1998	7	Syrian Arab Republic	2002	11
Norway	1999	7	Ghana	2003	11
Thailand	2000	7	Georgia	2008	11
Belarus	2001	7	Russia	2003	12
Turkey	2001	7	China	1998	13
Argentina	2003	7	Croatia	2009	14
Hungary	2003	7	South Africa	2000	15
Azerbaijan	2004	7	Egypt	2004	15
The Gambia	2004	7			

Source: Central bank's websites

5.2 Proofs

5.2.1 Proof of Lemma 1

The first order condition to this problem leads to the following expression for the inflation rate:

(A.1)
$$\pi^{B}=\frac{b_S}{1+b_S}\left(\pi^{e}-s\right)+\frac{1}{1+b_S}\left(\pi_S+b_S y_S\right).$$

(where B stands for benevolent). With rational expectations,

$$\pi^e = E\left[\frac{b_s}{1+b_s}\left(\pi^e - s\right) + \frac{1}{1+b_s}\left(\pi_s^* + b_s y_s^*\right)\right]$$
$$= \frac{b_s \pi^e + \pi_s + b_s y_s}{1+b_s}$$

so we have

$$\pi^e + \pi_s + b_s y_s$$

Substitution of π^e in (A.1) and in the supply curve leads to the expressions of inflation and output established in the lemma. Variance of inflation is

$$VAR\left(\pi^B\right) = E\left[\pi^B - E\left(\pi^B\right)\right]^2$$
$$= E\left[\pi_s + b_s y_s - \frac{b_s}{1+b_s} s - \pi_s - b_s y_s\right]^2$$
$$= \left(\frac{b_s}{1+b_s}\right)^2 \sigma^2.$$

Variance of output is

$$VAR\left(y^B\right) = E\left[y^B - E\left(y^B\right)\right]^2$$
$$= E\left(y^B\right)^2 = \left(\frac{1}{1+b_s}\right)^2 \sigma^2.$$

Society's expected loss is

$$
\begin{aligned}
EL_S &= \frac{1}{2}E\left(\pi^B\pi_s\right)^2 + \frac{1}{2}b_s E\left(y^B - y_s\right)^2 \\
&= \frac{1}{2}E\left[\left(\pi^B\right)^2 - 2\pi^B\pi_s\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_s E\left(\left[\left(y^B\right)^2 - 2yy_S\right]\right) + \frac{1}{2}b_s y_s^2 \\
&= \frac{1}{2}E\left[\left(\pi_s + b_s y_s - \frac{b_s}{1+b_s}s\right)^2 - 2\left(\pi_s + b_s y_s - \frac{b_s}{1+b_s}s\right)\pi_s\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_s E\left[\left(\frac{s}{1+b_s}\right)^2 - 2\frac{s}{1+b_s}y_S\right] + \frac{1}{2}b_s y_s^2 \\
&= \frac{1}{2}E\left[\begin{array}{c} \left(\pi_s + b_s y_s\right)^2 - 2\left(\pi_s + b_s y_s\right)\frac{b_s}{1+b_s}s + \left(\frac{b_s}{1+b_s}s\right)^2 \\ -2\pi_s\pi_s - 2\pi_s b_s y_s + 2\pi_s\frac{b_s}{1+b_s}s \end{array}\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_s E\left[\left(\frac{s}{1+b_s}\right)^2 - 2\frac{s}{1+b_s}y_S\right] + \frac{1}{2}b_s y_s^2 \\
&= \frac{1}{2}\left[\begin{array}{c} \pi_s^2 + 2\pi_s b_s y_s + \left(b_s y_s\right)^2 \underbrace{- 2\left(\pi_s + b_s y_s\right)\frac{b_s}{1+b_s}E(s)}_{=0} \\ + \left(\frac{b_s}{1+b_s}\right)^2 \underbrace{E(s)^2}_{=\sigma^2} \\ -2\pi_s^2 - 2\pi_s b_s y_S + \underbrace{2\pi_s\frac{b_s}{1+b_s}E(s)}_{=0} \end{array}\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}\left[\frac{b_s}{\left(1+b_s\right)^2}\underbrace{E(s)^2}_{=\sigma^2} - \underbrace{2\frac{b_s}{1+b_s}y_S E(s)}_{=0}\right] + \frac{1}{2}b_s y_s^2 \\
&= \frac{1}{2}\left[\pi_s^2 + 2\pi_s b_s y_s + \left(b_s y_s\right)^2 + \left(\frac{b_s}{1+b_s}\right)^2\sigma^2 - 2\pi_s^2 - 2\pi_s b_s y_S\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}\frac{b_s}{\left(1+b_s\right)^2}\sigma^2 + \frac{1}{2}b_s y_s^2 \\
&= \frac{1}{2}\left(b_s y_s\right)^2 + \underbrace{\frac{1}{2}\left(\frac{b_s}{1+b_s}\right)^2\sigma^2}_{=VAR\left(\pi^B\right)} - \frac{1}{2}\pi_s^2 + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_s\underbrace{\frac{\sigma_S}{\left(1+b_s\right)^2}}_{=VAR\left(y^B\right)} + \frac{1}{2}b_s y_s^2 \\
&= \frac{1}{2}\left[\left(b_s y_s\right)^2 + VAR\left(\pi^B\right) + b_s VAR\left(y^B\right) + b_s y_s^2\right]
\end{aligned}
$$

5.2.2 Proof of Proposition 1

Let z_E be the equilibrium inflation chosen by the committee; assume that at this value, every lobby pays a positive contribution (which allows us to focus on interior solutions). Additionally, assume that every lobby proposes a differentiable contribution schedule to each committee member. Condition (i) of Theorem 1 in Prat and Rustichini (2003) requires that equilibrium policy should maximize each committee member's objective function given contribution schedules proposed by each lobby. Recall that

$$L_n(z) = \frac{1}{2}\left[\left(z - \pi_n^*\right)^2 + b_n\left(z - \pi^e + s - y_n^*\right)^2\right],$$

where $z = \sum_{n=1}^{N}\eta_n\pi_n$ is the inflation rate that MPC chooses according to the weighting rule, then $\forall n \in N$, the following must be true:

$$\pi_n \in \arg\max_{\pi_n} - L_n + \sum_{l \in L} C_{l,n}$$

$$\text{given } \pi^e$$

so z_E is the equilibrium inflation rate if and only if the following first order condition is true for every *n*:

$$\sum_{l \in L} \frac{\partial C_{l,n}}{\partial \pi_n} = \frac{\partial L_n}{\partial z} \eta_n$$

or

$$\sum_{l \in L} \frac{1}{\eta_n} \frac{\partial C_{l,n}}{\partial \pi_n} = \frac{\partial L_n}{\partial z} \tag{A.2}$$

Condition *ii)* of theorem 1 in Prat and Rustichini (2003) states that $\forall j \in L$, the following must be true:

$$z_E \in \quad \arg\max_{z} - L_l + \sum_{n \in N} \left(-L_n + \sum_{j \in L j \neq l} C_{j,n} \right)$$

given π^e

This is an incentive compatibility condition: it establishes that given the other lobbies' contribution schedules, lobby *j* can set contributions in order to induce each member of the MPC to choose any inflation the lobby wants; in doing so, the lobby must increase the contribution to compensate member *n* for the loss of choosing that policy. If z_E is an equilibrium, then it does not pay to any lobby *j* to make this additional compensation.

The first order condition of this problem is

$$+\sum_{n \in N} \sum_{j \in L j \neq l} \frac{\partial C_{j,n}}{\partial z} = \frac{\partial L_l \left(z_E, \pi^e, s \right)}{\partial z} + \sum_{n \in N} \frac{\partial L_n \left(z_E, \pi^e, s \right)}{\partial z} . \tag{A.3}$$

By assumption, $z = \sum_{n=1}^{N} \eta_n \pi_n$. We have that if *z* is the inflation rate chosen by the MPC, then for every committee member *m*,

$$\pi_m = \frac{1}{\eta_m} z - \frac{1}{\eta_n} \sum_{n \neq m} \eta_n \pi_n ,$$

So

$$\frac{\partial C_{j,n}}{\partial z} = \frac{1}{\eta_n} \frac{\partial C_{j,n}}{\partial \pi_n} .$$

Inserting this expression in (11) we get

$$\sum_{n \in N} \sum_{j \in L, j \neq l} \frac{1}{\eta_n} \frac{\partial C_{j,n}}{\partial \pi_n} = \frac{\partial L_l \left(z_E, \pi^e, s \right)}{\partial z} + \sum_{n \in N} \frac{\partial L_n \left(z_E, \pi^e, s \right)}{\partial z} \tag{A. 4}$$

Adding (A. 2) over n and (A.3) over l we get

(A. 5)
$$\sum_{n\in N}\sum_{l\in L}\frac{\partial C_{j,n}}{\partial \pi_n}=\sum_{n\in N}\frac{\partial L_n}{\partial z}\eta_n$$

and

(A.6)
$$\sum_{l\in L}\sum_{n\in N}\sum_{j\in L, j\neq l}\frac{1}{\eta_n}\frac{\partial C_{j,n}}{\partial \pi_n}=\sum_{l\in L}\frac{\partial L_l}{\partial z}+\sum_{l\in L}\sum_{n\in N}\frac{\partial L_n}{\partial z}$$

Left hand side of (A. 6) is

$$(L-1)\sum_{n\in N}\sum_{l\in L}\frac{1}{\eta_n}\frac{\partial C_{j,n}}{\partial \pi_n}$$

so from (A. 5) and (A. 6) we obtain

$$(L-1)\sum_{n\in N}\frac{\partial L_n}{\partial z}=\sum_{l\in L}\frac{\partial L_l}{\partial z}+\sum_{l\in L}\sum_{n\in N}\frac{\partial L_n}{\partial z}$$

The derivative of the loss function of the proposition is

$$\frac{\partial L_i}{\partial z}=(z_E-\pi_i)+b_i\left(z_E-\pi^e+s-y_i\right), i\in N\cup L,$$

which lead us to the following first order condition:

$$\begin{aligned}&\sum_{n\in N}\left[z_E-\pi_n+b_n\left(z_E-\pi^e+s-y_n\right)\right]\\ =&\\ &\frac{1}{L-1}\sum_{l\in L}\left[z_E-\pi_l+b_l\left(z_E-\pi^e+s-y_l\right)\right]\\ &+\frac{1}{L-1}\sum_{l\in L}\left[Nz_E-\sum_{n\in N}\pi_n+\pi\sum_{n\in N}b_n+\pi^e\sum_{n\in N}b_n+s\sum_{n\in N}b_n-\sum_{n\in N}b_n\left(y_n\right)\right].\end{aligned}$$

In what follows we denote with $\tilde{\pi}_I$ the average inflation target among members of group I = L, N, and similarly, we denote $\tilde{b}_I$ the average of the preference parameter b_i. We also denote

$$\begin{aligned}&\Lambda_L\equiv\sum_{l\in L}b_l y_l,\\ &\Lambda_N\equiv\sum_{n\in N}b_n y_n,\\ &\xi\equiv\frac{N\tilde{\pi}_N+L\tilde{\pi}_L+\Lambda_N+\Lambda_L}{L+N+N\tilde{b}_N+L\tilde{b}_L},\\ &\beta\equiv\frac{L\tilde{b}_L+N\tilde{b}_N}{L+N},\end{aligned}$$

and

$$\eta\equiv\frac{L\tilde{b}_L+N\tilde{b}_N}{L+N+L\tilde{b}_L+N\tilde{b}_N}.$$

It is straightforward to show that equilibrium inflation rate is

$$z_E = \xi + \left(\pi^e - s\right)\eta.$$

With rational expectations,

$$\pi_E^e = \frac{\xi}{(1-\eta)}.$$

Thus, equilibrium inflation rate is

$$z_E = \xi + \frac{\xi\eta}{(1-\eta)} - s\eta = \tilde{\pi} + \tilde{y} - \frac{\beta}{1+\beta}s \ ,$$

where

$$\tilde{\pi} \equiv \frac{N\tilde{\pi}_N + L\tilde{\pi}_L}{L+N}$$

and

$$\tilde{y} \equiv \frac{\Lambda_N + \Lambda_L}{L+N}.$$

Equilibrium output is

$$\begin{aligned} y_E &= \pi_E - \pi_E^e + s \\ &= \frac{s}{1+\beta}. \end{aligned}$$

Now consider a single central banker solving

$$\begin{aligned} &\min_{\pi} \frac{1}{2}\left[\left(\pi - k\right)^2 + v\left(\pi - \pi^e + s - c\right)^2\right] \\ &\text{given} \quad \pi^e. \end{aligned}$$

for some k, v and c. First order condition leads to

$$\pi = \frac{1}{1+v}\left(k + v\pi^e - vs + vc\right).$$

By rational expectations

$$\pi^e = k + vc,$$

so

$$\pi = k + vc - \frac{v}{1+v}s$$

and

$$y = \frac{s}{1+v}.$$

Taking $k = \tilde{\pi}, c = \tilde{y}$ and $v = \beta$, we have that equilibrium policy solves

$$\min_{\pi} \frac{1}{2}\left[\left(\pi - \tilde{\pi}\right)^2 + \beta\left(\pi - \pi^e + s - \tilde{y}\right)^2 \right]$$
$$\text{given} \quad \pi^e.$$

5.2.3 Proof of Lemma 2

Expressions for inflation, output, bias and variances are derived in the same way as those of Lemma

1. Society's expected loss in equilibrium with lobby pressure is:

$$
\begin{aligned}
EL_S &= \frac{1}{2}E\left(\pi^* - \pi_S\right)^2 + \frac{1}{2}b_S E\left(y^* - y_S\right)^2 \\
&= \frac{1}{2}E\left[\left(\pi^*\right)^2 - 2\pi^*\pi_S\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_S E\left(\left[\left(y^*\right)^2 - 2y^* y_S\right]\right) + \frac{1}{2}b_S y_s^2 \\
&= \frac{1}{2}E\left[\left(\overline{\pi} + \beta\overline{y} - \frac{\beta}{1+\beta}s\right)^2 - 2\left(\overline{\pi} + \beta\overline{y} - \frac{\beta}{1+\beta}s\right)\pi_S\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_S E\left[\left(\frac{s}{1+\beta}\right)^2 - 2\frac{s}{1+\beta}y_S\right] + \frac{1}{2}b_S y_s^2 \\
&= \frac{1}{2}E\left[\left(\overline{\pi} + \beta\overline{y}\right)^2 - 2\left(\overline{\pi} + \beta\overline{y}\right)\frac{\beta}{1+\beta}s + \left(\frac{\beta}{1+\beta}s\right)^2\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_S E\left[\left(\frac{s}{1+\beta}\right)^2 - 2\frac{s}{1+\beta}y_S\right] + \frac{1}{2}b_S y_s^2 \\
&= \frac{1}{2}\begin{bmatrix} \left(\overline{\pi}\right)^2 + 2\overline{\pi}\beta\overline{y} + \left(\beta\overline{y}\right)^2 - \underbrace{2\left(\overline{\pi} + \beta\overline{y}\right)\frac{\beta}{1+\beta}E(s)}_{=0} \\ +\left(\frac{\beta}{1+\beta}\right)^2 \underbrace{E(s)^2}_{=\sigma^2} \\ -2\overline{\pi}\pi_S - 2\pi_S\beta\overline{y} + \underbrace{2\pi_S\frac{\beta}{1+\beta}E(s)}_{=0} \end{bmatrix} + \frac{1}{2}\pi_s^2 + \frac{1}{2}\left[b_S\left(\frac{1}{1+\beta}\right)^2 \underbrace{E(s)^2}_{=\sigma^2} - \underbrace{2b_S\frac{s}{1+\beta}y_S E(s)}_{=0}\right] + \frac{1}{2}b_S y_s^2 \\
&= \frac{1}{2}\left[\left(\overline{\pi}\right)^2 + 2\overline{\pi}\beta\overline{y} + \left(\beta\overline{y}\right)^2 - 2\overline{\pi}\pi_S - 2\pi_S\beta\overline{y} + \left(\frac{\beta}{1+\beta}\right)^2\sigma^2\right] + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_S\left(\frac{1}{1+\beta}\right)^2\sigma^2 + \frac{1}{2}b_S y_s^2 \\
&= \frac{1}{2}\left(\overline{\pi}\right)^2 + 2\overline{\pi}\beta\overline{y} + \left(\beta\overline{y}\right)^2 - \overline{\pi}\pi_S - \pi_S\beta\overline{y} + \frac{1}{2}\underbrace{\left(\frac{\beta}{1+\beta}\right)^2\sigma^2}_{=VAR\left(\pi^*\right)} + \frac{1}{2}\pi_s^2 + \frac{1}{2}b_S\underbrace{\frac{\sigma^2}{\left(1+\beta\right)^2}}_{=VAR\left(y^*\right)} + \frac{1}{2}b_S y_s^2 \\
&= \frac{1}{2}\left[\left(\overline{\pi} + \beta\overline{y}\right)^2 + \pi_s^2 - 2\pi_S\beta\overline{y} + 2\overline{\pi}\pi_S + VAR\left(\pi^*\right)\right] + \frac{1}{2}b_S\left[= VAR\left(y^*\right) + y_s^2\right]
\end{aligned}
$$

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