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Of Hawks and Doves: Monetary Policy by Heterogeneous Committees

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Abstract

This paper develops an institutional explanation based on strategic, heterogeneous committee members for the phenomenon of inertia in monetary policy rates, by exploring variations of a game-theoretic two-period, two-player bargaining model with an endogenous status quo. The results show that inertial policy-making can arise from heterogeneity in preferences and that gridlock and policy inefficiency can become more likely due to variability in agenda-setting power, or decreases in uncertainty over the future. These conclusions are shown to accord with the empirical evidence on monetary policy setting by committees at major central banks over the last decade.

Keywords

Monetary Policy; Bargaining; Committees; Interest Rates; Political Economy

Cover Page Footnote

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1 Introduction

In the academic literature and the popular press it is oftentimes noted that central banks are at times slow to adjust their policy rates to changes in the economic environment (Gerlach-Kristen, 2005). Moreover, some argue that there is a tendency for any changes in the policy variable to be only gradual when they eventually happen (Bernanke, 2004). At the same time, some of the most influential central banks differ notably in their responsiveness. For instance, with regard to the European Central Bank (ECB), The Economist (2005) once argued that, during the preceding years, "it has changed interest rates less often than the Fed has, giving the impression of paralysis". In Figure 1, we can see a plot of the time series of the main policy rates of the Bank of England (BoE), the ECB, and the Federal Reserve of the United States. It shows clearly, that the policy rates over the last decade sometimes remained constant for many months, even though the economic fundamentals underlying the policy decisions are unlikely to be static.

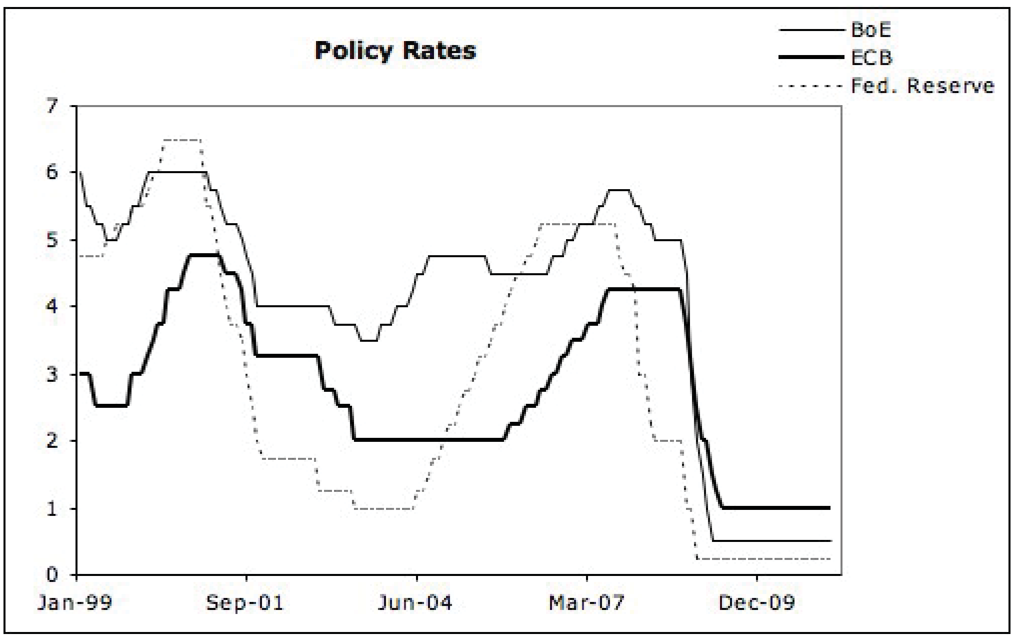

Figure 1: *Main policy rates at the Bank of England, European Central Bank and Federal Reserve; Data Source: Central bank websites*

One explanation for this policy inertia that is often emphasized in the media narrative of monetary policy-making but has so far only received sparse attention in theoretical models of monetary policy committees (MPC) is the potential conflict between "hawks" and "doves" on a committee - members who prefer systematically tighter or looser monetary policy respectively. The prominence of such a conflict has received considerable media attention in the example of the Federal Open Market

Committee (FOMC) that sets US interest rates (The Economist, 2008) and is considered obvious enough to be cited in the academic literature (Blinder, 2004, 2007) without further proof. Moreover, if committee decisions are made by consensus and the status quo policy is endogenous, different periods will be strategically linked.

In this paper, I will build on this potential for differences in preferences within a committee, to look for an explanation for the observed inertia in monetary policy-making. To this purpose, I will develop a game-theoretic bargaining model of MPC decision-making which incorporates the strategic considerations of members with systematically different policy preferences and an endogenous status quo. Moreover, I will explore how the efficiency of the strategic bargaining outcomes varies with changes in the economic environment and the institutional setup of the committee.

Although policy decisions with an endogenous status quo are relevant in many areas, for instance in budgetary approval proceedings, I will here focus on the application to monetary policy. Among the reasons for this choice of application is, firstly, the aforementioned media attention that has made committee deliberations in the monetary policy arena much more public than those of many other political committees. Secondly, monetary policy-makers played a particularly crucial role during the financial crisis and understanding their behavior therefore seems most likely to aid in preventing future crises.

Given that the majority of central banks around the world conduct monetary policy by committee, the question whether this arrangement is beneficial is an important one - with the answer not necessarily being obvious. While there are good reasons like democratic accountability or improved information pooling and processing for choosing a group over an individual decision-maker(Blinder, 2004, 2009; Gerlach-Kristen, 2006), there are also sociological (Sibert, 2006) and political issues (see for example Waller (1992)) that need to be accounted for.

There are specific characteristics of MPCs which would affect the applicability of any theoretical argument that can be made about them: one important institutional dimension by which central banks can be classified is whether their decisions are made in a collegial or an individualistic manner (Blinder, 2007). In a collegial committee, a group decision has to be reached together and a front of unity is usually presented to the outside world. In individualistic central banks, on the other hand, individual judgments are merely aggregated by a decision rule and accountability remains with the members themselves. In this paper, we will only be concerned with the collegial case, as it creates substantial room for strategic maneuvering during the decision-making process. That is, when public dissent has to be kept to a minimum, this puts substantial pressure on the agenda-setter to propose a policy setting that will be accepted by the other committee members. Conversely, the latter have the opportunity to weigh any offer based on how it will affect their bargaining position in future periods.

This internal mechanism of monetary policy committees becomes an important feature of the model explored in this paper: The dynamic link between bargaining episodes via the endogenous status quo makes the dynamic results substantially different from a bargaining situation with an exogenous status quo. As the bargaining outcome in the present will remain in place unless it is renegotiated in the next period, the players will try to anticipate, and improve the outcome of, the strategic proposals they expect to be made in future periods. Risk-averse strategic players are therefore willing to sacrifice some current utility in order to secure a more advantageous policy status quo from which to bargain over the response to future shocks. This hedging behavior is what leads to dynamic inefficiency via gridlock in my model.

Inertia is shown to result from the strategic bargaining both in the form of "too late" and "too little": Substantial gridlock, as well as pareto-inefficient policy outcomes are possible. Moreover, I find that, rather than leading to paralysis, an increase in uncertainty in the economic environment can actually improve the bargaining outcomes, whereas allocating the agenda-setting power more evenly among committee factions can exacerbate the inefficiencies.

This paper will be structured in the following way: First, I give a quick overview over the related literature. Then, I provide some empirical observations on monetary policy committees in order to motivate the assumptions of the basic bargaining model, which I introduce in the section thereafter. In section 4, three variations of the basic model with regard to economic environment and agenda-setting power will be analyzed and solved, with proofs of all propositions subsequently provided in section 5. Moreover, the implications of the theoretical results in terms of welfare and efficiency will be discussed in section 6 and then brought to bear upon some empirical observations in section 7, before I provide concluding remarks.

2 Related Literature

The rapid growth in contributions to the theory and empirics of central banking by committee - especially during the last decade - can probably be attributed to the increasing relevance of this kind of institutional setup for global economic policy: Maier (2010) cites a study by Mahadeva & Sterne (2000) which shows that 79 out of 94 sampled central banks at the time made decisions in an MPC, and - adding relevance to the analysis in this paper - out of these 43 reached their decisions by consensus.

In order to highlight the various lines of research that intersect in this paper, this section will briefly review the related literature on the political economy of policy-making, on committees in general, and on dynamic bargaining.

One of the earliest contributions to the study of strategic behavior in the context of policy-making with an agenda-setter and a status quo as the default option is probably Romer & Rosenthal (1978), who consider a static model with a single vote. Later applications of the agenda-setter model to political contexts, like the seminal paper by Baron & Ferejohn (1989), introduced dynamic thinking in the form of sequential voting but still retained a static policy environment.

However, besides this literature focusing on agenda-setter models, there exists a much larger number of studies that focus on committees and their decision-making processes more broadly. These studies often take an institutional design perspective, asking whether committees outperform individuals in policy decisions, why this would be the case and how this result varies with different aspects of the committee, such as size or voting mechanism. It should also be noted here, that, outside of economics and political science, there is also a literature on the psychological aspects of group decisions for which Kerr & Tindale (2004) might serve as a good summary, but on which I will not touch here further.

In terms of the institutional design debate, some of the advantages of group decision-making can probably be summarized as providing insurance and beneficial diversification against wildly inappropriate societal outcomes that might arise from the unrepresentative preferences of an individual decision-maker. The source of advantage for a committee over a single person is mainly seen in the fact that the checks and balances of the former may lower the unpredictability of policy decisions compared to the potentially extreme biases of an individual. That is, the committee decision may represent a mitigating compromise between its members' different information, preferences, models of the economy, forecasts or decision heuristics (Blinder, 2007). Moreover, a group might also be more transparent in its operations or more representative of a diverse society than an individual in its decision processes and might therefore be preferred from a democratic theory perspective (Blinder, 2004).

Another way in which the group setting might improve outcomes is the pooling of information. If individual policymakers are uncertain about the optimal policy, the aggregation of their information by a committee can reduce the policy error, as Gerlach-Kristen (2006) shows. However, how effective the information pooling is in practice, depends on various aspects of the institutional context (Gerlach-Kristen, 2005): If an information pooling model is adapted to account for the fact that interest rates can usually only be changed in discrete steps of at least 25 basis points, interest rate changes can become rare but large, hampering central bank effectiveness. Gerlach-Kristen (2005) show these effects to be larger for central banks using a consensus-based decision procedure rather than a simple majority vote. These results are similar to the ones shown in this paper in that they link consensus decisions to policy inertia, but they do not take into account heterogeneous preferences and strategic behavior. Of course, there may be multiple sources of institutional inertia and it is important to identify all of them: while the information-pooling results suggest that a large part of the inefficiency could perhaps be removed by simply encouraging continuous rate-setting, addressing the strategic inertia found in this paper would require a policy approach more cognizant of the committee's institutional setup.

However, some scholars are more skeptical of the impact of committees. Those who argue that groups might, in fact, underperform an individual can rely on various sociological phenomena to back up their claims: As Sibert (2006) argues, if individual effort is required to improve the group outcome but the result is attributed to the group as a whole, free riding on the effort of the other members - social loafing - might result. At the same time, due to the structured nature of group conversations, information can also never really be pooled simultaneously in a social situation so that information cascades might occur - or a vicious cycle of self-reinforcing "groupthink" might lead to extreme outcomes.

With regard to most central banks, however, the professionalism and communication practices of MPCs may mitigate any concerns over social loafing and information cascades. In fact, there is little empirical evidence of "groupthink" occurring in practice (Blinder, 2009). To the contrary, there seems to be some evidence of excessive caution in central banks' decisions (Gerdesmeier *et al.*, 2010). More generally, the often very formalized structure of monetary policy-making might make sociological criticisms less applicable. For instance, a recent study by Chappell *et al.* (2012) failed to find any evidence that members of the FOMC during the 1970s changed the policy proposal they announced in dependence on the announcements of other members during the policy go-around of their meetings. The authors concluded that either the revelation of new information during the FOMC meetings left the attendees' policy preferences unchanged or that, perhaps, all relevant interactions already took place before the policy go-around.

Unfortunately, given that central banks operate in a complex political and economic environment, most empirical claims about the effectiveness of monetary policy by a specific committee usually suffer from a lack of reasonable counterfactuals and scarce data on internal policy debates: The FOMC only publishes its (edited) meeting transcripts five years after a meeting is held and the ECB neither publishes minutes nor transcripts, but only holds a press conference shortly after a policy decision has been made.

In the light of this scarcity of data, it makes sense that Blinder and Morgan (2005; 2008) turn to experimental research to investigate the question whether committees outperform individuals in speed and optimality of their policy response. In two separate studies they find that groups do not need more information before a decision in a simple interest-rate-setting game can be reached and that they produce better decisions than individuals. More specifically, they find that groups are better at reaching a common policy goal in an environment of noisy signals. Moreover, the same study produces evidence that groups deciding by majority rule suffer less from inertia than those under unanimity rule in reacting to shocks. However, the authors caution that their results are limited to "*intellective* tasks rather than *judgmental* tasks" [1]. This limits the applicability of their results to collegial committees in real monetary policy settings, where committee members' preferences are neither perfectly identical - their *judgments* differ - nor is it necessarily obvious what the ultimate goal of policymaking should be.

One field in which the assumption of economic policy-makers acting in some kind of common interest has come under particular scrutiny is political science: For instance, Van de Walle (2001) attributes the failure to implement economic adjustment programs in Africa partly to the misguided ideological predispositions of country leaders. Moreover, the import of preference-based disagreements also extends to the political economy of monetary policy: As Shih (2008) argues, the inflationary cycles of the Chinese economy in the last three decades can be traced back to the struggle between a technocratic and a generalist political faction whose views on monetary policy differ systematically. Similarly, Posen (2000) casts doubt upon the notion of central banks as benevolent optimizers of the public welfare by highlighting systematic policy mistakes by the Bank of Japan over the last two decades. These cases illustrate, why it may be necessary to jettison the assumption of homogeneous preferences with regard to economic policy-makers if we want to understand the reasons for observed shortcomings in policymaking.

However, the literature that tries to address this issue using more complex theoretical models is still relatively small. Only recently have studies with a bargaining perspective started addressing the issue of dynamic linkage between policy-setting periods via an endogenous status quo: For instance, Dziuda & Loeper (2010) analyze an infinite horizon bargaining game with such linkages and find that the policy rate will be less than optimally responsive to shocks in the environment and that gridlock may occur between patient players and thus confirm the basic intuition behind my results. However, to make the solution tractable, they restrict their analysis to discrete policy choices and do not address agenda-setting power. Thus, their conclusions are not directly applicable to the environment with a continuum of status quo values and variations in proposal power that I analyze in this paper.

Montoro (2007) also analyzes dynamic bargaining over a one-dimensional policy between an agenda-setter and other committee members. However, although he presents results showing how inertia can come about in a committee with more than two factions, he only allows the proposal power to be allocated randomly every period and assumes decisions are made by majority vote. Thus, his model has very different strategic dynamics from the consensus-based approach I will employ in this paper and does not offer any conclusions with regard to variations in proposal power.

Similar to the model in this paper, Riboni & Ruge-Murcia (2008) solve a two-period, two-person bargaining game with an endogenous status quo. However, they

[1]Blinder & Morgan (2005) p. 792

model differences in preferences between the agenda-setter and the other committee faction as variable between periods and do not offer any insights regarding the effect of changes in the economic environment or proposal power. Nonetheless, they also manage to explain interest rate smoothing and inertia - with the important limitation that they assume transitions between states of agreement and disagreement and find that, in states of disagreement, there are never any policy changes made, which seems hard to justify empirically.

In my analysis, on the other hand, the difference in policy preferences is kept constant while the economy changes between states of optimal higher or lower policy values ("booms and recessions"), and I introduce variations in the allocation of proposal power. I believe that this captures an important empirical characteristic of MPC decisions, which had been missing from previous analyses. In the next section, I will review some of the empirical research on MPCs that motivates the theoretical analysis in the main sections of this paper.

3 Empirical Motivation

In this section, I will provide some details about monetary policy-making at the Federal Reserve and other central banks. The stylized facts based on these empirical observations will serve to justify the assumptions of the bargaining model and the subsequent discussion.

3.1 The Federal Open Market Committee

Although the theoretical results in this paper are applicable to all monetary policy committees of a specific structure, it might be helpful for the reader to keep in mind the basic structure underlying monetary policy in the US as one of the most prominent examples: The FOMC of the Federal Reserve System consists of the 12 regional Federal Reserve Bank ("Fed") Presidents and the seven members of the Board of Governors, including the chairman of the committee. A vote is granted to all the Board members, the President of the New York Fed, and four of the other regional Fed Presidents. The committee meets eight times per year and votes on changes in the federal funds rate - the inter-bank lending rate - and other aspects of monetary policy. However, the former is its main tool and is implemented by the New York Fed through open-market operations of buying and selling financial assets.

3.2 Stylized Fact 1: Agenda Setter

As regards the internal structure which contextualizes the interest rate decision, the FOMC has been described as an "autocratically collegial" committee (Blinder, 2007), where the chairman exerts a strong influence over the final policy decision and is expected to be on the winning side of the vote (See, for example Blinder (2009); Meyer (2004)). Although their role in the committee proceedings is diminished in comparison with the role of the Chairman of the Federal Reserve, both the Bank of England and the European Central Bank have a Governor and a President respectively who play a significant role in leading the meetings and communicating decisions to the public. In fact, the ECB has a provision in place that, in case of a tie, the chairman's vote determines the outcome (Maier, 2010).

3.3 Stylized Fact 2: Heterogeneous Factions

There is considerable empirical evidence for the heterogeneity of preferences in monetary policy committees. Chappell *et al.* (2005) find that during the period 1966-1996, the two major groups of FOMC members that are differentiated in its institutional setup - the Board of Governors and the presidents of the regional Reserve Banks - differ significantly in the occasions when they choose to dissent from the majority view of the committee: The latter do so in favor of a tighter rather than looser monetary policy while the former's preferences are the reverse. Moreover, Krause (1996) confirms fundamental differences between the same two groups and even finds empirical support for differences in sensitivity to the political environment in which the FOMC operates. This heterogeneity extends to other MPCs: among the most recent studies, Rouillard (2007), Gerlach-Kristen (2009) and Harris & Spencer (2009) all show how interest rate preferences of external and internal members of the Bank of England's MPC differ systematically. As the ECB does not publish minutes, it is harder to verify the role of heterogeneity in its Governing Council. However, the sheer diversity of economic situations among the 17 euro area countries represented should make fundamental difference in policy preferences at least as likely as on the single-country MPCs for which data is more plentiful.

3.4 Stylized Fact 3: Strategic Behavior

According to former Fed Governor Laurence Meyer, the open discussion before the vote at the FOMC and the rarely exercised possibility of dissent are geared towards achieving a consensus decision on policy. Moreover, there is a dynamic aspect to the meetings, which he describes as a belief that the current decision always "will shape the decision at the next meeting"(Meyer, 1998). There is also considerable evidence of this dynamic consensus-seeking approach by the chairman under Alan Greenspan from 1987-2006 (See, for example, Olson (2004)) and it seems to continue with Ben Bernanke at the helm of the FOMC ever since (Duke, 2010). In fact, given that the political economy literature often treats the Federal Reserve as a whole as a strategic actor (see Geraats (2002) for a partial survey), it seems only consistent to model the factions constituting an MPC as strategically forward-looking in their decisions as well.

3.5 Stylized Fact 4: Renegotiation and Endogenous Status Quo

Although the fact that monetary policy can be changed at every meeting and that the policy rate stays the same if it is not changed seems too obvious to back up with evidence, let me note that this is an aspect in which MPCs differ from the committees considered in much of the political economy literature: once a decision has been made, the game does not end. Monetary policy needs to be constantly adjusted to changes in the economic environment and is therefore open to renegotiation at every meeting. Because of the need to adapt the monetary policy rate to changes in the economic environment - often conceptualized as changes in the "natural rate of interest" Woodford (2003) -, the failure to reach consensus on a new policy does not mean that the effective stance of monetary policy in that period does not change: the failure to accommodate a change in the economic environment, by reverting to the status quo of the policy rate instead, may be just as problematic as an active change in the policy rate in the wrong direction. Based on these styIized facts, I will lay out a model of consensus-based dynamic policy bargaining by two heterogeneous parties in a committee in the following section.

4 The Basic Models

4.1 The Policy Preferences

There are two heterogeneous members of the committee: C, the chairman, and M. These two agents bargain over a policy outcome x_t, where $x \in [0, 1]$, in each of two rounds at times $t = 1, 2$. Their institutional role differs, as the chairman is the agenda-setter and proposes a new policy x_t in every round, while M can only accept or reject this proposal without amendments. However, in section 4.3, I will relax this constraint to see how giving the players an even chance at being the agenda-setter affects the results. For now, however, note that when M rejects the proposal, the policy setting at the beginning of the period - "the status quo" - remains in place until the beginning of the next period. Otherwise, the accepted new policy is implemented.

The sequence of the game is the following: There are crisis periods and calm periods. At the beginning of every crisis period t a state of the economy ϵ_t^S is drawn [2] from two possible values ϵ^1 and ϵ^2 with transition probabilities $prob(\epsilon^1 \mid \epsilon^2) = prob(\epsilon^2 \mid \epsilon^1) = 1/2$. This state variable determines the policy preferences $r_i(\epsilon_t) \in [0,1]$ of the policymakers $i = C, M$ in that bargaining period. In the first period only, a status quo q_1 is also exogenously given, whose value is always a point in the continuum $[0,1]$[3]. Then, the chairman C proposes a policy x_t to the other member and she accepts or rejects. Based on this decision, either the new policy or the status quo is implemented, and becomes q_2, the status quo for the second period. Every policymaker i incurs quadratic losses in every period for the distance between the implemented policy and her preferred policy $r_i(\epsilon_t)$ and discounts future losses by $\delta \in [0,1]$. The quadratic form of the loss function means that the players are risk-averse. In each period t, they receive the following payoff:

$$U_i(x_t, \epsilon_t) = -(x_t - r_i(\epsilon_t))^2 \tag{1}$$

Consequently, the expected utility of the two-period game to member i is

$$E(u_i(x_1, x_2)) = E\left(\sum_{t=1}^{2} \delta^{t-1} U_i(x_t, \epsilon_t)\right). \tag{2}$$

We will consider state-dependent preferences, where a state change leads to a shift in the same direction for both members' preferences by the same amount. Thus, their bias with respect to each other remains the same. That is, in state ϵ^1, we assume $r_C(\epsilon^1) = 0$ and $r_M(\epsilon^1) = 1/2$. In state ϵ^2, both preferences shift up, so that $r_C(\epsilon^2) = 1/2$ and $r_M(\epsilon^2) = 1$.

In a calm period, on the other hand, the economy is with certainty in an intermediate state ϵ^3. The bias distance between the two committee members is also $\frac{1}{2}$ and the preferences in the calm state are $r_C(\epsilon^3) = 1/4$ and $r_M(\epsilon^3) = 3/4$. Thus, the crisis period preferences are a mean-preserving spread over the calm period preferences.

The chairman's strategy in these policy bargaining games consists of choosing his preferred proposal, which we will call $G_{C,t}(q_t, \epsilon^s)$, among those that the other committee member will accept. Obversely, M's strategy consists in accepting only proposals that he expects to make him better off than the status quo. Both strategies will depend on the status quo, the period of the game, and the preferences derived from the state of the economy.

[2]The time subscript will be dropped at times to simplify the notation, when it is otherwise clear, which period the state variable is referring to.

[3]For the welfare analysis in section 6, I will have to rely on the assumption that q_1 is uniformly distributed over the policy space. However, for the analytical solution of the model this is immaterial

4.2 The Planner's Solution

In order to have a benchmark for comparison when I will derive the committee's equilibrium policy bargaining outcome, I derive the optimal solution that would be implemented by a utility-maximizing benevolent planner in a crisis period. The problem he would be faced with is to find a vector $X^S = (x_1, x_2)$ of policy outcomes for every period that solves

$$\max_X \left[E(u_C(x_1, x_2)) + E(u_M(x_1, x_2))\right]$$

conditional on the states ϵ_t^s. It is easy to see that, due to the symmetric payoffs, the planner will simply choose the average of the preferred policy values of the two members in every state. Moreover, as changing the policy is costless and no strategic concerns are involved, he will choose the welfare-maximizing policy in every period. That is, $x_1^*(\epsilon^1) = x_2^*(\epsilon^1) = 1/4$, $x_1^*(\epsilon^2) = x_2^*(\epsilon^2) = 3/4$ and $x_1^*(\epsilon^3) = x_2^*(\epsilon^3) = 1/2$. Note that this social welfare-maximizing outcome is independent of the status quo in either period.

4.3 Model 1: The Crisis-Calm Game

The first two-period scenario that I will consider is that of a crisis period followed by a calm period. The stylized story behind this scenario could be a shock to the economy, which shifts the committee members' policy preferences up or down in the short run but leaves their long term preferences unaffected because they know that the economic environment will be calm again quite soon. I would like to explore in this model, how their knowledge of the imminent return to different policy preferences affects the strategic committee members' ability to respond to the crisis in the first period given the status quo. In order to solve for the subgame perfect equilibria of the game I will use backward induction, approaching the problem as Baron & Ferejohn (1989) do in their seminal paper on bargaining in legislatures.

4.3.1 The Calm Second Period

In the second and last period of the game, which is equivalent to the one-period game, both the chairman, as the fixed agenda-setter, and the other committee member simply try to achieve an outcome as close as possible to their preferred policy, treating the first period policy x_1 as the given status quo q_2.

Consequently, for any $q_2 < 1/4$, the chairman simply proposes his preferred policy $G_{C,2}(q_2, \epsilon^3) = 1/4$ while gridlock occurs if the status quo falls in between the different preferences. To see this, note that M prefers $x_2 = 1/4$ to all lower policies because they would be farther away from his second-period preference $r_M(\epsilon^3) = 3/4$. For

$q_2 \in [1/4, 3/4]$, however, while M still prefers higher policy rates, C only benefits from policy outcomes lower than the q_2: consequently, the acceptance set only contains the status quo.

For $q_2 > 3/4$ however, both C and M would like the policy to be lower. Thus, C's agenda setter power allows him to propose and get accepted any policy which is at least as close to $r_M(\epsilon^3) = 3/4$ as the status quo. In equilibrium, C thus proposes $G_{C,2}(q_2, \epsilon^3) = \frac{3}{2} - q_2$ for these high status quo values, which is simply the reflection of q_2 in r_M. These equilibrium bargaining outcomes in the last period are shown in Figure 2. The graph shows the equilibrium policy outcome in that period for every possible value of the status quo.

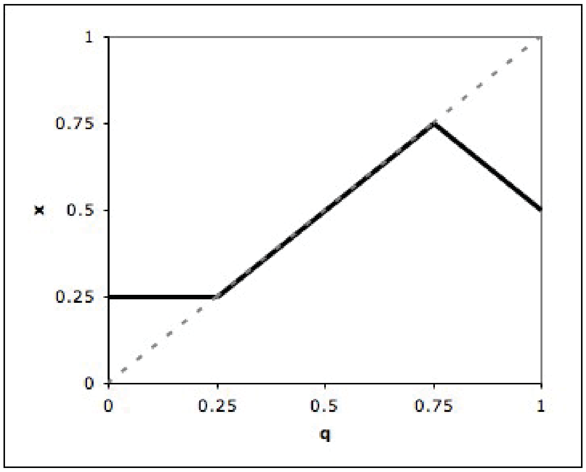

Figure 2: period 2, state ϵ^3

4.3.2 The First Period

As we have seen above, the second period strategies map every status quo q_2 to one, and only one, proposal $G_{C,2}(q_2, \epsilon^3)$ that maximizes C's payoff given M's acceptance set. As we are looking for subgame perfect equilibria for the game, both players will make their first-period decisions in expectation of the second-period equilibrium outcomes $G_{C,2}(q_2, \epsilon^3)$.

Because $q_2 = x_1$, we can reduce the chairman's problem in $t = 1$ to choosing the optimal $G_{C,1}(q_1, \epsilon^s)$ by solving

$$G_{C,1}(q_1, \epsilon^s) = \arg \max_{x \in A_1(q_1, \epsilon^s)} U_{C,1}(x_1, \epsilon^s) + \delta U_{C,2}(x_1, \epsilon^3) \tag{3}$$

for $s = 1, 2$. Here, $A_1(q_1, \epsilon^s)$ denotes M's acceptance set. More specifically, M accepts any policy proposal only under the condition

$$A_1(q_1, \epsilon^s) = x_1 \in [0, 1] \ s.t. \ U_{M,1}(x_1, \epsilon^s) + \delta U_{M,2}(x_1, \epsilon^s) \geq U_{M,1}(q_1, \epsilon^s) + \delta U_{M,2}(q_1, \epsilon^s)$$

with $s = 1, 2$.

In words, the chairman chooses his first-period proposal such that it will be accepted and optimal given what he knows about the feasible second-period policies that result from it. The other committee member M, on the other hand, will only accept first-period proposals, and their later consequences, that make him no worse off than the status quo and its second-period consequences. I will assume without loss of generality that M accepts if he is indifferent between the policy offered and the status quo and that C determines his choice of proposal by a coin flip, if his strategy suggests several policies between which he is indifferent[4].

The subgame perfect equilibrium strategies of the two-period game consist of the second period strategies as given above and the first period strategies, which are summarized in the following proposition (the proofs for all propositions are provided in section 5):

Proposition 1: In the two-period game with a fixed agenda-setter and a calm second period, for all $q_1 \in [0, 1]$ in the states ϵ^1 and ϵ^2, the chairman proposes, and M accepts, $G_{C,1}(q_1, \epsilon^1)$ and $G_{C,1}(q_1, \epsilon^2)$ respectively, where

$$G_{C,1}(q_1, \epsilon^1) = \begin{cases} q_1 & \text{for } q_1 \in \left[0, \dfrac{2+3\delta}{4+4\delta}\right] \\ 2\left(\dfrac{2+3\delta}{4+4\delta}\right) - q_1 & \text{for } q_1 \in \left[\dfrac{2+3\delta}{4+4\delta}, 2\left(\dfrac{2+3\delta}{4+4\delta}\right) - \dfrac{1}{4}\right] \\ \dfrac{1}{2} - z_1 & \text{for } q_1 \in \left[2\left(\dfrac{2+3\delta}{4+4\delta}\right) - \dfrac{1}{4}, 1\right] \end{cases}$$

for which $z_1 = \sqrt{(1+\delta)q_1^2 - (\frac{3\delta+2}{2})q_1 + \frac{5\delta}{16} + \frac{1}{4}}$, and

$$G_{C,1}(q_1, \epsilon^2) = \begin{cases} \dfrac{2+\delta}{4+4\delta} & \text{for } q_1 \in \left[0, \dfrac{2+\delta}{4+4\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{2+\delta}{4+4\delta}, \left(\dfrac{2+\delta+\sqrt{8\delta}}{4+4\delta}\right)\right] \\ \dfrac{2+5\delta}{4+4\delta} & \text{for } q_1 \in \left[\left(\dfrac{2+\delta+\sqrt{8\delta}}{4+4\delta}\right), \dfrac{2+5\delta}{4+4\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{2+5\delta}{4+4\delta}, \dfrac{4+3\delta}{4+4\delta}\right] \\ 2\left(\dfrac{4+3\delta}{4+4\delta}\right) - q_1 & \text{for } q_1 \in \left[\dfrac{4+3\delta}{4+4\delta}, \dfrac{6+\delta}{4+4\delta}\right] \\ \dfrac{2+5\delta}{4+4\delta} & \text{for } q_1 \in \left[\dfrac{6+\delta}{4+4\delta}, 1\right] \end{cases}$$

[4]This assumption is harmless as far as my results are concerned because the policy space is continuous, but it allows the notation not to be cluttered with the distinction between open and closed intervals.

for $\delta \in [0, 1]$. These results are graphed in Figure 3, for $\delta = 1/2$ in panels A and C and for $\delta = 1$ in panels B and D.

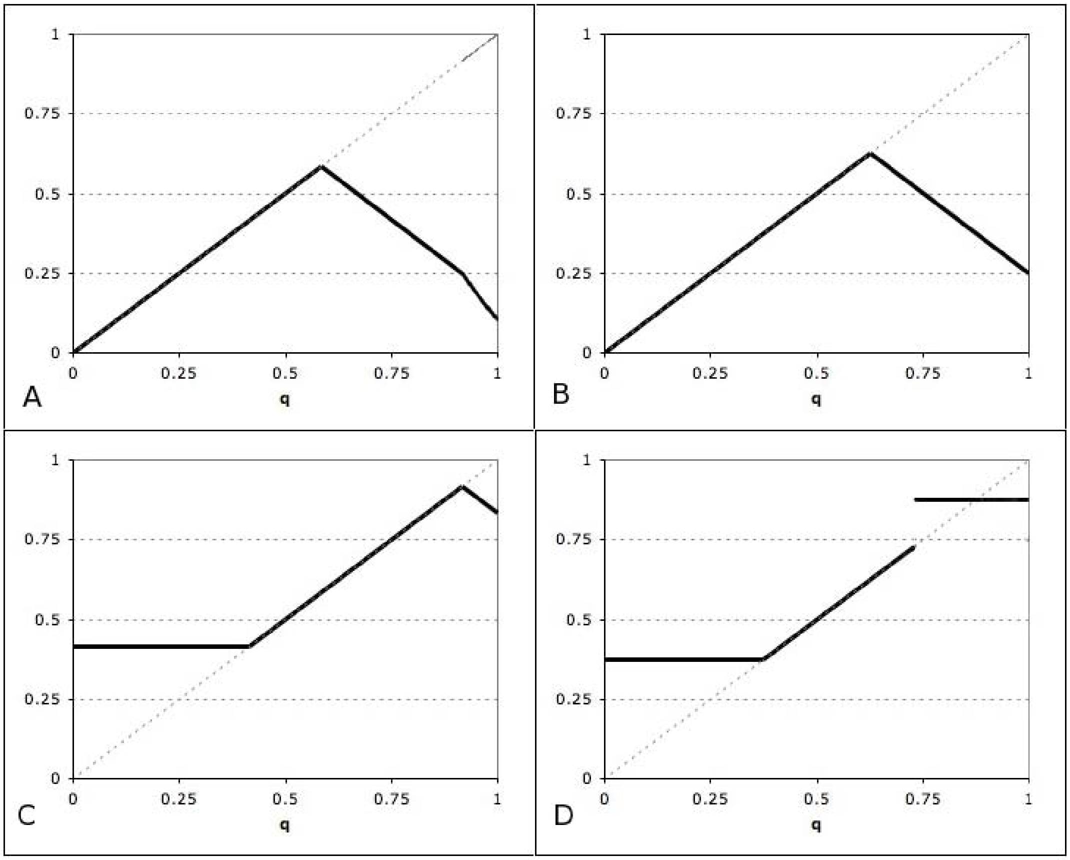

Figure 3: *First Period Proposals of Proposition 1:* $\delta = \frac{1}{2}, \epsilon^1$*(A);* $\delta = 1, \epsilon^1$*(B);* $\delta = \frac{1}{2}, \epsilon^2$*(C);* $\delta = 1, \epsilon^2$*(D)*

Considering this proposition, there are clear differences to the results in the "naive" repeated games without links between the bargaining periods. On the one hand, such one-shot bargaining outcomes (as shown in Figure 2) are all pareto-efficient in that they fall between the policy preferences of the two factions and thus neither committee member could be made better off without making the other worse off in the same period. This is not true in the first period of the dynamic game: Here, generally, a pareto-inefficient first-period policy results for $\frac{1}{2} \leq q_1 \leq (\frac{2+4\delta}{4+4\delta})$ in state ϵ^1 and for all $0 \leq q_1 \leq \frac{1}{2}$ in state ϵ^2. For instance, in the case where $\delta = 1$, in state ϵ^1 the bargaining outcome for $1/2 < q_1 < 3/4$ will not be pareto-efficient and in ϵ^2 this is true for all $q_1 < 1/2$.

Moreover, in the dynamic model, gridlock occurs for a wide range of values. In

ϵ^1, the status quo is not changed for all $q_1 \in \left[0, \frac{2+3\delta}{4+4\delta}\right]$ and in ϵ^2 for all $q_1 \in \left[\frac{2+\delta}{4+4\delta}, \left(\frac{2+\delta+\sqrt{8\delta}}{4+4\delta}\right)\right]$.

4.4 Model 2: The Strategic Effect of Uncertainty

In order to better understand the impact of uncertainty on the inertial behavior of committees, in this section I will explore the consequences of replacing the certain preferences in the previously "calm" second period with the variable economic environment another "crisis" period. Note that the only difference to the basic model is now that the possible preferences of each committee member in the last period are a mean-preserving spread of their calm period value. The narrative above is easily adapted to this scenario by imagining a profound and chaotic shift in the economic environment which leaves open the possibility of quick recovery or a continuation of the shock in the following period.

4.4.1 The Second Period

In order to derive the optimal decision rules for both members in the scenario with two crisis periods, we can again use backward induction: In the second period both members simply desire a policy outcome as close to their preference as possible, considering first period policy x_1 as the given status quo q_2. This preference now depends on the state of nature ϵ_2^S.

Thus, in state ϵ^1, for any $q_2 \in [0, 1/2]$, the status quo will also become the new policy outcome. To see this, note that the status quo's position in between the two preferred points means that any proposal that the chairman prefers to the status quo is farther away from M's optimal point than the status quo and would be rejected. Thus, gridlock occurs for $q_2 < 1/2$. However, for every $q_2 \in [1/2, 1]$, the chairman can make a proposal $G_{C,2}(q_2, \epsilon^1) = 1 - q_2$ which is strictly smaller than the status quo policy for all $q_2 > 1/2$ and thus preferred by the chairman. This is the most profitable outcome to the chairman which the other member will accept. M is indifferent between such a proposal and the status quo because

$$U_M(q_2, \epsilon^1) = -(q_2 - 1/2)^2 = ((1 - q_2) - 1/2)^2 = U_M(G_{C,2}(q_2, \epsilon^1), \epsilon^1).$$

In state ϵ^2, on the other hand, the gridlock interval moves up together with the preferences: Based on an argument similar to the one above, now for $q_2 \in [1/2, 1]$ no change in policy can be agreed upon - the status quo remains unchanged. In case of $q_2 \in [0, 1/2)$, the chairman's preferred policy point $x_2 = 1/2$ is also preferred by M to the status quo. Thus, the chairman proposes $G_{C,2}(q_2, \epsilon^2) = 1/2 \; \forall \; q_2 < 1/2$ and M accepts. These policy outcomes in equilibrium are summarized in Figure 4.

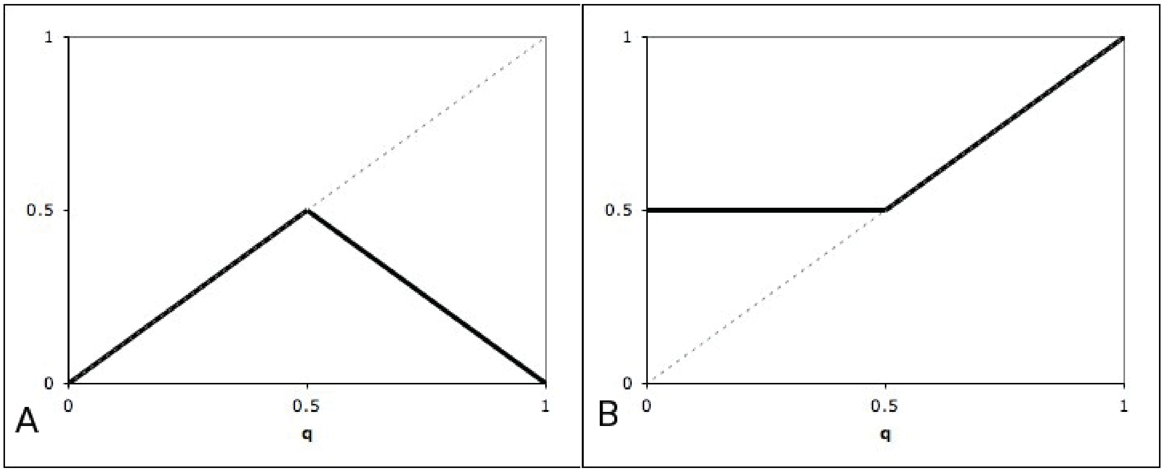

Figure 4: *Second period equilibrium proposals: state* ϵ^1*(A); state* ϵ^2 *(B)*

4.4.2 The First Period Game

As we have seen above, the second period game maps the status quo q_2 to one and only one best policy outcome attainable by C in either state. Given the chairman's second-period choice of policies $G_{C,2}(x_1, \epsilon^s)$ that will actually be accepted, the choice of x_1 determines the second-period outcome as well if the players are sequentially rational. Consequently, with both states equally likely, we can reduce the chairman's problem in period 1 to choosing the optimal $G_{C,1}(q_1, \epsilon^s)$ by solving

$$G_{C,1}(q_1, \epsilon^s) = \arg \max_{x \in A_1(q_1, \epsilon^s)} U_C(x_1, \epsilon^s) + \frac{\delta}{2} \left(\sum_{s=1}^{2} U_{C,2}(x_1, \epsilon^s) \right) \tag{4}$$

for $s = 1, 2$. Here, $A_1(q_1, \epsilon^s)$ denotes M's acceptance set. More specifically, M accepts any policy proposal only under the condition

$$A_1(q_1, \epsilon^s) = x_1 \in [0,1] \; s.t. \; U_M(x_1, \epsilon^s) + \frac{\delta}{2} \left(\sum_{s=1}^{2} U_{M,2}(x_1, \epsilon^s) \right) \geq U_M(q_1, \epsilon^s) + \frac{\delta}{2} \left(\sum_{s=1}^{2} U_{M,2}(q_1, \epsilon^s) \right)$$

with $s = 1, 2$.

The second period strategies are the same as above and below are the optimal strategies in the first period - the proof can be found in the section 5.

Proposition 2: In the two-period game with uncertainty over the second period state of the economy ϵ_2^s, for all $q_1 \in [0,1]$ and economic states ϵ_1^1 and ϵ_1^2, the chairman proposes (and M accepts) $G_{C,1}(q_1, \epsilon^1)$ and $G_{C,1}(q_1, \epsilon^2)$ respectively, where

$$G_{C,1}(q_1, \epsilon^1) = \begin{cases} q_1 & \text{for } q_1 \in \left[0, \dfrac{2+3\delta}{4+4\delta}\right] \\ 2\left(\dfrac{2+3\delta}{4+4\delta}\right) - q_1 & \text{for } q_1 \in \left[\dfrac{2+3\delta}{4+4\delta}, 2\left(\dfrac{2+3\delta}{4+4\delta}\right) - \frac{1}{2}\right] \\ \frac{1}{2} - v & \text{for } q_1 \in \left[2\left(\dfrac{2+3\delta}{4+4\delta}\right) - \frac{1}{2}, 1\right] \end{cases}$$

for which $v = \dfrac{\sqrt{(4q_1 - 2)(2q_1\delta^2 + 6q_1\delta + 4q_1 - 2\delta^2 - 5\delta - 2)}}{2\delta + 4}$, and

$$G_{C,1}(q_1, \epsilon^2) = \begin{cases} \dfrac{1}{2+\delta} & \text{for } q_1 \in \left[0, \dfrac{1}{2+\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{1}{2+\delta}, \left(\dfrac{1}{2+\delta}\right)\left(1 + \dfrac{\sqrt{2\delta^3}}{4\sqrt{\delta+1}}\right)\right] \\ \dfrac{2+3\delta}{4+4\delta} & \text{for } q_1 \in \left[\left(\dfrac{1}{2+\delta}\right)\left(1 + \dfrac{\sqrt{2\delta^3}}{4\sqrt{\delta+1}}\right), \dfrac{2+3\delta}{4+4\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{2+3\delta}{4+4\delta}, \dfrac{4+3\delta}{4+4\delta}\right] \\ 2\left(\dfrac{4+3\delta}{4+4\delta}\right) - q_1 & \text{for } q_1 \in \left[\dfrac{4+3\delta}{4+4\delta}, 1\right] \end{cases}$$

for $\delta \in [0, 1]$. These results are graphed in panels A and C, as well as B and D of Figure 5 for $\delta = 1/2$ and $\delta = 1$ respectively.

This proposition shows that a mean-preserving spread over the second period preferences changes the first period dynamics of the game. While the range of status quo values that lead to a bargaining outcome that is pareto-inefficient is unchanged from Model 1 for ϵ^1, in ϵ^2 it is reduced to

$$q_1 < \left(\frac{1}{2+\delta}\right)\left(1 + \frac{\sqrt{2\delta^3}}{4\sqrt{\delta+1}}\right) \leq \frac{1}{2}.$$

Moreover, while the gridlock interval is the same in state ϵ^1 of Proposition 2 as in Model 1, there are two gridlock intervals under uncertainty in state ϵ^2 instead of one. Their combined size is

$$\frac{\sqrt{2\delta^3}}{(8+4\delta)\sqrt{1+\delta}} + \frac{1}{2+2\delta}.$$

Note also, that there is a discrete and relatively large jump in the reaction function at $q_1 = \left(\dfrac{1}{2+\delta}\right)\left(1 + \dfrac{\sqrt{2\delta^3}}{4\sqrt{\delta+1}}\right) \leq \frac{1}{2}$ to a pareto-efficient bargaining outcome.

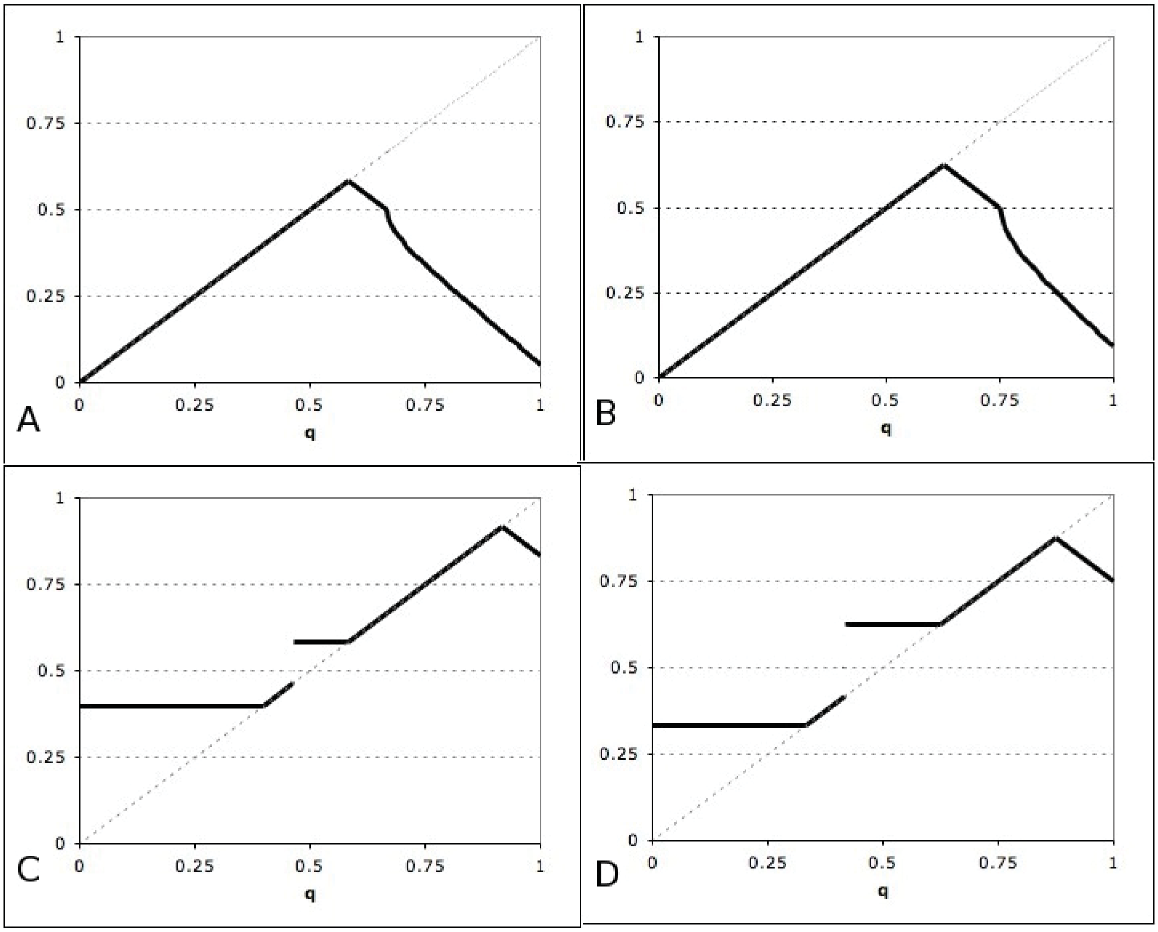

Figure 5: *First Period Proposals of Proposition 2:* $\delta = \frac{1}{2}, \epsilon^1(A)$; $\delta = 1, \epsilon^1(B)$; $\delta = \frac{1}{2}, \epsilon^2(C)$; $\delta = 1, \epsilon^2(D)$

4.5 Model 3: Taking Turns - The Effect of Proposal Power

While the difference between Model 1 and Model 2 illustrated the impact of a change in the economic environment, the inefficiency of the MPC might depend on its institutional setup of agenda-setting power. Therefore, I will in this section investigate how my results are affected by relaxing the monopoly on proposal power that the chairman holds. To that end, I will introduce another draw at the beginning of every period that determines which of the two committee factions gets to propose the policy, leaving the other to accept or reject the proposal. Thus, the chairman no longer is the fixed agenda-setter - C and M are ex ante identical in their institutional role. More specifically, the random variable λ_t^L - the state of leadership in the committee - has two possible values λ^1 and λ^2 with equal transition probabilities $prob(\lambda^1 \mid \lambda^2) = prob(\lambda^2 \mid \lambda^1) = 1/2$. I take λ^1 and λ^2 to represent C and M holding the proposal power respectively. Note that Model 2 is simply a special case of this model where the probability of λ^2 occurring is zero.

4.5.1 Second Period

The second period is basically as before, but for the two possible leadership states λ_2^L. Thus, there are now four different situations that are equally likely to occur if we consider every combination of the leadership with the two states of the economy. The state vectors (ϵ^1, λ^1) and (ϵ^2, λ^1) are the ones already analyzed in section 4.4.1 and graphed in Figure 4. Now we need to find the equilibrium strategies for (ϵ^1, λ^2) and (ϵ^2, λ^2), the second period bargaining outcomes of which are depicted in figure 6. The basic model I am considering is symmetric in the sense that the players' equilibrium strategies are mirror images: if the numbering of the policy space were inverted, the second period outcomes if M has the proposal power turn out to be symmetric to C's equilibrium proposals. Thus, the reasoning for M's second period proposals is strictly analogous to the one employed in section 4.4.1 above.

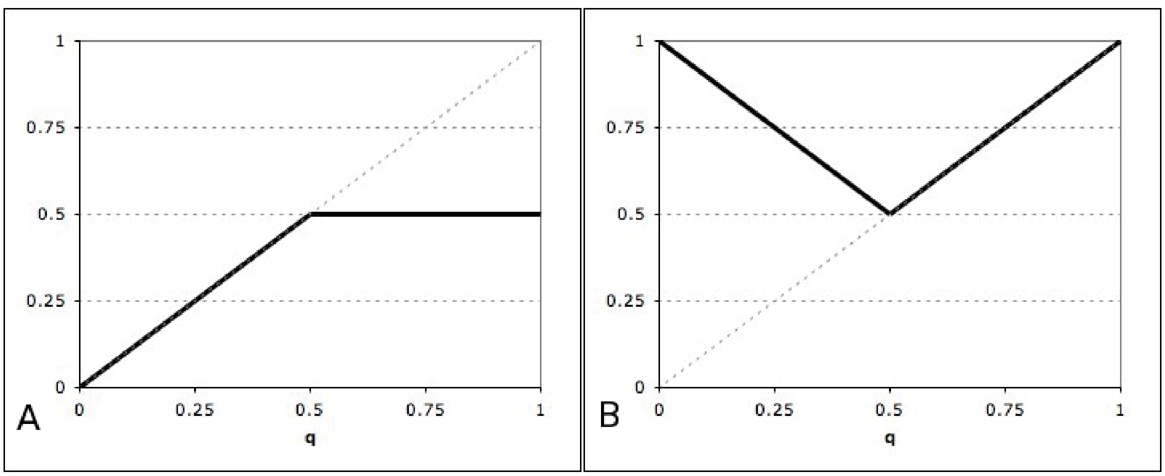

Figure 6: *Second Period equilibrium if M holds proposal power: state ϵ^1(A); state ϵ^2 (B)*

4.5.2 First Period

Knowing these four possible second-period scenarios and their likelihood, the party holding the agenda-setting power in the first period chooses the optimal acceptable policy $G_{L,1}(q_1, \epsilon^s)$. For the sake of being able to compare results more easily, I will assume that the draw has granted C the proposal power in the first period. However, due to the modeling symmetry, all results are easily transferable to M holding the proposal power first. Thus, in the first period C needs to solve

$$G_{C,1}(q_1, \epsilon_t^s, \lambda_2^L) = \arg \max_{x \in A_1^L(q_1, \epsilon_t^s, \lambda_t^L)} U_C(x_1, \epsilon_1^s) + \frac{\delta}{4}\left(\sum_{L=1}^{2}\sum_{s=1}^{2} U_{C,2}(x_1, \epsilon^s, \lambda_2^L)\right) \tag{5}$$

for $s = 1, 2$ and $L = 1, 2$. Here, $A_1^L(q_1, \epsilon^s, \lambda_t^L)$ denotes the acceptance set of the faction chosen to accept or reject the other party's proposal - by assumption this is M. More specifically, M accepts any policy proposal only under the condition that

$$A_1(q_1, \epsilon^s, \lambda_t^L) = x_1 \in [0, 1] \; s.t.$$

$$U_M(x_1, \epsilon^s) + \frac{\delta}{4}\left(\sum_{L=1}^{2}\sum_{s=1}^{2} U_{M,2}(x_1, \epsilon^s, \lambda_2^L)\right) \geq U_M(q_1, \epsilon^s) + \frac{\delta}{4}\left(\sum_{L=1}^{2}\sum_{s=1}^{2} U_{M,2}(q_1, \epsilon^s, \lambda_2^L)\right),$$

with $s = 1, 2$ and $L = 1, 2$.

Under these conditions, we can again derive the equilibrium proposals for any given status quo in the first period, given in Proposition 3, the proof of which can be found in section 5.

Proposition 3: In the two-period game with uncertainty over the second period state of the economy ϵ_2^s and assignment of proposal power λ_2^L in the second period, for all $q_1 \in [0, 1]$ in the states ϵ_1^1 and ϵ_1^2, the first-period agenda-setter C proposes (and M accepts) $G_{C,1}(q_1, \epsilon_1^1)$ and $G_{C,1}(q_1, \epsilon_1^2)$ respectively, where

$$G_{C,1}(q_1, \epsilon_1^1) = \begin{cases} \dfrac{\delta}{8+6\delta} & \text{for } q_1 \in \left[0, \dfrac{\delta}{8+6\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{\delta}{8+6\delta}, \dfrac{2+\delta}{4+3\delta}\right] \\ 2\left(\dfrac{2+\delta}{4+3\delta}\right) - q_1 & \text{for } q_1 \in \left[\dfrac{2+\delta}{4+3\delta}, \frac{1}{2}\right] \\ z(q_1, \delta) & \text{for } q_1 \in \left[2\left(\dfrac{2+\delta}{4+3\delta}\right) - \frac{1}{2}, J_1\right] \\ q_1 & \text{for } q_1 \in \left[J_1, \dfrac{4+5\delta}{8+6\delta}\right] \\ 2\dfrac{4+5\delta}{8+6\delta} - q_1 & \text{for } q_1 \in \left[\dfrac{4+5\delta}{8+6\delta}, 2\dfrac{4+5\delta}{8+6\delta} - J_1\right] \\ z(q_1, \delta) & \text{for } q_1 \in \left[2\dfrac{4+5\delta}{8+6\delta} - J_1, 1\right] \end{cases}$$

for which

$$z = \frac{2+\delta}{4+3\delta} - \frac{3}{8+6\delta}\sqrt{(1/9)(2\delta+4)^2 - 4(\delta+4/3)(q_1(4/3+5\delta/3) - q_1^2(\delta+4/3) - \delta/2)}$$

and

$$J_1 = \frac{15\delta^2 - \sqrt{3}(3\delta^2 + 4\delta) + 32\delta + 16}{2(3\delta + 4)^2}$$

.

$$G_{C,1}(q_1, \epsilon_1^2) = \begin{cases} \dfrac{4+\delta}{8+6\delta} & \text{for } q_1 \in \left[0, \dfrac{4+\delta}{8+6\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{4+\delta}{8+6\delta}, J_2\right] \\ \dfrac{2+2\delta}{4+3\delta} & \text{for } q_1 \in \left[J_2, \dfrac{2+2\delta}{4+3\delta}\right] \\ q_1 & \text{for } q_1 \in \left[\dfrac{2+2\delta}{4+3\delta}, \dfrac{8+5\delta}{8+6\delta}\right] \\ 2\left(\dfrac{8+5\delta}{8+6\delta}\right) - q_1 & \text{for } q_1 \in \left[\dfrac{8+5\delta}{8+6\delta}, 1\right] \end{cases}$$

where

$$J_2 = \frac{3\delta^2 + \sqrt{3}(3\delta^2 + 4\delta) + 16\delta + 16}{2(3\delta + 4)^2}$$

for $\delta \in [0, 1]$. These results are graphed for $\delta = 1/2$ and $\delta = 1$ in panels A and C, as well as B and D of Figure 7, respectively.

Under uncertainty over the future economic state and the proposal power, the dynamics are different from the two other models: now, as we can see in panels A and B of Figure 6, in ϵ^1 there are several inflection points of the proposal function, so that some proposals could result from up to four different status quo policy values.

As we have removed the ex ante asymmetry in proposal power, it turns out that this also equalizes the inefficiency of the two economic states: the gridlock intervals in, ϵ^1 and ϵ^2, both add up to equal J_2 respectively.

4.6 Results

In the three models solved above, we have found that substantial inertia and policy inefficiency can be found in dynamic bargaining models with an endogenous status quo. Moreover, three different variations in the model have been analyzed and fully solved: Firstly, the change between Model 1 and 2 illustrates the impact of uncertainty in the form of a mean-preserving spread in second period preferences on the policy outcome. Secondly, the institutional change from Model 2 to Model 3 shows that equilibrium strategies and inertial behavior can change substantially in response to a variation in agenda-setting power. The exact direction of these changes in policy inefficiency will be discussed in a later section.

However, the basic intuition underlying these observations of inertial behavior in the model, which will be important to understand the impact of the variations, is

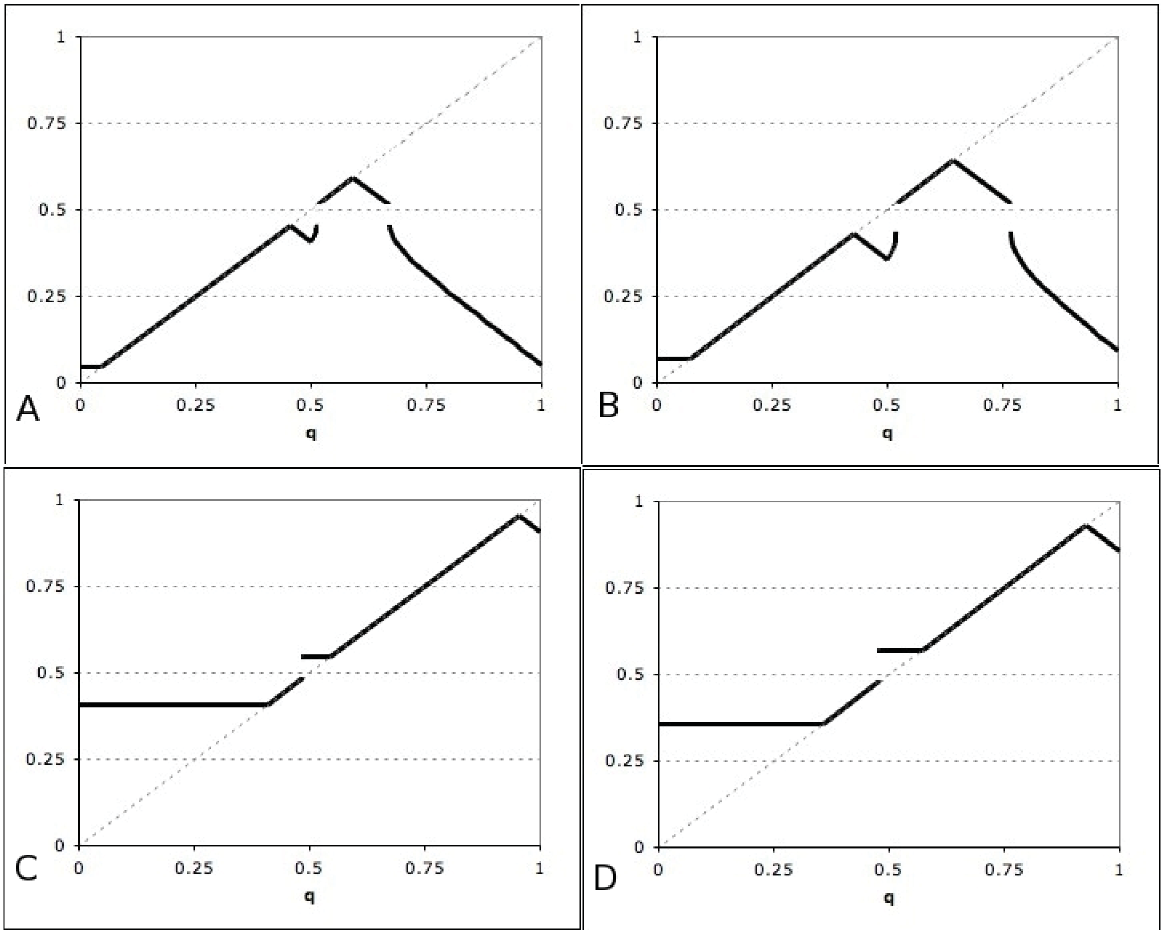

Figure 7: *First Period proposals of Proposition 3:* $\delta = \frac{1}{2}, \epsilon^1 (A); \delta = 1, \epsilon^1 (B); \delta = \frac{1}{2}, \epsilon^2 (C); \delta = 1, \epsilon^2 (D)$

the following: In every model analyzed above, the second-period outcomes that are anticipated make all first-period policy decisions a tradeoff for every player between attaining a policy close to the first-period preference, and gaining a status quo that will lead to more favorable outcomes in the second period. Due to the quadratic payoffs, both players are risk-averse. Consequently, there are policy values at the margin of the policy space that both players dislike. If the first-period status quo is in these areas, both players are willing to make concessions to move towards "safer" policy rates closer to the center of the range which give them a higher expected utility in the game as a whole. However, the agenda-setter can use his proposal power to extract most of this utility increase from the other committee member. In the graphs in this paper, we can see this effect in the kinks in the proposal curve that appear close to the upper end of the possible status quo range and bring the equilibrium outcome closer to the agenda-setter's preference.

In all three models, discrete jumps in the equilibrium proposal function are possible.

These occur because the second-period equilibrium outcome functions are multiple-to-one functions which can lead to multiple local utility maxima in the first period for every player. For instance, when in the first period one locally optimal policy rate for proposals in the lower half of the policy continuum is unattainable due to the veto power of the other committee member, the agenda setter might switch his proposal to the local maximum in the upper half of the policy continuum, which appears as a jump in the equilibrium proposal plot. Due to these jumps, marginal changes in the first-period status quo can, at times, lead to substantially different policy outcomes, which means that strategic policy committees can behave in seemingly erratic ways that are a result of their dynamic bargaining mechanism.

Moreover, in every possible first-period state of all three models, there are status quo values that result in a pareto-inefficient policy - a policy outcome that does not lie in between the two players' preferences $r_i(\epsilon^s)$ for that period. These inefficiencies are noteworthy because they could be improved upon from an overall welfare standpoint by simply appointing one of the two factions as the policy-setter without giving the other faction any input into the decision-making.

Two different aspects of the bargaining model together induce these inefficiencies: On the one hand, the consensus-seeking approach means that the other committee member can effectively veto future policy changes. On the other hand, the link between periods via the endogenous policy status quo enables the agenda-setter to hedge against being stuck - due to a lack of consensus - at a very unfavorable policy rate in the future. This hedging then comes at the cost of pareto-efficiency in the first period. In some sense, the inefficiency occurs because the agenda-setter only internalizes his private cost from the hedging when he weighs different proposals, imposing a negative externality on the overall welfare outcome.

The comparative statics of the variations on the basic model and the testable implications that can be derived from them are discussed in more detail in section 6.

5 Proofs of Propositions

5.1 Proof of Proposition 1

5.1.1 First-period state is ϵ^1

For all first-period proposals $x_1 \leq 1/4$, the second-period outcome is the same: the chairman's preference. Moreover, C's second-period payoff falls with higher x_1 for all $1/4 < x_1 \leq 1$. Thus, given any status quo $q_1 \leq 1/2$, the chairman's sole concern is to bring the outcome as close as possible to his preference $r_C(\epsilon^1) = 0$ in the first period - only proposals smaller or equal to the status quo will be made by the chairman.

However, as the second-period utility to M would be unaffected or lowered by accepting any $x_1 < q_1$ for all $q_1 \leq 1/2$, while his first-period utility actually decreases for higher policies x_1, his acceptance set only contains values at least as big as the status quo, that is

$$A_1(q_1 \leq \frac{1}{2}, \epsilon^1) = x_1 \in [0,1] \ s.t. \ \ x_1 \geq q_1.$$

Combining this restriction with C's payoffs, we see that the $G_{C,1}(q_1 \leq 1/2, \epsilon^1) = q_1$.

In order to define M's preferences for $q_1 > 1/2$, we need to find the first-period policy that maximizes his total game payoff:

$$\max_{x_1} -[(x_1 - \frac{1}{2})^2 + \delta(x_2 - \frac{3}{4})^2] \tag{6}$$

where the second period outcome as a function of the first-period outcome is given in section 4.3.1 . The unique solution is $x^*_{1,M} = \dfrac{2+3\delta}{4+4\delta}$. As payoffs are symmetric around $x^*_{1,M}$, M's acceptance set for a certain range of status quo values will only contain values of x_1 that are at least as close as q_1 to $x^*_{1,M}$. That is, we need

$$A_1(q_1 \geq \frac{1}{4}, \epsilon^1) = x_1 \in [1/4, 1] \ s.t. \ \ \|x_1 - \frac{2+3\delta}{4+4\delta}\| \leq \|q_1 - \frac{2+3\delta}{4+4\delta}\| \tag{7}$$

where the restriction to outcomes larger than 1/4 will be explained below. Again, the chairman prefers no outcome in the acceptance set to the status quo as long as $q_1 \leq x^*_{1,M}$. Thus the gridlock with $G_{C,1}(q_1, \epsilon^1) = q_1$ is in fact the equilibrium outcome for all status quo values $0 \leq q_1 \leq x^*_{1,M}$.

However, for $q_1 > x^*_{1,M}$ it is easy to see that M's utility decreases for higher status quo values. Thus, M's equidistance acceptance set given in equation 7 will contain some policies $x_1 < q_1$. These are of course preferred by C to the status quo. Thus, the equilibrium proposal by C will be the lowest one of these, that is,

$$G_{C,1}(q_1, \epsilon^1) = \left\{x_1 \ s.t. \ \ \|x_1 - x^*_{1,M}\| = \|q_1 - x^*_{1,M}\|\right\} = 2x^*_{1,M} - q_1. \tag{8}$$

for all values $x^*_{1,M} \leq q_1 \leq (2x^*_{1,M} - 1/4)$. The latter limit comes about, because for $x_1 < 1/4$, the maximization in equation 6 no longer accurate because the second-period outcome function changes there - for $q_2 \leq 1/4$, it is simply constant at $\frac{\delta}{4}$. Thus, we need to adjust the utility function that we compare to the utility that M obtains from the status quo accordingly. in order to find the outcomes $x_1 < 1/4$ in M's acceptance set, which give him higher utility than the status quo, we need to solve:

$$-\left[(x_1 - \frac{1}{2})^2 + \frac{\delta}{4}\right] \geq -\left[(q_1 - \frac{1}{2})^2 + \delta(\frac{3}{4} - q_1)^2\right]$$

where the second-period payoff on the right-hand side is a result of $G_{C,2}(q_2 > 3/4, \epsilon^3) = \frac{3}{2} - q_2$. This inequality condition will be binding in equilibrium, as the chairman chooses the lowest value of this acceptance set. The only solution to the binding constraint for which $0 \leq x_1 \leq 1/4$, is defined by

$$G_{C,1}(q_1, \epsilon^1) = \frac{1}{2} - \sqrt{(1+\delta)q_1^2 - (\frac{3\delta+2}{2})q_1 + \frac{5\delta}{16} + \frac{1}{4}}.$$

which will therefore be the equilibrium proposal for $(2x^*_{1,M} - 1/4) \leq q_1 \leq 1$. Note that this proposal function declines more steeply than the one in equation 8. The intuition behind this is that for $1/4 < x_1 < 3/4$, a lower first-period policy led to lower utility for M in the second period. For $x_1 < 1/4$, however, the second-period outcome is constant in this low range of first-period policies so that lower first-period policies do not "hurt" M at the margin in the second period. Thus, C can extract larger concessions in terms of policy space in the first period while leaving M no worse off than staying with the status quo.

5.1.2 First-period state is ϵ^2

Here, we start by finding the optimal first-period policy for M by solving:

$$\max_{x_1} -[(x_1 - 1)^2 + \delta(x_1 - \frac{3}{4})^2]$$

The solution is

$$x^*_{1,M} = \frac{4+3\delta}{4+4\delta}.$$

As above, this maximization accurately describes M's optimization problem unless we have $x_1 < 1/4$ as the chairman's proposal, which is never the case in equilibrium, as I will show below. Consequently, M's acceptance set is

$$A_1(q_1, \epsilon^1) = x_1 \in [0,1] \; s.t. \; \|x_1 - x^*_{1,M}\| \leq \|q_1 - x^*_{1,M}\|. \quad (9)$$

Similarly, we can find C's optimal first-period policy for low q_1 by solving

$$\max_{x_1} -[(x_1 - \frac{1}{2})^2 + \delta(x_1 - \frac{1}{4})^2] \;\; \forall \;\; x_1 \in [1/4, 3/4]. \quad (10)$$

Here, the solution is

$$x^*_{1,C} = \frac{2+\delta}{4+4\delta}.$$

For $x_1 < 1/4$, the maximization in equation 10 is not valid, because the second period payoff is constant over that interval. However, we can easily see that the optimal proposal for C with a constant second-period payoff is 1/2 which lies outside of the interval over which we are maximizing. Thus the chairman never proposes $x_1 < 1/4$

in equlibrium. This is possible, because some $x_1 > 1/4$ will always be accepted as we see below - making the maximizations in equation 10 sufficient t characterize the equilibrium strategies in spite of the change in the second-period payoff function for low $q_1 < 1/4$.

Consequently, as long as $x^*_{1,C} \geq q_1$, that is, for all $q_1 < \dfrac{2+\delta}{4+4\delta}$ the chairman can propose his optimal policy in equilibrium and M accepts. However, for greater status quo values, the chairman's preferred policy is lower than the status quo. We know from the definition of M's acceptance set in (9) above that M will reject values lower than the status quo if both proposal and status quo are lower than $x^*_{1,M}$. Thus, an interval of gridlock begins, whose lower bound is given by $q_1 = \dfrac{2+\delta}{4+4\delta} = x^*_{1,C}$.

In order to determine the upper bound of the gridlock interval we need to consider the point where C's second-period payoff function changes: For all $x_1 > 3/4$, we have seen in section 4.3.1 that $G_{C,2}(q_2, \epsilon^3) = \frac{3}{2} - x_1$. Again, we can calculate C's optimal policy - we will call it $x^{**}_{1,C}$ to differentiate it from $x^*_{1,C}$ - if he chooses an x_1 in this range. We solve

$$\max_{x_1} -[(x_1 - \frac{1}{2})^2 + \delta(\frac{3}{2} - x_1 - \frac{1}{4})^2] \;\; \forall \;\; x_1 \in [3/4, 1] \tag{11}$$

and find that

$$x^{**}_{1,C} = \frac{2+5\delta}{4+4\delta}.$$

Now, in order to determine when, if ever, C prefers to propose such a high x_1 to sticking with the status quo under gridlock, we can simply look for a threshold value q^r_1 after which continuing with the gridlock yields a lower payoff than switching to proposing $x^{**}_{1,C}$ instead. We solve for q^r_1 in

$$(q_1 - \frac{1}{2})^2 + \delta(q_1 - \frac{1}{4})^2 = (x^{**}_{1,C} - \frac{1}{2})^2 + \delta(\frac{3}{2} - x^{**}_{1,C} - \frac{1}{4})^2. \tag{12}$$

The only solution for which the q^r_1 - the *reaction point* at which the equilibrium policy jumps discontinuously to $x^{**}_{1,C}$ - is greater than 1/4, so that the left-hand side of the equation is valid, is

$$q^r_1 = \frac{2+\delta+\sqrt{8\delta}}{4+4\delta}. \tag{13}$$

So for any $q^r_1 \leq q_1 \leq x^{**}_{1,C}$, we have $G_{C,1}(q_1, \epsilon^2) = x^{**}_{1,C}$. The intuition behind this jump is that, due to the quadratic disutilitites, for high δ the game payoff for $C$is very negatively affected by unfavorable second-period outcomes. Moreover, the second-period outcomes are kinked so that for very high x_1, C can actually extract a better policy in the second round than for slightly lower ones. Thus, there comes a point where taking the hit to first-period utility by deliberately proposing a policy more removed from C's first-period preference is more than made up for by the more favorable policy in the second period that very high status quo values allow C to get.

Note that $x^{**}_{1,C} \leq x^*_{1,M}$. Therefore, there will again be a gridlock interval whose lower bound is $q_1 = x^{**}_{1,C}$, because after that point the status quo is closer to $x^*_{1,M}$ than the chairman's optimal proposal and the value in M's acceptance set that maximizes C's utility is the lowest one - the status quo.

Once the status quo is *higher* than $x^*_{1,M}$, however, we can see from (9) that there are policy proposals in M's acceptance set correspondingly *lower* than $x^*_{1,M}$ which are preferred by C and yields the same payoff to M. Thus, in equilibrium C will propose a policy that leaves M just indifferent between the proposal and the higher status quo. That is, C offers

$$G_{C,1}(q_1 \geq x^*_{1,M}, \epsilon^2) = \{x_1 \ s.t. \ \|x_1 - x^*_{1,M}\| = \|q_1 - x^*_{1,M}\|\} = 2x^*_{1,M} - q_1 \tag{14}$$

and M accepts. However, C will only lower his proposal away from $x^*_{1,M}$ until it is equal to $x^{**}_{1,C}$ - his preferred policy in the upper half of the policy range - and then propose $x^{**}_{1,C}$ for all $q_1 > 2x^*_{1,M} - x^{**}_{1,C}$.

5.2 Proof of Proposition 2

5.2.1 First-period state is ϵ^1

As we saw in the previous proof, knowing the agenda-setter's local utility maxima is very useful in determining his equilibrium strategy. In Model 2, the second-period payoff functions change at $q_2 = 1/2$, which means that there are two policy intervals to consider that could have different local utility maxima. In ϵ^1, for all $x_1 \in [0, \frac{1}{2}]$ - the lower half of the policy space - the chairman solves the optimization problem

$$\max_{x_1} -[x^2 + \frac{\delta}{2}(x^2)] \tag{15}$$

which has the unique solution that we will call $x^*_C = 0$ for $\delta \in [0, 1]$. On the other hand, If he considers proposals in the upper half $x_1 \in [\frac{1}{2}, 1]$, he solves

$$\max_{x_1} -[x^2 + \frac{\delta}{2}((x-1)^2) + (x - \frac{1}{2})^2)], \tag{16}$$

which has no interior solution, but decreases in x_1. Thus, choosing a proposal in $x_1 \in [0, \frac{1}{2}]$ always gives C a utility at least as high as any $x_1 \in [\frac{1}{2}, 1]$. Consequently, the chairman would like x_1 to be as close as possible to $x^*_C = 0$ and, in equilibrium, it needs to be true that $x_1 \leq q_1$.

Similarly, we can find player M's local utility-maximizing first-period policies in the lower and the upper half of the policy spectrum - let's call them $x^*_{M,L}$ and $x^*_{M,U}$.

The preferred policy for $x_1 \in [0, \frac{1}{2})$ can be found by solving

$$\max_{x_1} -[(x-\frac{1}{2})^2 + \frac{\delta}{2}((x-\frac{\delta}{2})^2) + (\frac{1}{2})^2)] \tag{17}$$

gives the boundary solution $x^*_{M,L} = 1/2$. Thus, the utility to M increases in x_1. On the other hand, for policy rates $x_1 \in [\frac{1}{2}, 1]$, M solves

$$\max_{x_1} -[(x-\frac{1}{2})^2 + \frac{\delta}{2}((x-\frac{\delta}{2})^2) + (x-1)^2)]$$

which results in a preferred policy value of $x^*_{M,U} = \dfrac{2+3\delta}{4+4\delta}$. It can be easily verified that for $1/2 \leq x_1 \leq x^*_{M,U}$, M's payoff strictly increases in x_1. Thus, for $q_1 < x^*_{M,U}$, M will only accept policy proposals greater than the status quo.

policy is symmetric around $x_1 = \dfrac{2+3\delta}{4+4\delta}$ and for $x_1 \in \left(\frac{1}{2}, \dfrac{2+3\delta}{4+4\delta}\right]$ M's payoff is strictly greater than for any $x_1 \in [0, \frac{1}{2}]$. Thus, M accepts any proposal closer to $\dfrac{2+3\delta}{4+4\delta}$ than the status quo.

Consequently, for this interval $q_1 \in [0, x^*_{M,U}]$, C's preferred value in the acceptance set is the status quo - gridlock occurs. As long as a policy from the upper half of the spectrum is chosen, $M's$ payoff is symmetric around $x^*_{M,U}$ due to the quadratic loss function. Thus, for the interval $q_1 \in \left[x^*_{U,M}, 2x^*_{M,U} - \frac{1}{2}\right]$ there is a policy $x_1 = 2x^*_{M,U} - q_1$ that makes M indifferent between the status quo and is the lowest acceptable proposal. As the chairman's utility increases with lower policies, this indifference point conditional on the status quo will be the equilibrium proposal. in this interval.

For $q_1 \geq 2x^*_{M,U} - \frac{1}{2}$, however, we know that the lowest acceptable x_1 is smaller than $\frac{1}{2}$. But at $q_2 = 1/2$ the second-period payoff function changes and with it the range of policy values which make M better off than the status quo. We can describe the lowest acceptable policy in this interval by a function that chooses the lowest possible x_1 such that M is indifferent between the status quo and the policy offered, given the discount factor. More specifically, we want to find $v(q_1, \delta)$ such that

$$-\left[(-\frac{1}{2})^2 + \frac{\delta}{2}((z-\frac{1}{2})^2 + (\frac{1}{2})^2)\right] = -\left[(q_1-\frac{1}{2})^2 + \frac{\delta}{2}((q_1-\frac{1}{2})^2 + (q_1-1)^2)\right]. \tag{18}$$

Some algebra gives us $v = \dfrac{\sqrt{(4q_1-2)(2q_1\delta^2 + 6q_1\delta + 4q_1 - 2\delta^2 - 5\delta - 2)}}{2\delta+4}$, which will be the equilibrium proposal for $q_1 \geq 2x^*_{M,U} - \frac{1}{2}$.

5.2.2 First-period state is ϵ^2

Using the by now familiar method of maximizing the interval-specific utility function with regard to x_1 we find that if a policy from $x_1 \in [0, \frac{1}{2}]$ is chosen, the chairman's utility is maximized at $x^*_{C,L} = \dfrac{1}{2+\delta}$. On the other hand, for $x_1 \in [\frac{1}{2}, 1]$, C's local utility maximum occurs at $x^*_{C,U} = \dfrac{2+3\delta}{4+4\delta}$. We can also easily compute that of these two policies, $x^*_{C,L}$ is the global maximizer of the chairman's utility for all $x_1 \in [0, 1]$.

Analogously, for the interval $x_1 \in [\frac{1}{2}, 1]$, member M now solves

$$\max_{x_1} -[(x-1)^2 + \frac{\delta}{2}((x-1)^2) + (x-\frac{1}{2})^2)) \tag{19}$$

yielding the solution $x^*_{M,U} = \dfrac{2+3\delta}{4+4\delta}$, which is the only utility maximum. To see this, note that when policies from $x_1 \in [0, \frac{1}{2}]$ are considered by M, he solves

$$\max_{x_1} -[(x-1)^2 + \frac{\delta}{2}((\frac{1}{2})^2 + (x-\frac{1}{2})^2))] \tag{20}$$

which only has the boundary solution $x^*_{M,L} = \frac{1}{2}$, indicating that But we know that $x^*_{M,L}$ cannot be a maximum of the policy continuum because for $x_1 \in [\frac{1}{2}, 1]$ utility increases for policy values closer to $x^*_{M,U}$ and thus some policy values adjacent to $x^*_{M,L}$ have a higher utility. This also implies that for $0 \leq q_1 \leq x^*_{M,U}$ all proposals in M's acceptance set are at least as great as the status quo.

From the latter fact, we can derive the equilibrium proposals by the chairman in the same interval: C can get his global utility maximum $x^*_{L,C} = \dfrac{1}{2+\delta}$ accepted for all $q_1 \in [0, x^*_{U,M}]$. Moreover, for status quo values slightly greater than $x^*_{M,U}$, the status quo will be the policy with the highest utility to C in the acceptance set so that gridlock occurs.

This gridlock interval of status quo values will be bounded at the lower end by $x^*_{M,U}$ and at the upper end by the status quo value at which the utility for C from gridlock is less than his payoff from getting his preferred value in the upper half of the policy continuum - $x^*_{C,U}$ - accepted. We can find the status quo value at which his policy proposal jumps between the two main intervals - let's call it the *reaction point* - by solving C's indifference condition comparing the utility from proposing the status quo in $x_1 \in [0, \frac{1}{2}]$ to the utility from $x^*_{C,U}$:

$$\left(x_1 - \frac{1}{2}\right)^2 + \frac{\delta}{2}(x_1)^2 = \left(\frac{2+3\delta}{4+4\delta} - \frac{1}{2}\right)^2 + \frac{\delta}{2}\left[\left(\frac{2+3\delta}{4+4\delta} - \frac{1}{2}\right)^2 + \left(1 - \frac{2+3\delta}{4+4\delta}\right)^2\right]$$

From this condition, we find that

$$y = \left(\frac{1}{2+\delta}\right)\left(1 + \frac{\sqrt{2\delta^3}}{4\sqrt{\delta+1}}\right) \tag{21}$$

is the *reaction point*. Note that $y \leq \frac{1}{2} \; \forall \; \delta \in [0, 1]$.

Moreover, note that

$$x^*_{C,U} = \frac{2 + 3\delta}{4 + 4\delta} < \frac{4 + 3\delta}{4 + 4\delta} = x^*_{M,U} \quad \forall \; \delta \in [0, 1] \tag{22}$$

Thus, M will accept $x^*_{C,U}$ as long as it is greater than the status quo, which is true for $y \leq q_1 \leq x^*_{C,U}$ with y given in (21) above.

By the same reasoning, for $x^*_{C,U} \leq q_1 \leq x^*_{M,U}$, gridlock occurs because the status quo is the lowest and utility-maximizing policy in M's acceptance set.

However, when the status quo policy is above $x^*_{M,U}$, as noted several times before, the acceptance set also contains values lower than $x^*_{M,U}$ that are at most equidistant with the status quo from it. The local symmetry of payoffs to M will suffice here to determine the equilibrium proposal as no equilibrium policies in this interval will be from the lower half of the policy space. The value in the acceptance set that maximizes C's utility is the lowest one, which is simply obtained by reflecting the status quo in M's preferred policy $x^*_{M,U}$. Thus, the equilibrium proposal for $x^*_{M,U} \leq q_1 \leq 1$ will be

$$G_{C,1}(q_1, \epsilon^2) = 2x^*_{M,U} - q_1 = 2\left(\frac{2 + 3\delta}{4 + 4\delta}\right) - q_1 \; . \tag{23}$$

5.3 Proof of Proposition 3

First, we should note that there are two different possible states of the economy in the first period, as well as two different factions in the committee, and two different halves of the policy space in which the policy choice x_1 can fall. Thus, we can think about every player having a preferred policy outcome in the first period for every economic state and half of the policy space. In order to simplify the strategic analysis of the equilibrium decisions, I will first compute these eight different unconstrained preferences for first period policy and then derive the equilibrium proposal function by C based on these.

5.3.1 Unconstrained Optimal Policy

If there were no bargaining taking place in the first period and one of the two players were simply allowed to pick his preferred policy rate X^*_P, the two players C and M would simply solve the following unconstrained maximization problem, taking into account the uncertainty over the bargaining outcome in the second period:

$$G_{P,1}(q_1, \epsilon^s, \lambda_2^L) = \arg\max_{x \in [0,1]} U_P(x_1, \epsilon_1^s) + \frac{\delta}{4}\left(\sum_{L=1}^{2}\sum_{s=1}^{2} U_{P,2}(x_1, \epsilon^s, \lambda_2^L)\right)$$

where $P \in \{C, M\}$. Temporarily ignoring the institutional bargaining structure in the first period, the optimal unconstrained choices, obtained by solving that maximization problem using the known second-period outcomes, are the ones in the table below.

Table 1: Players' Local Utility Maxima for First-Period Policy

Players	States			
	ϵ^1		ϵ^2	
	$x_1 < \frac{1}{2}$	$x_1 \geq \frac{1}{2}$	$x_1 < \frac{1}{2}$	$x_1 \geq \frac{1}{2}$
C	$\frac{\delta}{8+6\delta}$	N/A	$\frac{4+5\delta}{8+6\delta}$	$\frac{2+2\delta}{4+3\delta}$
M	$\frac{2+\delta}{4+3\delta}$	$\frac{4+5\delta}{8+6\delta}$	N/A	$\frac{8+5\delta}{8+6\delta}$

The two fields left empty indicate that there is no minimum of the loss function with these characteristics, making the solution in the other half of the policy space the preferred choice by that player for the entire policy space.

5.3.2 First-period state is ϵ^1

To find the equilibrium strategies, we can proceed as in the previous sections, by considering all possible status quo values in turn and finding the policy rate most favorable to the proposer that will also be accepted by the responding player over the status quo.

We can easily see from the table above that C's preferred policy x_C^* is greater or equal to zero and smaller than M's corresponding utility-maximizing choice in the lower half of the policy space - which I will call $x_{M,L}^*$. Thus, for $q_1 \in [0, x_C^*]$, it is true that x_C^* will be closer to $x_{M,L}^*$ than the status quo and therefore C will propose his optimal choice for that status quo interval and it will be accepted.

For status quo values from x_C^* upwards, however, gridlock occurs. More specifically, for $q_1 \in [x_C^*, x_{M,L}^*]$, the given status quo is in between the preferred first-period policies of the two players and thus the only point in the acceptance set that C wants to propose is the status quo itself.

Once the status quo is higher than $x_{M,L}^*$, however, we know that locally

$$A_1(q_1, \epsilon^1) = x_1 \in [0, 1] \; s.t. \; \|x_1 - x_{M,L}^*\| \leq \|q_1 - x_{M,L}^*\|.$$

and thus the lowest acceptable policy rate will be equidistant to $x_{M,L}^*$ with the status quo but lower. This is the policy in the acceptance set closest to x_C^* and is thus proposed by C in equilibrium.

However, we need to remember from the table above that there are two local maxima of M's utility over the entire policy range, of which $x_{M,U}^*$ - the maximum in the upper half of the range - turns out to be the global maximum. Thus, as the status quo approaches $x^*_{M,U}$ its utility to M increases towards its global maximum. Eventually, there comes a point when C cannot find a lower-half policy that would compensate M for agreeing to move the policy down from the status quo q_1. At first, however C can offer a policy choice more favorable to M than the one equidistant to $x^*_{M,L}$ to keep M indifferent between the latter and the status quo. The point at which C needs to change its proposal function in this way is where

$$(q_1 - \frac{1}{2})^2 + \delta \left(\frac{1}{2}(q_1 - \frac{1}{2}^2 + \frac{1}{16} + \frac{1}{4} q_1^2 \right) \geq (q_1 - \frac{1}{2})^2 + \delta \left(\frac{1}{4}(q_1 - \frac{1}{2}^2 + \frac{1}{4}(q_1 - 1)^2 \right) .$$

The left-hand side of this equation is the disutility to M of accepting a proposal equidistant to $x^*_{M,L}$ with the status quo in the lower half of the policy spectrum (and thus with the same disutility as the status quo with regard to $x^*_{M,L}$), while the right-hand side is the disutility of rejecting any proposal in favor of the status quo in the upper half of the policy range. This is fulfilled for $x_1 \geq \frac{1}{2}$. Of course, this result is not surprising, because we know that the point where the second-period strategies change is $x_1 = q_2 = \frac{1}{2}$.

Consequently, for $q_1 \geq \frac{1}{2}$, the proposal function $G_{C,1}(q_1, \epsilon_1^1)$ steeply increases again towards $x^*_{M,L}$, in order to induce M not to reject the proposal in favor of the status quo. More specifically, the proposal needs to be equal to the compensation function $z(q_1, \delta)$, which is defined by

$$(z - \frac{1}{2})^2 + \delta \left(\frac{1}{2}(z - \frac{1}{2})^2 + \frac{1}{16} + \frac{1}{4}(z)^2 \right) \leq (q_1 - \frac{1}{2})^2 + \delta \left(\frac{1}{4}(q_1 - \frac{1}{2}^2 + \frac{1}{4}(q_1 - 1)^2 \right) \tag{24}$$

as the proposal that will give M at least as high a utility as the status quo q_1. In equilibrium, this equation will hold with equality. From this, we can compute the necessary proposal function $z(q_1, \delta)$ that will make M indifferent between accepting and reverting to the status quo to be

$$z = \frac{2+\delta}{4+3\delta} - \frac{1}{2}\sqrt{(1/9)(2\delta+4)^2 - 4(\delta+4/3)(q_1(4/3+5\delta/3) - q_1^2(\delta+4/3) - \delta/2}.$$

However, for status quo values higher than the value at which this proposal function is equal to $x^*_{M,L}$, there is no better proposal in the lower half of the policy spectrum that C could make to induce M not to revert to the status quo in the upper half. Thus, for $z(q_1, \delta) \geq x^*_{M,L}$ the equilibrium proposal function discontinuously jumps into the upper half of the policy spectrum and gridlock results. The *reaction point* J_1 at which this occurs can be computed from equating the two expressions for $x^*_{M,L}$ and $z(q_1, \delta)$ above to obtain

$$J_1 = \frac{15\delta^2 - \sqrt{3}(3\delta^2 + 4\delta) + 32\delta + 16}{2(3\delta+4)^2}.$$

A familiar pattern of strategic behavior will repeat itself in the upper half of the policy space: the gridlock continues until $x^*_{M,U}$ because C does not prefer any proposals in the acceptance set - which only contains policy values larger than q_1 - to the status quo. However, for $q_1 \geq x^*_{M,U}$, a policy equidistant to $x^*_{M,U}$ with the status quo, but lower, can be extracted from M's willingness to move away from the status quo and thus will be proposed in equilibrium. From above, we can easily see that the proposal function will thus be

$$G_{C,1}(q_1, \epsilon_1^1) = 2\left(\frac{4+5\delta}{8+6\delta}\right) - q_1 \tag{25}$$

for this interval of status quo policies. The inverse effect from the one we saw above is going to take place: As the status quo becomes more and more distant from $x^*_{M,U}$ on the upside, there will come a point where C can even offer a policy in the lower half of the continuum and get it accepted. The first policy value in the lower half that M will accept over increasingly higher status quo values will of course be $x^*_{M,L}$. In analogy to the analysis above, the jump when C starts proposing $x^*_{M,L}$, instead of the proposal given by (25), occurs where

$$2\left(\frac{4+5\delta}{8+6\delta}\right) - q_1 = J_1,$$

at which point M is indifferent between $x^*_{M,L}$ and the status quo. Thus, in equilibrium, for all $q_1 \geq 2(\frac{4+5\delta}{8+6\delta}) - J_1$, the accepted equilibrium proposal will be the policy function for which M is indifferent between the disutility of a proposal in the lower half of the range and leaving the rate at the status quo in the upper half of the policy range. This condition is the same as the one for $z(q_1, \delta)$ computed above and thus the equilibrium proposal will be $z(q_1, \delta)$ for $2(\frac{4+5\delta}{8+6\delta}) - J_1 \leq q_1 \leq 1$.

5.3.3 First-period state is ϵ^2

Considering the table of unconstrained first-period optima, we can immediately see that for very low status quo values in state ϵ_1^2, the proposer (C in this case) can get his lower-range optimum $x^*_{C,L}$ accepted, because M always prefers higher policy values to lower values in the lower half of the policy spectrum. Thus, for $q_1 \leq x^*_{C,L}$, the equilibrium proposal will be $G_{C,1}(q_1, \epsilon_1^2) = x^*_{C,L}$.

From $q_1 \geq x^*_{C,L}$ upwards, however, gridlock occurs, because M prefers the status quo to lower values and C prefers the status quo to any policy value above it.

This gridlock interval lasts until the utility of continuing to propose the status quo in the lower half of the policy range becomes lower than the utility at C's local optimum in the upper half, $x^*_{C,U} = \dfrac{2+2\delta}{4+3\delta}$. That is, a discrete upward jump in equilibrium policy to $x^*_{C,U}$ will occur where

$$(x^*_{C,U}-\frac{1}{2})^2+\delta\left(\frac{1}{4}(x^*_{C,U}-1)^2+\frac{1}{16}+\frac{1}{2}(x^*_{C,U}-\frac{1}{2})^2\right) = (x-\frac{1}{2})^2+\delta\left(\frac{1}{2}(q_1)^2+\frac{1}{4}(x-\frac{1}{2})^2\right).$$

In this equation, the left side represents the disutility from $x^*_{C,U}$ and the right side is the disutility of staying with a lower-half status quo. This equality is holds at

$$J_2 = \frac{3\delta^2 + \sqrt{3}(3\delta^2 + 4\delta) + 16\delta + 16}{2(3\delta + 4)^2}$$

for $\delta \in [0, 1]$. Thus, $q_1 = J_2$ is the *reaction point* at which the equilibrium policy proposal jumps up to $x^*_{C,U}$.

For status quo values of $J_2 \leq q_1 \leq x^*_{C,U}$, C will be able to get his upper-half optimum accepted, because it is lower than M's optimum policy (see Table 1) but higher than the status quo and thus preferred by M to it.

From $x^*_{C,U} \leq q_1 \leq x^*_{M,U}$, we find ourselves in a gridlock interval again, because the status quo is closer to M's optimum than any lower policy values but C prefers the status quo to any higher policy values.

However for all $q_1 \geq x^*_{M,U}$, the tradeoff of the disutility to M of a status quo above his optimal value against a lower policy proposal becomes possible. As payoffs are symmetric around the optimal value, a lower proposal with the same utility to M as the status quo has to be equidistant to $x^*_{M,U}$. Thus, the lowest proposal that C can get accepted in equilibrium is

$$G_{C,1}(q_1, \epsilon_1^2) = 2x^*_{C,L} - q_1$$

for all $x^*_{M,U} \leq q_1 \leq 1$.

6 Welfare Implications and Efficiency

In this section, I will expand upon the results above, by analyzing the effects of the introduced variations from a welfare perspective and thereby developing stylized implications of my model.

6.1 Strategic Gridlock

Given that the policy space is a continuum, the probability of the given status quo policy being exactly equal to the utility-maximizing policy in any period is effectively zero. Thus, from an overall welfare perspective, every period in which the policy rate remains unchanged is a foregone opportunity to move the policy rate closer to the optimum. That is, in some sense gridlock periods are an indication of institutional failure. Consequently, we can look at changes in the likelihood of gridlock to draw qualitative conclusions about how the change in the economic environment between models 1 and 2, or the institutional variation between models 2 and 3 affect policy-making.

In table 2 below, I summarize the total width of all status quo intervals that lead to gridlock in equilibrium in the first period of the three propositions respectively.

Table 2: General Gridlock Intervals

	Prop. 1	Prop. 2	Prop. 3
ϵ^1	$\frac{2+3\delta}{4+4\delta}$	$\frac{2+3\delta}{4+4\delta}$	J_2
ϵ^2	$\frac{2-2\delta+\sqrt{8\delta}}{4+4\delta}$	$\frac{\sqrt{2\delta^3}}{(8+4\delta)\sqrt{1+\delta}} + \frac{1}{2+2\delta}$	J_2

where

$$J_2 = \frac{3\delta^2 + \sqrt{3}(3\delta^2 + 4\delta) + 16\delta + 16}{2(3\delta + 4)^2}.$$

In order to be able to interpret these interval widths directly as probabilities and compare them, we have to assume that the first period status quo policy is drawn from a uniform distribution over the policy space [0,1] [5]. Otherwise, the possibility of gridlock occurring for a status quo interval would need to be weighted by the likelihood of that status quo occurring. However, besides the difficulty of deriving such a status quo density function from real data and adapting it to my stylized model, the uniform distribution assumption has several points in its favor: the size and direction of a future change in monetary policy required does not seem to be biased in one direction - as the time series of interest rates in Figure 1 showed, no strong long-run drift or clustering of policy rates around specific values seems to occur in practice.

More specifically, gridlock can occur for almost every possible status quo value in one of the economic states in my models. Moreover, the approximate location of the gridlock intervals in the policy space is similar for the three models. Thus, the different weighting of certain status quo values would not necessarily change the qualitative conclusions presented here. Consequently, I consider it justifiable to assume for simplicity here that status quo states are drawn uniformly.

Under this assumption, we can compute the numerical value of the interval widths above for specific discount factors explicitly and interpret the results as the probability of gridlock occurring in the first period of that model, given the state of the economy. These probabilities are shown for $\delta = \frac{1}{2}$ and $\delta = 1$ in the tables below. In order to compare the overall ex-ante probability of gridlock in the different models, I also show the sum of the gridlock likelihood in the two states of the economy, weighted by their probability of occurring.

[5] Here I am especially indebted to Wolfgang Pesendorfer for alerting me to the necessity of making this assumption explicit.

Table 3: Gridlock probability for $\delta = 1$

$\delta = 1$	Prop. 1	Prop. 2	Prop. 3
ϵ^1	.625	.625	.481
ϵ^2	.354	.333	.481
Weighted Total	**.490**	**.479**	**.481**

Table 4: Gridlock probability for $\delta = \frac{1}{2}$

$\delta = 1$	Prop. 1	Prop. 2	Prop. 3
ϵ^1	.583	.583	.488
ϵ^2	.500	.374	.488
Weighted Total	**.542**	**.479**	**.488**

We can see from these numbers that gridlock is least likely to occur in Model 2. In comparison both, the decrease in uncertainty over second-period preferences in Model 1 and the increase in uncertainty over the agenda-setting authority in Model 3, lead to a higher chance of gridlock. Although these implications might at first sound surprising, the intuition behind them is simple: Firstly, as had been noted in section 4.6, the reason behind some of the kinks in the proposal functions is that for policy values at the margin of the policy space, the risk averse players' incentives are aligned in trying to bring the first-period policy rate to "safer" values closer to the center of the policy space. When the spread of possible second-period preferences is increased from Model 1to Model 2, the risk averse utility functions mean that the aversion to these marginal policies in the second period increases more than proportionally. Consequently, the agenda-setter can extract relatively large concessions in his favor in the second period. But given that he knows this, the agenda-setter will also be more willing to move the policy towards its pareto-efficient value in the first period.

In short, more extreme preferences in the second period lead to more favorable second-period outcomes for the agenda setter. Therefore, he has to hedge less against adverse second-period outcomes, which, in turn, makes first-period policy more efficient. In the plots of the equilibrium proposals we can partly see this effect in the fact that there are more and larger jumps in Model 2 than in Model 1: the jumps occur between different local utility-maxima for C, and their height and number is in some sense a function of the fact that in the second period of Model 2, C can get his preferred policy in state ϵ^1 with the lowest status quo q_2 as well as with the highest status quo.

The increase in gridlock between Model 2 and 3 has a very similar intuition: the institutional change towards an equal chance of holding agenda-setting power in the second period for both players means that whosoever holds the agenda-setting power in the first period will need to hedge much more against unfavorable outcomes in the second period than the fixed agenda-setter in Model 2. This hedging by the agenda-setter occurs by gaining greater utility in the first period when proposal power is certain and proposing policies that are more biased towards "his" side of the policy space. This makes first-period policy less efficient and more "partisan" in a broad sense: the jumps in the equilibrium function are much smaller in state ϵ^2 in Model 3 than for Model 2 because the local maxima are less spread out due to less certainty whether concessions in the first period could be recovered in the second period when the other player might hold the proposal power.

6.2 Pareto Efficiency

In this section, I will explore how a different measure of efficiency in policymaking is affected by the variations in economic environment and institutional setup in my model. Whereas in the previous section, we looked at the likelihood of failing to change the policy, here we will see whether occurred policy changes, if any, are large enough. The criterion of comparison will be the probability of a pareto-efficient outcome. That is, a first period outcome is pareto-efficient if neither player could gain a higher utility in that period without the other player being made worse off. In my models, this is the same as saying that a pareto-efficient policy lies in between the naive policy preferences $r_M(\epsilon_t^s)$ and $r_C(\epsilon_t^s)$ of the two players.

For status quo intervals whose equilibrium bargaining outcome does not fulfill this condition, the institutional setup is clearly inefficient: it could be improved upon in any specific period by replacing the bargaining process with complete policy control by only one of the two players. The latter change would lead to the player who fully controls the policy rate choosing his preferred value in every period, which is pareto-efficient by definition. Similarly, a pareto-efficiency could be ensured in every period, if the status quo were exogenously given so that periods would not be linked anymore[6]. In that case, no hedging occurs and an equilibrium consensus decision will always fall in the interval between the players' preferences.

Table 5: Status quo intervals with pareto-inefficient outcomes

	Prop. 1	Prop. 2	Prop. 3
ϵ^1	$[\frac{1}{2}, \frac{1+2\delta}{2+2\delta}]$	$[\frac{1}{2}, \frac{1+2\delta}{2+2\delta}]$	$[J_1, \frac{4+5\delta}{4+3\delta} - J_1]$
ϵ^2	$[0, \frac{1}{2}$	$[0, (\frac{1}{2+\delta})(1 + \frac{\sqrt{2\delta^3}}{4\sqrt{\delta+1}})]$	$[0, J_2]$

Table 5 summarizes the probability of the status quo leading to such an inefficiency

[6] This is actually a practicable alternative to a system of leaving the previous interest rate as the default option: a credible central bank can change market interest rates almost instantaneously with the announcement of its rate target, without even having to engage in open-market operations. Thus, the previous period's interest rate is in some sense no more "in place" than any other, making "falling back" to it in case of disagreement unnecessary.

for the three different models. These probabilities are computed as the share of the total policy interval which is constituted by status quo intervals leading to pareto-inefficient outcomes. These shares are equivalent to the probability of a pareto-inefficient outcome occuring in that state, as long as the status quo distribution in the first period is uniform, with the same caveats as in the previous section. Weighting these probabilities of pareto-inefficiency by the likelihood of the two possible economic states ϵ^s, we can also obtain the ex-ante likelihood of a pareto-ineffcient first-period outcome for the whole two-period policy game. In Tables 5 and 6, I report the computed values of these probabilities for $\delta \in \{\frac{1}{2}, 1\}$.

Table 6: Pareto-inefficient outcome probability for $\delta = 1$

$\delta = 1$	Prop. 1	Prop. 2	Prop. 3
ϵ^1	.25	.25	.2474
ϵ^2	.5	.4167	.4809
Weighted Total	**.3750**	**.3333**	**.3641**

Table 7: Pareto-inefficient outcome probability for $\delta = \frac{1}{2}$

$\delta = 1$	Prop. 1	Prop. 2	Prop. 3
ϵ^1	.1667	.1667	.1575
ϵ^2	.5	.4408	.4878
Weighted Total	**.3333**	**.3037**	**.3227**

Comparing the likelihood of pareto-inefficiency between the three different models, we find that the pattern mirrors that found for gridlock in the previous section. The change in probability is negative for the increased uncertainty in the economic environment. That is, greater uncertainty over the second-period state of the economy leads to more pareto-efficient policy outcomes in the first period. On the other hand, the agenda-setting uncertainty in model 3 makes the policy outcomes less pareto-efficient than Model 2 with a fixed agenda-setter.

The intuition behind this is the same as in the previous section: environmental uncertainty actually improves second-period outcomes for the first-period agenda-setter. The same is true when the agenda-setter gains certainty over his proposal power in the second period. Consequently, there is less of a need for hedging against adverse second-period outcomes, which makes first-period policy more likely to be pareto-efficient.

Thus, the pareto-inefficiency probabilities exactly confirm the qualitative effects found when considering the likelihood of gridlock in the previous section. In the next section, I will see whether these results have some empirical validity.

7 Empirical Application of Results

From the preceding analysis of my theoretical results, we can derive some simple implications to test empirically:

1. Monetary policy made by a committee can diverge considerably from the optimal rate by underreacting to economic events: "interest rate smoothing" occurs.
2. Consensus-based MPCs that have a fixed agenda setter will outperform those that do not at making pareto-efficient policy decisions
3. Consensus-based MPCs without a fixed agenda setter are less likely to change the policy rate so that more gridlock occurs.
4. The inefficiency of monetary policy made by consensus-based committees is reduced as economic uncertainty increases.

This analysis will be partly based on the categorization employed in Blinder (2007), based on which the FOMC - an "autocratically-collegial" committee - probably comes closest to the setup of my model in Proposition 2 in that there is a clearly designated and powerful agenda setter and rare dissent. On the other hand, the ECB's Governing Council - a "genuinely-collegial" committee - has a strong emphasis on unanimity, but its President, like the proposer in Proposition 3, has considerably less influence on decision-making than the Chairman of the Federal Reserve Board in the FOMC. The Bank of England's MPC, however, neither has a strong chairman nor an emphasis on consensus, reaching its decisions by an open vote in an "individualistic" manner and is therefore only included here to put the other two time series in perspective.

7.1 Interest Rate Smoothing

As a general empirical phenomenon, the inertial behavior of central bank policy rates, similar to the one found in this paper, has been noted and analyzed in several theoretical (for references see Gerlach-Kristen (2004)) and empirical studies: for instance, there is considerable empirical evidence in Clarida *et al.* (2000) and Coibion & Gorodnichenko (2011) that the Federal Reserve only partially adjusts interest rates to economic shocks and that there is substantial autocorrelation between interest rates from one period to the next. For a full empirical exploration of interest rate smoothing I refer the reader to these studies and the references contained therein.

Here, I would simply like to note that my models add a possible institutional explanation to the existing explanations of policy inertia: the strategic behavior of players in a dynamic bargaining setting can lead to substantial policy inefficiencies and might thus be part of the solution to the puzzle.

7.2 Monetary Policy Performance

When we are considering the empirical evidence for whether or not monetary policy is efficient, there are two different ways of looking at the evidence: On the one hand, we can look at outcome-based measures of monetary policy performance, as I will do in this section. On the other hand, we can consider direct measures of policymaking activity, which will be analyzed in the next section.

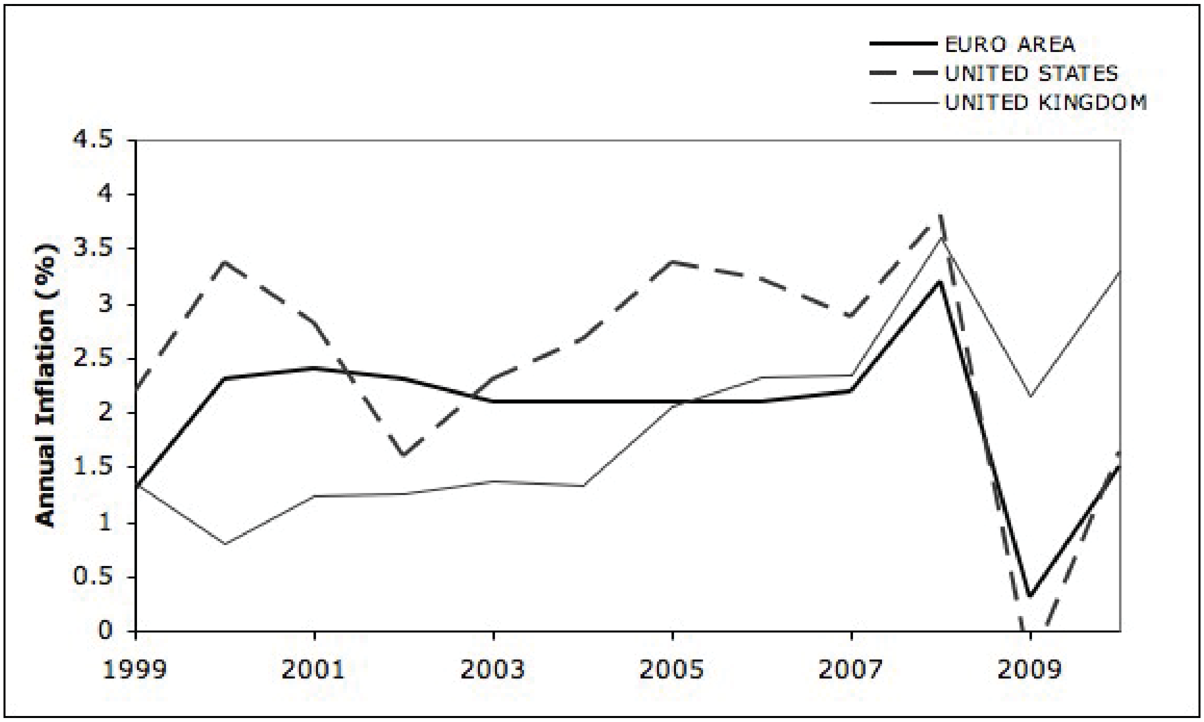

Figure 8: *Inflation Performance of the ECB (Euro Area), the Fed (US) and the Bank of England (UK); Data Source: Economist Intelligence Unit*

Of course, efficiency in monetary policy is hard to define, as data on the exact preferences of committee factions and the true state of the economy are hard to obtain. However, we can look at a measure that should be related to policy rates being set according to the actual mandate of the institution: the ex post success of the central banks at attaining and stabilizing the target value of certain macroeconomic variables. Success at stabilizing the economy is assumed to be a rough indicator of how closely an MPCs decisions track the optimally neutralizing policy response to economic shocks. Note, however, that due to the multitude of unobserved confounding variables any observations I will make here in this regard will be merely suggestive. With this note of caution in mind, I will compare the performance of the ECB and the Federal Reserve with regard to the rate of inflation and the growth rates of real gross domestic product (RGDP) over the last decade.

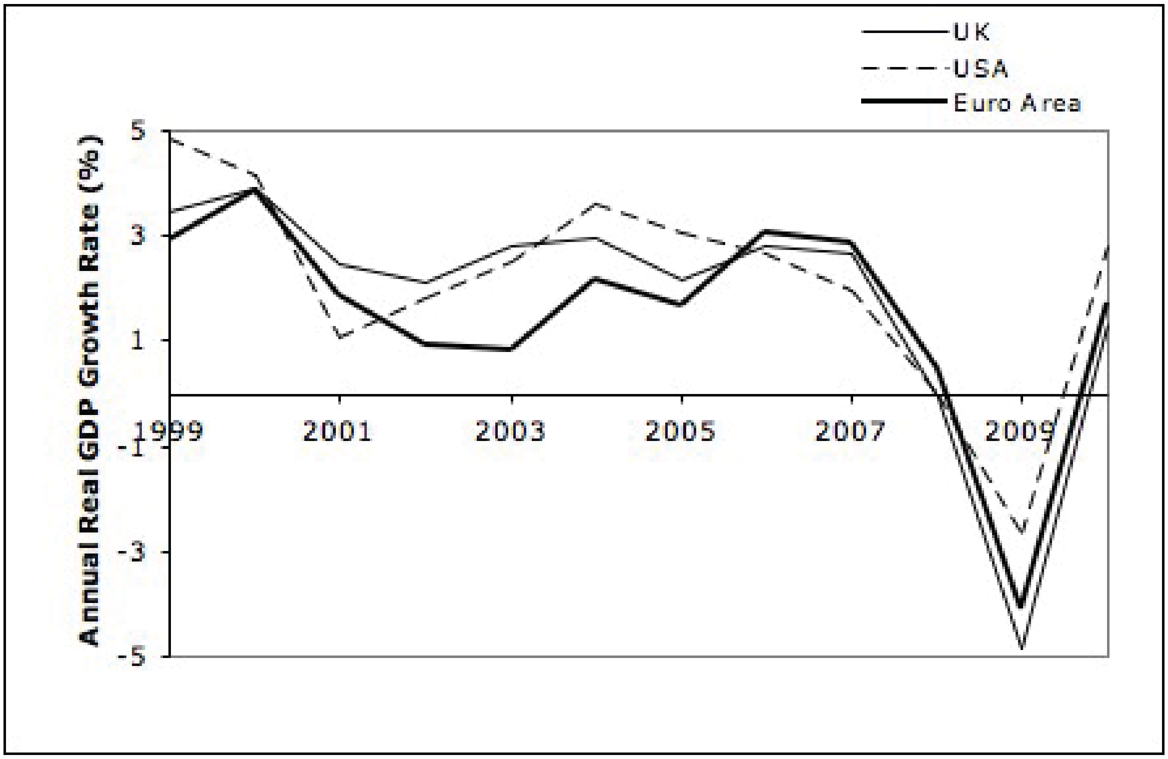

Figure 9: *RGDP Growth Performance Performance of the ECB (Euro Area) and the Fed (US); Data Source: Economist Intelligence Unit*

Most central banks have an explicit or implicit inflation target - with the ECB and the Fed being no exceptions. The ECB's Governing Council has defined its mandate of price stability to mean below, but close to, 2% inflation. It should be noted though that low inflation is rarely an end in itself for a central bank - even for the ECB (Duisenberg, 1997) it is usually the means by which economic stability and growth are supposed to be achieved. The Fed, in fact, has an explicit dual mandate to promote maximum employment and stable prices[7]. As maximum employment is hard to define exactly, I will use RGDP here instead, assuming that a high and stable growth in output is a good proxy for high employment.

The time series of inflation and RGDP for the Euro Area, the United States and the United Kingdom are graphed in Figures 8 and 9 respectively. We can see from the graphs that the ECB achieved the most stable inflation out of the three central banks, keeping it almost constant at about 2%, while US inflation was more variable at a higher level. However, given that the Fed is explicitly, and the ECB perhaps implicitly, mandated to also guarantee favorable conditions for economic growth, we need to take into account the tradeoff between inflation stabilization and RGDP

[7]According to the Federal Reserve Act, Section 2a: "Monetary Policy Objectives", available at (URL): http://www.federalreserve.gov/aboutthefed/section2a.htm

growth. Figure 9 suggests that inflation stability might come at an economic cost for the ECB: its RGDP growth was lower than that for the US or the UK in most years. Even for the years 2006-2008, when Euro Area growth exceeded American rates, the comparison is biased in the ECB's favor because the global financial crisis started earlier in the US than in other countries.

Table 8: Sample mean (μ) and variance (σ) of economic variables

Sample Period: Jan. 1999 to Dec.2010			
	Inflation	RGDP Growth	
	σ	σ	μ
Fed	0.48	4.04	2.15
ECB	1.20	4.14	1.52
BoE	0.70	5.48	1.81

In Table 8, I make these comparisons more explicit by computing the variance of inflation and RGDP growth as well as the mean of growth over the sample period[8]. These numbers lend some support to the notion that the Fed was more successful at ensuring both high and stable growth than the ECB, while the latter had more success at stabilizing inflation. Thus, there might be weak evidence in favor of my model's prediction that economic performance overall was better for the fixed-agenda setter Fed than for the ECB over the last decade. However, as noted before, this result is necessarily somewhat speculative and should be considered jointly with the empirical evidence in the following sections.

7.3 Gridlock

As noted above, one way of looking at the efficiency of MPCs is looking at the data on the actual policymaking process. As the event of changing the policy rate can be measured directly, the empirical data on gridlock provide an immediate test for my model's implications.

On the one hand, there is anecdotal evidence supporting my conclusions: for instance, with regard to the ECB, The Economist (2005) argues that, during the last decade, "it has changed interest rates less often than the Fed has, giving the impression of paralysis". In other words, it is alleged to exhibit considerably more gridlock

[8]The mean of inflation is left out here, because for very low values of inflation what matters is whether or not it can be anticipated, not the exact level, as Duisenberg (1997) notes. From a seminar with Alan Blinder at Princeton University, I also learned that due to sticky prices it is not exactly clear whether the gradient of economic costs as a function of inflation is negative or positive as the annual inflation rate approaches zero - which is another reason not to compare the levels of inflation.

than the FOMC. This is is exactly what my results predict, as my variable agenda-setter Model 3 - resembling the ECB's leadership - shows more gridlock than the fixed proposer in the same economically uncertain environment in Model 2, which more closely resembles the FOMC.

On the other hand, we can investigate this claim more rigorously by looking at empirical data on MPC decisions for the Bank of England, the Federal Reserve and the ECB during the last decade. The time series of these banks' respective main policy rates are for convenience displayed again in Figure 10 [9].

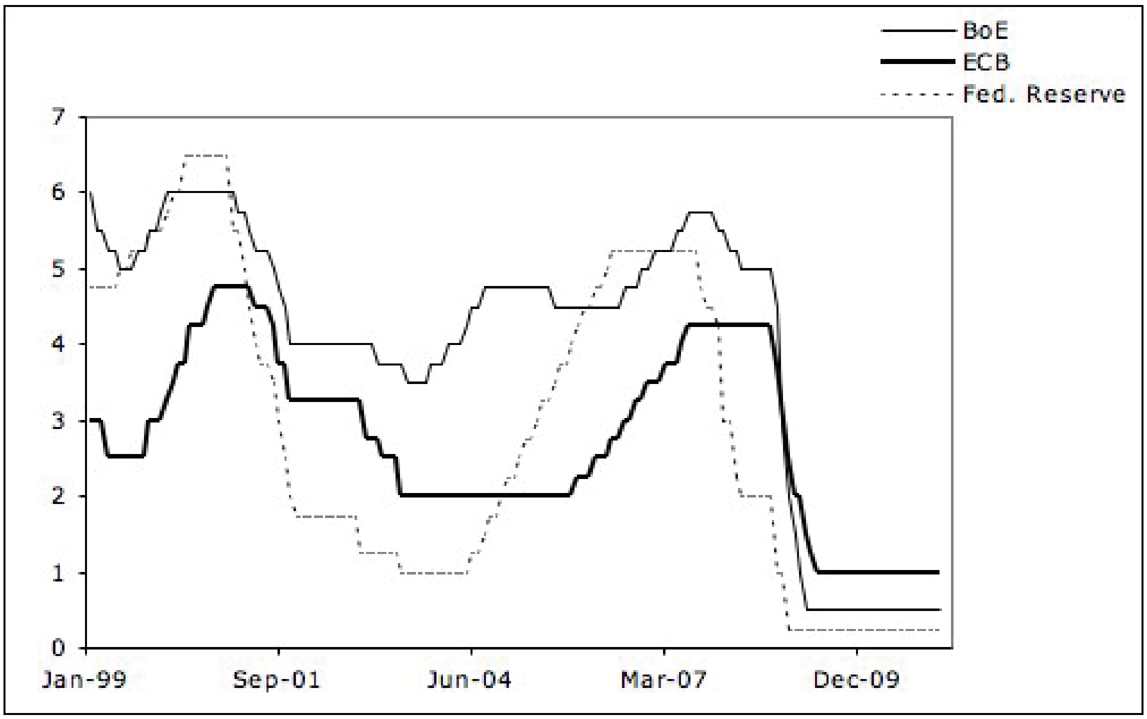

Figure 10: *Main policy rates at the Bank of England, European Central Bank and Federal Reserve; Data Source: Central bank websites*

We can see quite clearly from the graph that the ECB's policy rate shows much more inertia than the Fed's, and is even somewhat more inert than the Bank of England's, with lower peaks and higher troughs than the rates of the latter two central banks. Moreover, assuming that these three large developed economies are exposed to similar economic shocks, the ECB's Governing Council can be seen to lag behind the other two banks' MPCs in its responses, consistently starting to raise or lower rates after them.

In Table 9, this observation is made more explicit by the probability π of an MPC

[9] These are: the Federal Funds Rate for the Fed, the Bank of England's official Bank Rate and the ECB's main refinancing operations rate

meeting by that central bank leading to a change in the policy rate [10] during the period from January 1999 to December 2010[11]. Because the FOMC only meets eight times per year, while the other two MPCs meet twelve times per year, in brackets I also report the FOMC's adjusted probability if it had been meeting four more times every year without a rate change. Moreover, the table shows the average size of the moves in the policy rate.

Table 9: Policy rate changes

Sample Period January 1999 to December 2010		
	π	Δ
Fed	47.9(31.9)	35.9
ECB	21.5	35.5
BoE	25.0	34.7

This clearly confirms my model's predictions: the Federal Reserve, with its chairman as a fixed and strong policy proposer, is much less likely to leave the policy rate unchanged in a meeting than the ECB with its less certain agenda-setter. Moreover, it is not the case that the ECB makes up for this inefficiency in timing by moving the rate more aggressively when it does - the almost identical average sizes of rate changes indicate that there is no such compensation effect.

7.4 Monetary Policy under Uncertainty

In this section, I will try to see whether there is some evidence that my model's implications with regard to monetary policy efficiency under uncertainty have empirical relevance. If they do, we would expect the policymaking to be more efficient as uncertainty over the economic environment increases. Here, efficiency is defined the same way as in the previous section as a greater likelihood of changing the policy rate and greater rate movements when they occur.

In order to test whether uncertainty is correlated with the chance of gridlock or the absolute size of the rate changes, I will regress those two variables - which can be easily obtained from the central bank websites - on the VIX[12] - the Chicago Board Options Exchange Market Volatility Index - which is a measure of market expectations of stock market volatility over the next 30 days and is thus a reasonable measure of uncertainty over short-term economic developments. The sample period is February

[10] This way of illustrating differentials in central bank decision-making was inspired by Gerlach-Kristen (2004)

[11] The starting date has been chosen to coincide with the beginning of monetary policy-making by the ECB in 1999

[12] The VIX data were downloaded directly from http://www.cboe.com

1999 to May 2009, because the latter is the date when all three central banks hit their respective lower bound of the policy rate - the value below which they would not set it - and after which they engaged in unconventional monetary policy instead of changing the policy rate. Thus the value of the latter would not be an accurate indicator of changes in monetary policy after that date. However, the conclusions are not substantially altered by including the most recent data as well.

Table 10: Regression of policy change dummy on volatility index

Sample Period: Feb. 1999 to May 2009			
	Probability of policy change at...		
	BoE	ECB	Fed
VIX(lagged)	.0146***	.0130***	-.000879
	(.00398)	(.00419)	.(00474)
Constant	-.0283	-.0345	.366***
	(.0932)	(.0976)	(.113)
n	124	124	124

In Table 10, I report the OLS estimates obtained from regressing a dummy variable indicating whether or not the central bank changed its main policy rate in that month [13] on the VIX volatility expectation at the end of the previous month. The estimates show that both for the Bank of England and the ECB, we find that greater expected volatility for a given month is correlated with a significantly higher likelihood of a rate change. For the Fed however, the estimate is not statistically significant.

The estimates in Table 11 lend further support to the hypothesis implied by my theoretical analysis that uncertainty in fact improves the efficiency of policymaking in a strategic bargaining setting: When we regress the absolute size in % of the rate changes that were made on the expected stock volatility for the month when they occurred, we find that the policy rate is moved in significantly larger increments during months of higher uncertainty. This also means that the greater likelihood of reaching agreement on a new policy, documented in Table 10, is not simply a consequence of few large adjustments being replaced by many small adjustments. To the contrary, policy changes are not only more likely but also larger in volatile months.

Arguably, these empirical applications jointly lend some support to my hypothesis that several aspects of real central bank behavior can be explained by a strategic bargaining approach to the policymaking process.

[13] I am not correcting for the fact that not every month had an MPC meeting because unless MPC meetings are more likely to occur in volatile months - which is not the case as they operate on a schedule set far in advance - the only effect of that adjustment would be to reduce the standard errors, which would not significantly affect the qualitative conclusions drawn here

Table 11: Regression of size of rate change on volatility index

Sample Period: Feb. 1999 to May 2009			
	Size of policy change at...		
	BoE	ECB	Fed
VIX(lagged)	.0171***	.00675***	.0163***
	(.00447)	(.00172)	.(00298)
Constant	-.0953	.179***	.0297
	(.101)	(.0403)	(.0549)
n	36	31	43

8 Concluding Remarks

On the one hand, I have shown in this study that a simple two-person bargaining model with an endogenous status quo and strategic players can replicate the observed inertia in monetary policy-making by committee. On the other hand, variations in the economic environment and the agenda-setting power in such a model can lead to stylized and non-obvious implications that seem to be supported by empirical observations: Uncertainty over the future policymaking environment can actually lead to more effective policymaking in the present, and committees with a fixed agenda-setter may outperform those with a variable agenda-setter in achieving a change in policy and setting pareto-efficient policy rates.

These results show that it is important to consider committee members as strategic actors when designing monetary policy committees because differences in preferences between them can otherwise undermine the effectiveness of the institution. Furthermore, different committees can differ substantially in their success depending on the environment in which they operate and their internal structures - a point that is often lost in debates over the historical success of policy institutions.

Further research should expand upon the rudimentary statistical analysis employed here to test my specific claims or those of competing institutional explanations of committee behavior in order to further refine our understanding of the actual decision-making processes that shape economic policy.

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