

Allies or Commitment Devices? A Model of Appointments to the Federal Reserve

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Abstract

We present a model of executive-legislative bargaining over appointments to independent central banks in the face of an uncertain economy with strategic economic actors. The model highlights the contrast between two idealized views of Federal Reserve appointments. In one view, all politicians prefer to appoint conservatively biased central bankers to overcome credible commitment problems that arise in monetary policy. In the other, politicians prefer to appoint allies, and appointments are well described by the spatial model used to describe appointments to other agencies. Both ideals are limiting cases of our model, which depend on the level of economic uncertainty. When economic uncertainty is extremely low, politicians prefer very conservative appointments. When economic uncertainty increases, politicians' prefer central bank appointees closer to their own ideal points. In the typical case, the results are somewhere in between: equilibrium appointments move in the direction of politician's preferences but with a moderate conservative bias.

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The extent to which politicians influence monetary policy has long been of interest to scholars. In the United States, the process of Presidential appointment and Senate confirmation of Federal Open Market Committee (FOMC) members is the most important avenue for political influence on monetary policy. Two different theoretical traditions inform political scientists' understanding of Federal Reserve appointments. The first tradition, beginning with the work of Kydland and Prescott (1977) and Barro and Gordon (1983), pointed out that politicians face incentives to *ex ante* commit to low inflation policies and *ex post* break those commitments to generate short-term improvements in real economic outcomes, *e.g.*, growth and employment (Bernhard, Broz and Clark, 2002). Thus, Rogoff (1985) argued that delegating monetary policy authority to a relatively conservative, independent central bank(er) can serve as a commitment device that allows politicians to *credibly* commit to low inflation policies thereby mitigating the time-inconsistency problem (see also Alesina and Summers, 1993, for instance). The second tradition, represented by the work of Chang (2001, 2003) and Morris (2000), assumes instead that politicians prefer to appoint bankers that agree with them on matters of monetary policy and represents appointments using spatial appointments models similar to those used in analyses of appointments to other political agencies as well as the judiciary.¹ These models are consistent with “the ally principle” which states that politicians prefer agents that represent their preferences as closely as possible (Bendor and Meirowitz, 2004).

These two theoretical traditions contradict one another, yet both appear to be consistent with the data in important ways. In favor of the credible commitment approach, comparative empirical evidence suggests that countries with independent central banks experience lower levels of inflation (Alesina and Summers, 1993). In favor of the ally approach, empirical studies show that preferences of appointed FOMC governors track those of their appointing parties.² Though

¹For example, see Lewis (2008); McCarty (2004); Nixon (2004) for work on appointments to other agencies and (*e.g.*, Binder and Maltzman, 2009; Epstein and Segal, 2005; Shepsle and Rohde, 2007) for work on judicial appointments.

²See, for example, Adolph (2013); Havrilesky (1988, 1994, 1995); Havrilesky and Gildea (1992); Chappell, Havrilesky and McGregor (1993); Chappell, McGregor and Vermilyea (2004*a,b*). However, as Adolph (2013) dis-

the theories are inconsistent with each other, we think that they represent a realistic trade-off that politicians face when delegating monetary policy: delegate to an ally and suffer high inflation due to the commitment problem, or appoint conservatively biased central bankers and allow some policy drift.

In this paper we develop a model of appointments to the Federal Reserve with a focus on the bargaining over appointments that takes place between the President and the Senate. The main research question is when bargaining over Federal Reserve appointments is dominated by commitment concerns versus ally concerns.³ A secondary purpose of the model is to integrate an economic model with rational expectations into models of interbranch bargaining that are commonly adapted to spatial environments. In our model, the President nominates a central banker that is subject to veto by the Senate.⁴ Inflationary expectations in the market then adjust to account for the central banker, and then at some later point the central banker sets monetary policy in response to an economic shock. The nature of appointment bargaining depends on the level of economic uncertainty. If uncertainty is extremely low then appointments are perfectly conservative and there is no conflict over nominees. Higher levels of economic uncertainty are associated with less conservative bias in appointments. As economic uncertainty gets very large, preferences over appointments converge to those in spatial models of appointments – each politician would prefer to appoint an ally.

cussed, this finding is also consistent with Rogoff's approach.

³We contrast commitment versus ally concerns to draw attention to the strategic incentives at play in economic models of monetary policy as opposed to those common to models of appointments to other agencies and to the judiciary (*e.g.*, Binder and Maltzman, 2009; Epstein and Segal, 2005; Lewis, 2008; McCarty, 2004; Nixon, 2004; Shepsle and Rohde, 2007). We do not mean to imply that these two things are mutually exclusive. In fact, in our model, preferences over economic outcomes take on a natural spatial interpretation.

⁴The game, at its base, closely resembles the bargaining model by Romer and Rosenthal (1978). In this same regard, the model is similar to that of Ferejohn and Shipan (1990), which is a Romer-Rosenthal style bargaining framework applied to a separation-of-powers environment.

1 A Model of Appointments to the Federal Reserve

To formalize the appointment process to the Federal Reserve we develop a non-cooperative game with a *President*, a representative *Senator*,⁵ a *Central Banker*, and a *Wage Setter*. We define the preferences of the actors by relying on a set of familiar economic assumptions, which are similar to several papers in the central banks literature (e.g., Alesina, 1987; Alesina, Roubini and Cohen, 1997; Lohmann, 1992; Keefer and Stasavage, 2003). The economy is characterized by a “natural rate of inflation,” denoted by \bar{y} and a Phillips curve slope parameter $\alpha > 0$ that quantifies the trade-off between unemployment and inflation. Unemployment is generated by the following function:

$$y(\pi, w) = \bar{y} - \alpha(\pi - w) - \varepsilon, \quad (1)$$

where π denotes the level of inflation, w is the nominal wage, and ε is a stochastic shock to output distributed around mean 0 with finite variance σ^2 . Equation 1 captures the intuition from classic economic models: unemployment can be driven to an unnaturally low level if the rate of inflation is higher than the growth in nominal wages. This is where the credible commitment problem becomes relevant to appointments of central bankers. Politicians have an incentive to strategically drive unemployment down by creating surprise inflation and therefore delegation to an independent central banker that is relatively conservative (inflation-averse) is deemed desirable. The optimal level of conservatism will hinge on these economic considerations.

With the unemployment function in hand we now characterize the preferences of the *President*, *Senator*, and *Central Banker*. These preferences are given by the following utility function,

$$u_i(\pi, y(\pi, w)) = -\pi^2 - b_i y^2 \text{ for } i \in \{P, S, C\}. \quad (2)$$

Each actor has the same target rates of inflation and unemployment, which are normalized to 0,

⁵This player could be understood as the pivotal member of the Senate banking committee or, perhaps, the filibuster pivot in the Senate (Krehbiel, 1990).

and differ only by the relative weights they place on inflation and unemployment represented by $b_i \geq 0$.⁶ We refer to b_i as the actor i 's *ideal point* or monetary policy *position* where lower levels of b_i denote a more *conservative* or inflation-averse ideal point whereas a higher b_i denotes a *liberal* or more employment-focused ideal point.

The preferences of the *Wage Setter* are given by the following utility function,

$$u_W = -(\pi - w)^2. \quad (3)$$

Equation 3 ensures that nominal wages will be set equal to expected inflation in equilibrium.

Prior to any actions there is a status quo Central Banker with ideal point b^{SQ} who remains in office until replaced by a newly appointed Central Banker. We understand b^{SQ} to represent the common understanding of how current members of the FOMC will implement monetary policy in the absence of a new appointment. The timing of the game, then, is as follows.

1. The *President* selects a nominee by proposing $b > 0$.
2. The *Senator* accepts or rejects the nominee:
 - (a) If S accepts the nominee, then $b_C = b$.
 - (b) If S rejects the nominee, then $b_C = b^{SQ}$.
3. *Wage setters* choose w .
4. The output shock, ε , is realized.
5. The *Central Banker* sets the level of inflation, π .

We utilize subgame perfect Nash equilibrium (SPNE) as our solution concept, which can be found through backward induction. Section 2.1 describes equilibrium inflation and unemployment

⁶The quadratic form of the politicians' utility functions is not essential to the results below, but concavity of the utility function plays a critical role in the comparative statics of the model. The concavity, which implies risk-aversion, is key to some of the predictions.

for a given choice of b_C and Sections 2.2 and 3 characterize the appointments that occur in equilibrium with a particular focus on how the level of politicization of the appointments process fluctuates with economic uncertainty. Put another way, we characterize when the appointments process more closely resembles either a politicized spatial model of appointments á la Chang (2003) or a less politicized conservative central banker model of appointments á la Rogoff (1985).

2 Analysis

2.1 Equilibrium Inflation and Unemployment

In the final stage of the game the *Central Banker* sets the target rate of inflation, π . Thus, the *Central Banker* takes an action solving the following problem:

$$\pi^*(b_C, w) = \arg \max_{\pi} \left[-\pi^2 - b_C(\bar{y} - \alpha(\pi - w) - \varepsilon)^2 \right].$$

Essentially, the *Central Banker* chooses the inflation rate that maximizes her expected utility. Solving this problem for the *Central Banker* leads to the following best response function,

$$\pi^*(b_C, w) = \frac{b_C \alpha (w \alpha + \bar{y} - \varepsilon)}{b_C \alpha^2 + 1}. \quad (4)$$

Notice that the best response $\pi^*(b_C, w)$ depends on w : the *Wage Setter's* choice of wage level. Thus, to fully characterize the subgame following approval (or rejection) of the central bank appointment we solve the *Wage Setter's* problem, given by:

$$w^*(b_C) = \arg \max_w \left[-\mathbb{E}[(w - \pi^*(b_C))^2] \right]. \quad (5)$$

At the solution, wages are simply set equal to the expected level of inflation. Thus, the wage rate in equilibrium is $w^*(b_C) = b_C \bar{y} \alpha$. We can substitute this expression into the solution for $\pi^*(b_C, w)$, which yields the following result.

Lemma 1. *In equilibrium, a Central Banker with monetary policy ideal point b_C sets the target*

level of inflation according to the following equation:

$$\pi^*(b_C) = \frac{\alpha b_C (\alpha^2 \bar{y} b_C + \bar{y} - \varepsilon)}{\alpha^2 b_C + 1}. \quad (6)$$

The pair $(w^*(b_C), \pi^*(b_C))$ is an equilibrium to the subgame involving the *Wage Setter's* and *Central Banker's* decisions. The equilibrium to this subgame depends on b_C and therefore induce preferences for the *President* and *Senator* regarding the best central bank appointment. We can now characterize how economic outcomes are affected according to the preferences of the *Central Banker*. Proposition 1 describes how these economic outcomes—inflation and unemployment—depend on these preferences.

Proposition 1. *The preferences of the Central Banker affect economic outcomes as follows:*

1. *Expected **inflation** is both higher and more variable as the Central Banker becomes more liberal.*
2. *Expected **unemployment** levels are independent of the Central Banker but become less variable as the Central Banker becomes more liberal.*

The conclusions in Proposition 1 are straightforward. Central Bankers who place less emphasis on low inflation relative to low unemployment will be more tempted to generate inflation, therefore expected inflation is higher for these actors. Moreover, while conservative Central Bankers tend to moderate the effects of output shocks, liberal Central Bankers utilize shocks to generate lower unemployment, thereby creating higher levels of variability in the rate of inflation.

The inability of the *Central Banker* to raise expected unemployment is a result of the standard argument about rational expectations: wage setters anticipate the effect of a liberal central banker on expected inflation and incorporate this information into wage contracts, so that the average effect of monetary policy on unemployment is null. However, since the central banker is, at times, able to take advantage of output shocks, employment is more stable for more liberal central bankers.

The distribution of outcomes following appointment of a given Central Banker (a given b_C) provides the basis of both the President and Senator's induced preferences over appointments.

Appointing liberal central bankers is costly in that it results in higher inflation with no expected decrease in unemployment (though there is less uncertainty in unemployment levels). Therefore, we might expect a rational politician to appoint a conservatively biased central banker. However, the increased variability of unemployment for conservative central bankers introduces another consideration for the politician. For extreme output shocks, a very conservative central banker will pursue policies that seem extremely costly to a more liberal politician. Therefore, since the politicians are risk-averse, less conservative politicians, at times, prefer relatively less conservative central bankers. The next section formalizes these arguments.

2.2 Equilibrium Central Bank Appointments

With the equilibrium behavior of the *Wage Setter*, the *Central Banker*, and how the preferences of a given appointed *Central Banker* affect inflation and unemployment in hand we can now finish constructing the SPNE of the appointments game by characterizing the equilibrium appointment strategy of the *President* and the equilibrium approval strategy of the *Senator*. Given the strategies characterized in the previous section and the fact that both the *President* and the *Senator* must act prior to the realization of the output shock ε , their equilibrium strategies are based on expected utility. In particular, the expected (squared) level of inflation, as characterized in Lemma 1, is given by:

$$\pi^*(b_C)^2 = \text{Var}[\pi^*(b_C)] + \mathbb{E}[\pi^*(b_C)] = \frac{\alpha^2 \sigma^2 b_C^2}{(\alpha^2 b_C + 1)^2} + b_C^2 \bar{y}^2 \alpha^2.$$

Similarly, the expected (squared) level of unemployment is given by:

$$\mathbb{E}[y(\pi, w)^2] = \frac{\sigma^2}{(\alpha^2 b_C + 1)^2} + \bar{y}^2.$$

Substituting these expectations into the utility functions for the *President* and the *Senator* yields the following expected utility:

$$U_i(b_C) = \mathbb{E}(u_i(\pi, y(\pi, w)|b_C) = -\frac{(\alpha^2 b_C^2 + b_i) \left(\bar{y}^2 (\alpha^2 b_C + 1)^2 + \sigma^2 \right)}{(\alpha^2 b_C + 1)^2}, \quad i \in \{S, P\}. \quad (7)$$

From this expected utility expression, we can conclude that there is a unique ideal appointee for the *President* and for the *Senator*. Furthermore, the ideal appointee for each actor is strictly more conservative than that actor. Thus, induced preferences over appointees take on a spatial structure, but it is one in which neither of the actors prefer to appoint an agent that exactly represents their own interests. The preferences of the actors therefore violate the ally principle, which holds in a wide range of other models of delegation (Bendor, Glazer and Hammond, 2001; Bendor and Meirowitz, 2004).

Proposition 2. *The President and Senator each have an “ideal” Central Bank appointee and both actors prefer to delegate to a Central Banker who is strictly more conservative than themselves.*

A best response for the *Senator* involves accepting nominees for appointment such that the *Senator’s* expected utility given the appointee’s monetary policy ideology (weakly) outweighs the utility the *Senator* would receive from rejecting the nominee and retaining the status quo, *i.e.*, $U_S(b) \geq U_S(b^{SQ})$. This is akin to the *Senator* using a threshold acceptance strategy, which can also be represented by an equivalent “acceptance set.” The *Senator* will approve a Central Bank nominee with monetary policy ideology b if and only if the nominee is in the *Senator’s* acceptance set A_S (*i.e.*, $b \in A_S = \{b : U_S(b) \geq U_S(b^{SQ})\}$). The *President* knows what nominees are acceptable to the *Senator* and which are not and therefore maximizes his expected utility subject to the constraint provided by A_S . Since $b^{SQ} \in A_S$ and the *President* is indifferent between choosing a status quo nominee and being rejected, we assume that the *President* chooses b^{SQ} in the event that no element of A_S is preferred to the status quo. The full SPNE to this game therefore is the solution to a standard spatial bargaining game (Romer and Rosenthal, 1978; Ferejohn and Shipan, 1990) with these induced preferences. In the next section, we characterize the predictions that arise from the equilibrium to the game.

3 Economic Uncertainty and the Optimal Central Banker

When does the appointment of a central banker violate or conform to the ally principle? Similarly, when does the appointment process approach a spatial model of appointments in which the polit-

ical actors seek to appoint a like-minded central banker and when does the process more closely approximate a situation where the political actors prefer to appoint a more conservative central banker to overcome time-inconsistency problems? To answer these questions we provide two results that speak directly to how politicized the appointments process is conditional on the economic environment. First, we present a result that concerns the relationship between the positions of the *President* and *Senator* and that of the equilibrium nominee. Although Proposition 2 predicts that the *President* and *Senator* both prefer a nominee more conservative than themselves the following result confirms that the ideal position of nominees is positively correlated with the positions of the *President* and *Senator*.

Proposition 3. *The ideological position of the equilibrium Central Bank appointment is weakly increasing in the positions of the President and the Senator.*

The *President* and the *Senator* prefer a central bank appointee that is more conservative than they are (Proposition 2), but *how* conservative the equilibrium appointment will be relative to the political actors bargaining over the appointment depends on the ideological positioning of the *President* and *Senator*. As Adolph (2013) has noted, the prediction of Proposition 3 holds both in the spatial models of Chang (2001, 2003) and in the economic models like that of Rogoff (1985). Notice, however, that Proposition 3 merely shows that as the *President* and the *Senator* become more liberal, the *Central Banker* appointed in equilibrium could become more liberal as well. The main insight here is that as the ideal points of the actors bargaining over the appointment move toward more liberal monetary policy preferences, the ideal appointment become (weakly) more liberal. This result does not, in itself, provide insight into when and why the appointments process is more or less politicized. Combined with the following results, however, we do begin to generate insight into the effect of economic uncertainty on the political appointment process.

As described informally in the previous section, the relationship between politicians' preferences and equilibrium appointees observed in this model depends critically on uncertainty in the economy. Since large variations in unemployment can occur with very conservative central bankers, risk averse politicians will strike a balance between delegating to conservative central

bankers and appointing allies. This dynamic leads to the following result.

Proposition 4. *Equilibrium Central Banker appointments become more liberal as the economy becomes more volatile.*

Combined with the previous result, Proposition 4 gives us two limiting cases for equilibrium appointments. As economic uncertainty approaches zero, *i.e.*, $\sigma \rightarrow 0$, appointments become perfectly conservative; all politicians prefer appointees that are fully focused on inflation and do not care at all about unemployment. Conversely, as economic uncertainty rises, *i.e.*, $\sigma \rightarrow \infty$, individual behavior resembles a politicized appointment process in which both the *President* and the *Senator* prefer ideological allies. The second observation follows from the fact that, for any finite σ , Proposition 2 tells us that politicians prefer appointees that are strictly more conservative than themselves. Thus, since preferred appointments are strictly increasing in economic uncertainty, σ , the politician's ideal appointment approaches their own position from below as this uncertainty becomes large. The combination of the limiting cases provided by Propositions 3 and 4 lead to the main insight of this paper.

Proposition 5. *As the economy becomes more volatile, the President and the Senator both prefer appointing allies as in a politicized spatial model of appointments, whereas, as the economy becomes less volatile, they both prefer to appoint a more conservative Central Banker as a commitment mechanism as in the canonical conservative Central Banker model of appointments.*

Proposition 5 provides a testable restriction on the strategies of the *President* and the *Senator* that can be contrasted with traditional spatial models of central bank appointments (*e.g.*, Chang, 2001, 2003; Morris, 2000). In particular, Proposition 5 suggests that, in certain economic environments, the political actors involved in bargaining over the appointed central banker—the *President* and the *Senator*—will prefer an appointee that more closely resembles their respective ideal monetary policy ideologies while in other environments they will be more aligned in their collective preference for a conservative central banker.

When uncertainty is high the results predict that we should observe higher levels of conflict between ideologically divergent executives and legislative actors (as in Chang, 2003; Morris, 2000, for example). When uncertainty is lower we should observe a more consensual process characterized by a common value, relatively conservative, appointment (as in Rogoff, 1985, for example).⁷

4 Discussion

The results in Section 3 provide a political-economic logic for how the process of appointments of central bankers operate. In contrast to an either/or approach to a theory of central bank appointments, *i.e.*, either a canonical conservative central banker solving time-inconsistency problems view *or* an ideologically conflict-ridden spatial model of appointments view, our results suggest that the qualitative properties of the process itself are dependent on the economic environment. As the economy becomes more volatile the political actors involved in the appointment process prefer ideological allies—approximate conformation with the ally principle—as predicted in traditional spatial models of appointments (see Bendor and Meirowitz, 2004, for instance). In times of high economic uncertainty the central bank appointment process is characterized by politicization and ideological conflict. The level of politicization and conflict, of course, is further dependent on the level of preference divergence between the President and the pivotal Senator. However, when operating in economic environments characterized by low economic uncertainty the political actors involved in bargaining over appointments have less conflicting preferences with respect to the optimal central bank appointee as both actors' preference moves toward a perfectly conservative

⁷These results, with a slight reinterpretation, are also complementary to the work of Adolph (2013). In particular, Adolph shows that central banker preferences vary systematically conditional on their career histories. Central bankers who have served as career bureaucrats correlate more highly with favoring “dovish” or liberal monetary policy, while central bankers who spent most of their careers in the banking industry prefer more “hawkish” or conservative policies. Our results suggest that when the economy is more volatile we should observe relatively more career bureaucrats being appointed to the central bank, while, in contrast, when economic uncertainty is low our results suggest that there will be a higher likelihood of a career banker being appointed to the central bank. This is qualitatively similar to our discussion of the results in more general—“conservative” and “liberal”—terminology given the correlated relationship between ideology and career paths borne out in Adolph (2013).

central banker. In times of low uncertainty, then, the process is characterized by a common value (relatively conservative) equilibrium appointment in which politicians use the appointment as a credible commitment mechanism to inflation-reducing policies.

Our theory also has normative implications for one of the major justifications for delegation of monetary policy to independent central banks. In particular, our results suggest that the notion of independent central bankers as commitment mechanisms will work well in times of economic stability (*i.e.*, low economic uncertainty), while this logic may not hold up in times of economic crisis (*i.e.*, high economic uncertainty) because politicians' central bank appointment strategies become more and more reminiscent of politicized appointment processes as uncertainty in the economy rises. This could be both normatively and positively problematic in the sense that economic crises are precisely the times in which we may want to free central bankers from political influence so that they can more ably focus on long-term economic stability (Bernanke, 2010). In times of economic crisis, politicians feel pressure to take action immediately, often to produce short-term benefits, lest they appear incompetent to important political constituencies.⁸ This is precisely the reason underlying the justification of delegating monetary policy authority to a (relatively) conservative, independent central banker to overcome time-inconsistency problems; politicians have an incentive to manipulate monetary policy instruments to generate short-term benefits in real economic outcomes even when they have previously committed to long-term price stabilizing policies. Our model suggests that, insofar as the appointments of central bankers represent significant political influence on monetary policy,⁹ in times of economic crisis this stabilization through credible commitment logic may break down.

⁸For instance, Romano (2012) argues that The Sarbanes-Oxley Act of 2002 and Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 are both examples of sub-optimal regulatory actions enacted by electorally pressured politicians in response to financial crises. She argues that these pieces of legislation are sub-optimal precisely because they are reactionary and, subsequently, ill-considered. The electoral pressure for politicians to take action, she contends, led to these (from her view) poorly crafted policies.

⁹The empirical work cited in the introduction suggests that it does.

5 Conclusion

In this paper we developed a political-economic theory of appointments to the Federal Reserve. Political actors prefer to appoint allies when economic uncertainty levels are high and to use appointments as credible commitment mechanisms to overcome time-inconsistency problems when economic uncertainty levels are low. Our results are congruent with both canonical economic models of delegating monetary policy authority to a relatively conservative central banker (Rogoff, 1985) and to politicized spatial models of appointments (*e.g.*, Chang, 2001, 2003). Specifically, we show that both political actors in the model prefer a conservative central bank appointee relative to their own ideal points, but the relativity of conservatism is both positively correlated with the actors' monetary policy ideal points and the underlying economic environment within which the bargaining over appointments takes place. Importantly, the political process is affected directly by economic outcomes. This is because the (induced) preferences of the political actors bargaining over appointments are directly linked to economic outcomes.

The main insight — that the political appointment process of central bankers is dependent on the underlying uncertainty of the economy — has clear normative implications for our understanding of the logic underlying the justification for delegating monetary policy authority to an independent central bank. In particular, our results suggest that during times in which politicians are most vulnerable to renegeing on their commitment to long-term price stabilizing policy, *i.e.*, times of economic crisis, the commitment mechanism is overcome with political considerations when appointing central bankers. This further suggests a conditional relationship between credible commitment to inflation-reducing policies by politicians and the underlying uncertainty of the economic environment in which the political actors are interacting.

Finally, this framework can be extended in a multitude of interesting ways to examine other political-economic phenomena in the realm of monetary policy and central banking. One extension would be to examine how the addition of a richer political bargaining environment may alter the ultimate central banker appointed in terms of monetary policy ideology. By adding more “pivot players” to the bargaining stage of the game this model would more closely resemble work by

Keefer and Stasavage (2003) and Stasavage (2003). While their focus was more on the effects of political interactions on economic outcomes combining the two insights — induced political preferences from economic outcomes conditional on the underlying economic environment and the efficacy of political influence on monetary policy as mitigated through the number of effective veto players in the game — we may gain further leverage in understanding the inter-dependency of political processes and economic outcomes.

Another interesting extension would be to further enrich the monetary policy choice component(s) of the model in this paper. Combining this framework with work on committee decision-making in monetary institutions would lead to a political bargaining setting over central bank appointments that more closely approximates the real Federal Reserve monetary policy decision process (*i.e.*, the FOMC) (see Sibert, 2003, 2006, for instance). What appointment is open, in terms of the distribution of monetary policy preferences already on the FOMC, may alter the strategies of the political actors bargaining over appointments. This could either ameliorate or exacerbate the effects of economic outcomes on the political process of appointing central bankers. Thus, while this paper has provided insight into an interesting dynamic present in the appointments of central bankers to the Federal Reserve — the effect of the economic environment on the political appointments process itself — there is much more interesting work to be done.

6 Appendix

This section provides proof of formal results presented in the text.

6.1 Proof of Formal Results

Lemma 1. *In equilibrium, a Central Banker with monetary policy ideal point b_C sets the target level of inflation according to the following equation:*

$$\pi^*(b_C) = \frac{\alpha b_C (\alpha^2 \bar{y} b_C + \bar{y} - \varepsilon)}{\alpha^2 b_C + 1}.$$

Proof. Recall the *Central Banker* solves the following problem:

$$\max_{\pi} \left[-\pi^2 - b_C(\bar{y} - \alpha(\pi - w) - \varepsilon)^2 \right].$$

The first order condition for a maximum is:

$$-2\pi - b_C\alpha(\bar{y} - \alpha(\pi - w) - \varepsilon) = 0.$$

Solving the first order condition and substituting in $w^*(b_C)$ yields the best response given by Equation 6. The second order condition is met since u_C is concave. Therefore, this is a best response for the *Central Banker* and $\pi^*(b_C)$ is the inflation rate chosen in a SPNE. ■

Proposition 1. *The preferences of the Central Banker affect economic outcomes in the following ways:*

1. *The expected value and variance of inflation is higher for more liberal central bankers.*
2. *The expected value of unemployment is independent of the central banker and the variance of unemployment is lower for more liberal central bankers.*

Proof. Claim (1) follows easily from the derived strategies. The expected value of inflation is $b_C\bar{y}\alpha$ which is clearly increasing in b_C . The variance of inflation is

$$\frac{\alpha^2\sigma^2b_C^2}{(\alpha^2b_C + 1)^2} \tag{8}$$

which is increasing in b_C since

$$\frac{\partial}{\partial b_C} \frac{\alpha^2\sigma^2b_C^2}{(\alpha^2b_C + 1)^2} = \frac{2\alpha^2\sigma^2b_C}{(\alpha^2 + 1)^2} > 0. \tag{9}$$

Since $E(w^*(b_C) - \pi^*(b_C)) = 0$ for any b_C and $E(\varepsilon) = 0$, the expected value of unemployment is

simply \bar{y} for all b_C . The variance of $y(\pi^*(b_C), w^*(b_C))$ is

$$\frac{\sigma^2}{(\alpha^2 b_C + 1)^2} \quad (10)$$

which is strictly decreasing in b_C , proving claim (2). ■

Proposition 2. *The President and Senator each have an “ideal” Central Bank appointee and each actor prefers to delegate to a Central Banker who is strictly more conservative than herself.*

Proof. We will show that there exists one local maximum to U_i which lies in the open interval $(0, b_i)$ for any $b_i > 0$. The first order condition is

$$\begin{aligned} \frac{\partial U_i}{\partial b_C} &= \frac{2\alpha^2 (\alpha^2 b_C^2 + b_i) (\bar{y}^2 (\alpha^2 b_C + 1)^2 + \sigma^2)}{(\alpha^2 b_C + 1)^3} - \frac{2\alpha^2 \bar{y}^2 (\alpha^2 b_C^2 + b_i)}{\alpha^2 b_C + 1} \\ &\quad - \frac{2\alpha^2 b_C (\bar{y}^2 (\alpha^2 b_C + 1)^2 + \sigma^2)}{(\alpha^2 b_C + 1)^2} \\ &= - \frac{2\alpha^2 (\alpha^6 \bar{y}^2 b_C^4 + 3\alpha^4 \bar{y}^2 b_C^3 + 3\alpha^2 \bar{y}^2 b_C^2 + b_C (\bar{y}^2 + \sigma^2) - \sigma^2 b_i)}{(\alpha^2 b_C + 1)^3} = 0 \end{aligned}$$

Since the denominator and the term $2\alpha^2$ must be strictly greater than zero, the solution to the first order condition must be a root to the quartic equation in the numerator:

$$\alpha^6 \bar{y}^2 b_C^4 + 3\alpha^4 \bar{y}^2 b_C^3 + 3\alpha^2 \bar{y}^2 b_C^2 + b_C (\bar{y}^2 + \sigma^2) - \sigma^2 b_i = 0.$$

We can re-write this expression as

$$b_C = g(b_C) = b_i \cdot \frac{\sigma^2}{\bar{y}^2 (\alpha^2 b_C + 1)^3 + \sigma^2}. \quad (11)$$

Thus, the solution to our first-order condition is a fixed point of the function $g(\cdot)$. Since the fraction in Equation 11 is always less than 1, g is bounded above by b_i . Since g is also strictly positive, g is a continuous function mapping the interval $[0, b_i]$ onto itself. By Brouwer’s fixed point theorem, there exists a fixed point of g on this interval. By the arguments above, the fixed point is on the

interior of this interval. Since U_i is strictly concave, this fixed point is a maximum of U_i and is unique. ■

Proposition 3. *The ideological position of the equilibrium Central Bank appointment is weakly increasing in the positions of the President and the Senator.*

Proof. The following Lemma will also be useful for the next result.

Lemma 2. For any parameter θ , if U_S satisfies increasing differences¹⁰ for (b_C, θ) , A_S is weakly increasing in θ in the strong set order.¹¹

Proof: Let $\bar{\theta} > \underline{\theta}$ and denote $\overline{A_S}$ and $\underline{A_S}$ denote the set A_S when the parameter θ is set equal to $\bar{\theta}$ and $\underline{\theta}$, respectively. We consider three cases: (1) there is no $b'_C \neq b^{SQ}$ such that $U_i(b'_C, \underline{\theta}) = U_i(b^{SQ}, \underline{\theta})$; (2) there exists such a b'_C , and $b'_C > b^{SQ}$; and (3) there exists such a b'_C , and $b'_C > b^{SQ}$. If there does not exist b'_C such that $U_i(b'_C, \underline{\theta}) = U_i(b^{SQ}, \underline{\theta})$, then $\underline{A_S} = [0, b^{SQ}]$. Since $\overline{A_S}$ must be an interval including b^{SQ} , we have $\overline{A_S} \geq_s \underline{A_S}$.

Now assume there exists a b'_C such that $U_i(b'_C, \underline{\theta}) = U_i(b^{SQ}, \underline{\theta})$. If $b'_C > b^{SQ}$, then $\underline{A_S} = [b'_C, b^{SQ}]$. In this case, we must show that, for any $b''_C < b'_C$, $b''_C \notin \overline{A_S}$. By increasing differences,¹²

$$\begin{aligned} U_S(b'_C, \underline{\theta}) - U_S(b''_C, \underline{\theta}) > 0 &\Rightarrow U_S(b'_C, \bar{\theta}) - U_S(b''_C, \bar{\theta}) \geq 0 \\ U_S(b^{SQ}, \underline{\theta}) - U_S(b'_C, \underline{\theta}) = 0 &\Rightarrow U_S(b^{SQ}, \bar{\theta}) - U_S(b'_C, \bar{\theta}) \geq 0. \end{aligned}$$

¹⁰A function $f(x, \theta)$ satisfies **increasing differences** for (x, θ) if the incremental return, $f(x, \cdot) - f(x', \cdot)$, is weakly increasing in the parameter, θ (Ashworth and Bueno De Mesquita, 2006).

¹¹Given two sets S^*, S^o . We say that S^* is higher than S^o in the **strong set order** (we write $S^* \geq_s S^o$) if and only if for any $x^o \in S^o$ and $x^* \in S^*$, if $x^o \geq x^*$, then $x^o \in S^*$ and $x^* \in S^o$. Note that, when the choice set is a subset of the real line as in this paper and S^* and S^o are intervals, we will have $S^* \geq_s S^o$ provided that the end-points of S^* are greater than or equal to the end-points of S^o .

¹²This statement is an application of the single-crossing condition, which is implied by increasing differences (Ashworth and Bueno De Mesquita, 2006).

Hence, $U_S(b^{SQ}, \bar{\theta}) \geq U_S(b'_C, \bar{\theta}) > U_S(b''_C, \bar{\theta})$, which implies that $b''_C \notin \bar{A}_S$. Since \bar{A}_S must be an interval including b^{SQ} , this implies that $\bar{A}_S \geq_s \underline{A}_S$.

Finally, if $b'_C > b^{SQ}$, then $\underline{A}_S = [b^{SQ}, b'_C]$. In this case, we must show that $b'_C \in \bar{A}_S$. By increasing differences,

$$U_S(b'_C, \underline{\theta}) - U_S(b^{SQ}, \underline{\theta}) = 0 \Rightarrow U_S(b'_C, \bar{\theta}) - U_S(b^{SQ}, \bar{\theta}) \geq 0$$

which implies that $b'_C \in \bar{A}_S$. The argument in Case 2 shows that there is no point in \bar{A}_S smaller than b^{SQ} . \square

we will use the following result, which follows from the monotone selection theorem of Milgrom and Shannon (1994):¹³

Monotone Selection Theorem (Milgrom and Shannon (1994)): Let $X \subseteq \mathbb{R}$ be the set of all possible choices of x and $\Theta \subseteq \mathbb{R}$ be the set of possible values of a parameter θ . Let $f : X \times \Theta \rightarrow \mathbb{R}$. If $S : \Theta \rightarrow 2^X$ is nondecreasing and f satisfies the single-crossing condition for (x, θ) , then every selection $x^*(\theta)$ from $\arg \max_{x \in S(\theta)} f(x, \theta)$ is monotone nondecreasing in θ .

Proof of Proposition 3: Using the theorem of Milgrom and Shannon (1994), it is sufficient to show that $U_P(b)$ satisfies single-crossing for (b, b_P) and for (b, b_S) and that A_S is nondecreasing in b_P and b_S . Since b_S does not enter $U_P(b)$, so $U_P(b)$ satisfies single-crossing for (b, b_S) since the cross-partial derivative of $U_P(b)$ with respect to b and b_S is zero. Similarly, since $U_S(b_C)$ does not depend on b_P , A_S is non-decreasing in b_P . To show that $U_P(b)$ satisfies single-crossing for (b, b_P) , note that

$$\frac{\partial U_P}{\partial b_C \partial b_P} = \frac{2\alpha^2 \sigma^2}{(\alpha^2 b_C + 1)^3} > 0,$$

which shows that the increasing differences condition is satisfied, implying that the single-crossing is met. Since, by the same argument, $U_S(b_C)$ satisfies single-crossing for (b_C, b_S) , Lemma 2 estab-

¹³This is Theorem 4' in Milgrom and Shannon (1994). Their result is stated for more general multidimensional problems and requires introducing concepts that we have not defined above, so we restate it for the special case of one-dimensional choice sets and parameters and using the notation introduced above.

lishes that A_S is nondecreasing in b_S , completing the proof. ■

Proposition 4. *Equilibrium Central Banker appointments become more liberal as the economy becomes more volatile.*

Proof. By the arguments above, we need to show that U_i satisfies single crossing for (b_C, σ) when b_C is in the interval $(0, b_i)$. Note that

$$\frac{\partial U_i}{\partial b_C \partial \sigma} = \frac{4\alpha^2 \sigma (b_i - b_C)}{(\alpha^2 b_C + 1)^3},$$

which is strictly positive given that $b_C < b_i$. Thus, U_i satisfies increasing differences (therefore single-crossing) for (b_C, σ) , completing the proof. ■

Proposition 5. *As the economy becomes more volatile, the Central Banker Appointments Game approaches a politicized spatial model of appointments, whereas, as the economy becomes less volatile, the Central Banker Appointments Game more closely approximates the canonical conservative Central Banker model of appointments.*

Proof. By Equation 11 in the proof of Proposition 2, the ideal appointment of each agent i is equal to

$$b_i \cdot \frac{\sigma^2}{\bar{y}^2 (\alpha^2 b_C + 1)^3 + \sigma^2}.$$

We have

$$\lim_{\sigma \rightarrow 0} b_i \cdot \frac{\sigma^2}{\bar{y}^2 (\alpha^2 b_C + 1)^3 + \sigma^2} = 0$$

and

$$\lim_{\sigma \rightarrow \infty} b_i \cdot \frac{\sigma^2}{\bar{y}^2 (\alpha^2 b_C + 1)^3 + \sigma^2} = b_i \lim_{\sigma \rightarrow \infty} \frac{\sigma^2}{\bar{y}^2 (\alpha^2 b_C + 1)^3 + \sigma^2} = b_i.$$

Furthermore, Proposition 4 shows that every agent's ideal appointment is increasing in σ . Thus, as σ goes to zero, the game approaches one with perfectly conservative appointments and as σ gets large the game monotonically approaches the spatial model of appointments in which agents seek appointees at their own ideal point. ■

6.2 Existence and Uniqueness of Equilibrium

Proposition 6. *There exists a unique SPNE to the Appointments Game.*

Proof. We have already derived equilibrium strategies for the Senator, Wage Setter, and Central Banker, so we must show that there exists a unique solution to the President's decision problem: $\arg \max_{b \in A_S} U_P(b)$. A_S is closed by construction and bounded by $[0, \max\{b_S, b^{SQ}\}]$ since $U_S(b_C)$ is strictly decreasing for $b_C > b_S$ (Proposition 2). Thus, A_S is compact. As has been noted, U_P is continuous. Since a continuous function on a compact set must attain a maximum, there exists a solution to the President's decision problem. By strict concavity of U_P , any internal solution is unique. Since any corner solution must yield the same expected payoffs as b^{SQ} and we assume that the President breaks ties in favor of b^{SQ} , the solution to the President's decision problem is unique.

■

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