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Bargaining over Monetary Policy and Optimal Committee Composition in a Currency Union

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Abstract

Drawing on the Barro-Gordon framework, this paper investigates the design of the monetary policy committee in a currency union which implements the optimal time-consistent policy. The monetary policy is determined through Nash bargaining between member countries, where the outside options consist of non-cooperation within the union. It is shown that the member which experiences a higher output should have a greater bargaining power to reduce the inflationary bias. We also found that the richer member's optimal bargaining power, which induces the equilibrium policy time-consistent, is U-shaped with respect to the heterogeneity in the output shock.

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1. Introduction

Since the seminal contributions by Kydland and Prescott (1977) and Barro and Gordon (1983), the design of monetary institutions has been a huge problem in macroeconomics. In the context of monetary unions, where member countries are heterogeneous in their domestic economic conditions, the problem seems to be a rather difficult one for of the following reasons. First, monetary unions contain conflicts of interests among member countries, which make the commitment solution unrealistic. Second, each member has the option to exit the monetary union, if the common monetary policy is extremely undesirable, which influences the formation of the private sector's expectations. In the European Union, for instance, exit options have been a huge political issue among several countries since the vote for Brexit (Lyons and Darroch, 2016). Regarding monetary policymaking, the existence of the exit option influences it by affecting the bargaining situation among the members and the private sector's expected inflation. However, there is no relevant theory to appeal to.

Taking the above discussion as a motivation, this paper revisits the classical time-inconsistency problem in monetary policymaking (Barro and Gordon, 1983) in a monetary union setting. In our model, there are two member countries, which are heterogeneous in the within-country output shocks, and they discretionarily choose a common monetary policy through Nash bargaining. Our goal is to find the characteristics of the monetary institution which implements the efficient time-consistent policy as a consequence of the discretionary collective policymaking.

We show that the member with a higher output should have greater bargaining power to reduce the inflationary bias, which is similar to the result of Rogoff (1985)'s conservative central banker study. Also, we illustrate that the optimal bargaining power for richer members, which implements the optimal monetary policy, is U-shaped with respect to the heterogeneity of output shocks among members; hence the monetary union cannot implement the optimal policy with an extremely small (or large) heterogeneity in output.

This paper hopes to contribute to the literature on the time-inconsistency problem on discretionary policymaking by Kydland and Prescott (1977) and Barro and Gordon (1983), among others, which lead to several solutions such as those proposed by Rogoff (1985) and Walsh (1995). In the context of monetary unions, Von Hagen and Süppel (1994) compare different institutional frameworks for the committees without threats of exits. Farvaque et al. (2009) investigate the sustainability of a monetary union, where the policy is determined by majority voting on external shocks. Using a Nash bargaining setup with exogenously fixed outside options, Aaron-Cureau and Kempf (2006) compare the welfare of the two scenarios: (i) the case where the delegates directly bargain over the monetary policy, and (ii) the case where the countries bargain over the delegation of an independent central banker, and suggest the possibility that every country is better off when they directly bargain. In contrast to Aaron-Cureau and Kempf (2006), this paper builds a Nash bargaining scenario with endogenous outside options, and investigates the optimal institutional design of the monetary policy committee.

The remainder of the article is organized as follows: Section 2 describes the model. Section 3 illustrates the results. Section 4 provides the conclusion.

2. Model

We extend the canonical framework of a discretionary monetary policy Barro and Gordon (1983) to a collective policymaking problem in a monetary union. Let us describe an arbitrary economy to that of country i. Suppose that the output, y_i, follows the Lucas supply function:

$$y_i = \pi_i - \pi^e + \epsilon_i. \tag{1}$$

where π_i is inflation and π^e is expected inflation, and ϵ_i is the normally distributed supply shock with zero mean and variance σ^2. For the sake of simplicity, we suppose that the monetary authority can directly control inflation. The social loss function is given as:

$$L_i = \frac{1}{2}\left[b\left(y_i - k\right)^2 + \pi_i^2\right] \tag{2}$$

where $b \in (0, +\infty)$ is the socially preferred weight attributed to the cost of deviation of output from its target value, which is supposed to be zero, and $k \in (0, +\infty)$ is the target level of output. In the discretionary equilibrium, the private sector rationally forms its expectation:

$$\pi^e = E[\pi]. \tag{3}$$

2.1 Single Country Benchmark

As a baseline, this section illustrates the discretionary equilibrium in a single policymaker setting.[1] Given π^e, the monetary authority minimizes the loss function 2 subject to the supply function 1. The first order condition can be written as:

$$\pi_i^* = \frac{b}{1+b}\left(\pi^e + k - \epsilon_i\right) \tag{4}$$

[1] An example of the single monetary policymaker is the Reserve Bank of New Zealand.

which describes the bliss inflation for i given π^e. By imposing rational expectation condition 3 into Eq. 4, we find that:

$$\pi_i^D = b\left(k - \frac{\epsilon_i}{1+b}\right),\; y_i^D = \frac{\epsilon_i}{1+b}$$

where D stands for discretion. If the policymaker can commit to the target inflation level, on the other hand, the outcomes are given by:

$$\pi_i^C = 0\;, y_i^C = \epsilon_i$$

where C stands for commitment. In a standard setting, the policymaker chooses the commitment rule if and only if the rule reduces the social loss, i.e. $L_i^C < L_i^D$, which leads that $\sigma^2 < (1+b)k^2$. Hence, in the single country setting, the rule is enforced when the volatility of the output is relatively small.

2.2 Monetary Union

Now we will consider the problem in the context of a simple monetary union. There are two members, namely H and L, which are heterogeneous with respect to the country-specific output shocks ϵ_i. We suppose that the measure of them are same, the shocks are normally distributed with zero mean, variance σ^2, orthogonal to each other, and offset each other in aggregate:

$$\epsilon_H + \epsilon_L = 0\, with\, \epsilon_H > \epsilon_L. \tag{5}$$

The social loss of the monetary union, $\mathcal{L}$, is given by the weighted sum of the social loss of all members $\mathcal{L} = \frac{1}{2}\left(L_H + L_L\right)$. Using the supply function 1 and the assumption 5, we have:

$$\mathcal{L} = b\left(\pi - \pi^e - k\right)^2 + \pi^2 + b\sigma^2 \tag{6}$$

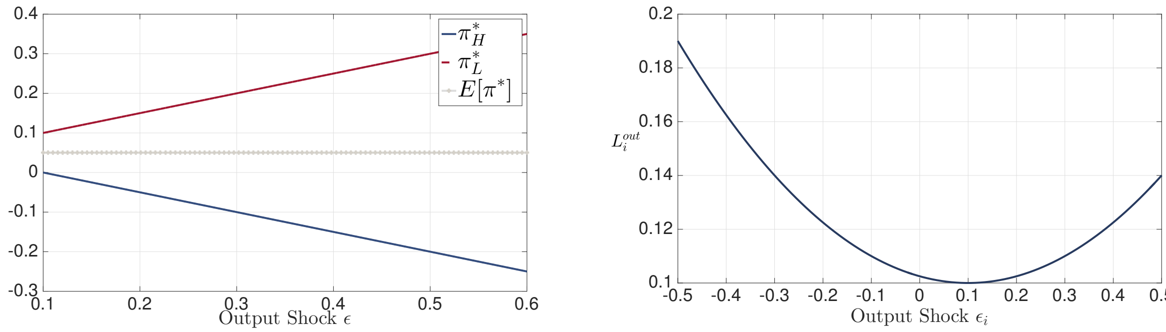
which yields the following first-order condition:

$$\pi = \frac{b}{1+b}\left(\pi^e + k\right). \tag{7}$$

Suppose that a social planner, who has the loss function 6, chooses the monetary policy. Then, by imposing the rational expectation condition on Eq. 7, we obtain the discretionary solution:

$$\pi^D = bk,\; Y^D = 0,$$

where Y denotes the aggregate output, i.e. $Y \coloneqq y_H + y_L$. Instead, the commitment



(a) Bliss inflations π_i^* given π^e

(b) Loss of outside option L_i^{out}

Figure 1: Bliss inflations and outside options ($b = 1$, $k = 0.1$, $\delta = 0.1$, $\pi^e = 0$)

solution is given by:

$$\pi^C = 0, \; Y^C = 0.$$

Hence the commitment rule keeps inflation lower while realizing the same output, which implies that it lowers social loss in any condition in the monetary union setting. The goal of this paper is to find out the committee characteristics in a discretionary collective policy choice setting, which achieve the same outcome to the commitment solution in the social planning problem.

We specify the timing of events as follows:

1. *The private sector rationally forms the expectation*

2. *The stochastic shock vector is realized*

3. *The members collectively choose inflation via Nash bargaining*

Notice that the outside options in Nash bargaining consist of non-cooperation within the union.

3. Solution and Committee Design

This section solves the model by backward induction. If a country left the monetary union, it discretionarily chooses inflation as in the single policymaker case:

$$\pi_i^{out} = \frac{b}{1+b}\left(\pi^e + k - \epsilon_i\right) \tag{8}$$

which leads to the welfare loss of its outside option:

$$L_i^{out} = \frac{1}{2}\left[b\left(\pi_i^{out} - \pi^e + \epsilon_i - k\right)^2 + \left(\pi_i^{out}\right)^2\right] + \delta \tag{9}$$

where $\delta > 0$ denotes a fixed cost regarding exit. Let γ be the bargaining power of the member H such that $\gamma \in (0,1)$. Given expected inflation π^e, the bargaining solution π^{union} is given by the problem as follows:

$$\min_{\pi^{union}} \left(L_H - L_H^{out}\right)^{\gamma} \left(L_L - L_L^{out}\right)^{1-\gamma} \tag{10}$$

subject to

$$L_i = \frac{1}{2}\left[b\left(\pi^{union} - \pi^e + \epsilon_i - k\right)^2 + \left(\pi^{union}\right)^2\right] \; for \; i = H, L$$

$$L_i - L_i^{out} \leq 0 \; i = H, L \tag{11}$$

The constraint *(11)* ensures that each member prefers to remain in the union, which is needed to avoid the occurrence of a deadlock in the bargaining.

3.1 Solution

The first-order condition of the bargaining problem can be written as:

$$\gamma \frac{L_H'}{L_H - L_H^{out}} + (1-\gamma) \frac{L_L'}{L_L - L_L^{out}} = 0 \tag{12}$$

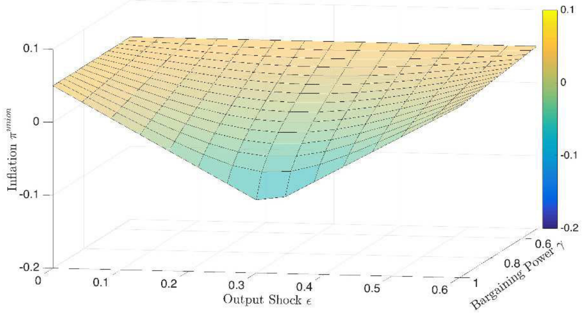
which characterizes the policy choice in the union. Figure 2 plots the bargaining outcomes for different sets of parameters. The results are summarized as follows.

Result 1 (Bargaining Outcome).

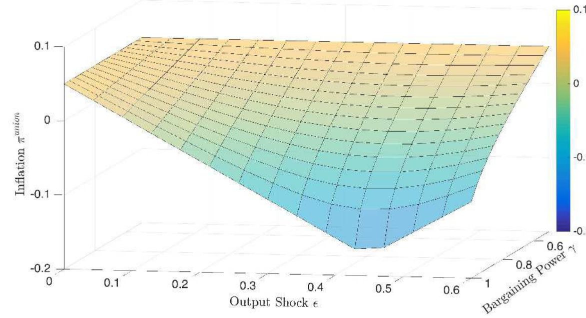
1. *The inflation in the monetary union π^{union} depends positively on the expected inflation π^e and the target output k, and depends negatively on H's bargaining power γ.*

2. *An increase in the cost of exit δ decreases the inflation π^{union} and shifts to the right the minimum of π^{union}, if $\gamma > 0.5$.*

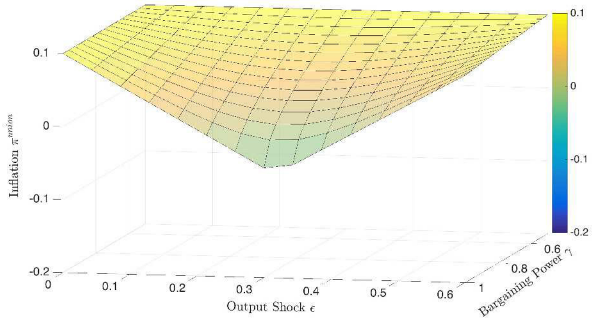
3. *The relationship between the inflation in the monetary union π^{union} and the output shock ϵ is U-shaped.*



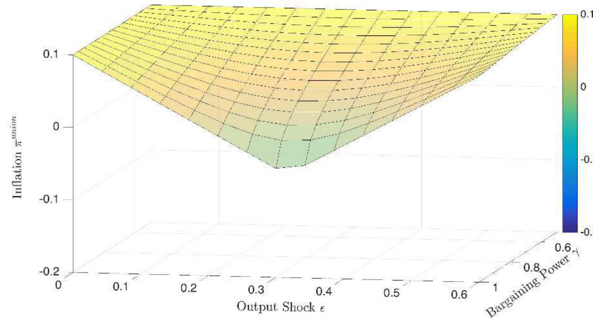
(a) Benchmark ($b = 1$, $k = 0.1$, $\delta = 0.1$, $\pi^e = 0$)



(b) High Cost of Exit ($b = 1$, $k = 0.1$, $\delta = 0.2$, $\pi^e = 0$)



(c) High Expected Inflation ($b = 1$, $k = 0.1$, $\delta = 0.1$, $\pi^e = 0.1$)



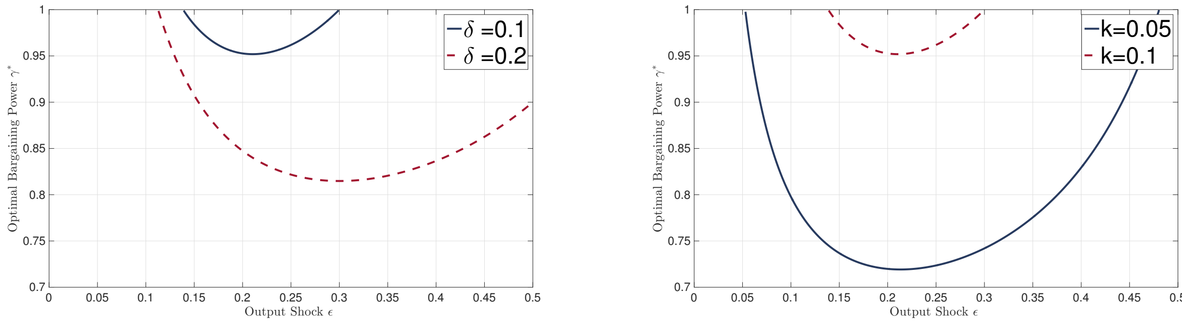
(d) High Output Target ($b = 1$, $k = 0.2$, $\delta = 0.1$, $\pi^e = 0$)

Figure 2: Inflation π^{union}, bargaining power γ, and output shock ϵ

Firstly, a larger expected inflation or an output target increases the inflation rate in the monetary union, as in the single monetary authority case. Also, a higher cost of exit makes the inflation lower since it makes the loss of outside option higher, which induces that the member L to accept the inflation that it could not accept with a lower cost of exit. Additionally, a larger γ reduces inflation since H prefers lower inflation than L.

The relation between inflation and output shock is based on two elements. The first element, which decreases the equilibrium inflation as shock increases, is related to the fact that the optimal inflation for H is a decreasing function of ϵ. While L's bliss inflation is increasing in ϵ, this channel decreases the inflation in our setting, i.e. $\epsilon_H = -\epsilon_L$ and $\gamma \geq 0.5$.[2] The second element which increases the inflation as shock increases, is related to the requirement of an agreement. If the difference in the output shocks become larger, L requires higher inflation to satisfy the constraint 11 for L. The endogenous outside options *9* increase this effect, since the difference between the outside options hike up as the shock

[2]We only display the case with $\gamma \geq 0.5$ since we cannot achieve the optimal outcome with $\gamma < 0.5$, which is stated in Result 2.



(a) Effect of Cost of Exit δ ($b = 1$, $k = 0.1$, $\pi^e = 0$) (b) Effect of Output Target k ($b = 1$, $\delta = 0.1$, $\pi^e = 0$)

Figure 3: Optimal bargaining power γ^*

increases.[3]

Figure 2 also illustrates the outcomes under the rational expectation equilibrium. In the benchmark case, for instance, the area in which $\pi^{union} = 0$ shows the equilibrium outcomes since $\pi^e = 0$ is supposed. Note that in that case, the outcome coincides with the optimal commitment solution. Clearly, the possibility of realizing the optimal solution depends on the balance of bargaining power. The next section describes the values of bargaining power which leads to the optimal outcome.

3.2 Committee Design

Proposition 1.

There is an optimal value of bargaining power γ^* which achieves the optimal outcome such that:

$$\gamma^* = \frac{\frac{\epsilon^2 - k^2}{2}(\epsilon - k) - L_H^{out}(\epsilon + k)}{\epsilon(\epsilon^2 - k^2) - L_L^{out}(\epsilon - k) - L_H^{out}(\epsilon + k)}$$

Proof. *The condition (12) can be written as a cubic equation $\Phi(\pi) = 0$ such that:*

$$\Phi(\pi) = \frac{1}{2}\left[\phi_3\pi^3 + \phi_2\pi^2 + \phi_1\pi + \phi_0\right] \tag{13}$$

where $\phi_3 = (1 + b)^2$,

$$\phi_2 = b(1 + b)\left\{\gamma\left(\epsilon_H - \pi^e - k + 2(\epsilon_L - \pi^e - k)\right) + (1 - \gamma)\left(\epsilon_L - \pi^e - k + 2\left(\epsilon_H - \pi^e - k\right)\right)\right\},$$

[3] See Fig 1- b.

$$
\begin{aligned}
\phi_1 &= 2b\left(\epsilon_H - \pi^e - k\right)\left(\epsilon_L - \pi^e - k\right) \\
&+ (1+b)\left[\gamma\left\{\left(\epsilon_L - \pi^e - k\right)^2 - 2L_L^{out}\right\} + (1-\gamma)\left\{\left(\epsilon_H - \pi^e - k\right)^2 - 2L_H^{out}\right\}\right],
\end{aligned}
$$

$$
\begin{aligned}
\phi_0 &= b\left(\epsilon_H - \pi^e - k\right)\left(\epsilon_L - \pi^e - k\right)\left\{\gamma\left(\epsilon_L - \pi^e - k\right) + (1-\gamma)\left(\epsilon_H - \pi^e - k\right)\right\} \\
&- 2b\left\{\gamma\left(\epsilon_H - \pi^e - k\right)L_L^{out} + (1-\gamma)\left(\epsilon_L - \pi^e - k\right)L_H^{out}\right\}.
\end{aligned}
$$

By imposing $\pi = \pi^e = 0$ on $\Phi(\pi) = 0$ and solving for γ, the result is obtained. □

Figure 3 illustrates the optimal bargaining power γ^* for our experimental parameter values. The results are interpreted as follows.

Result 2 (CommitteeDesign).

1. *The optimal bargaining power γ^* is no less than* 0.5*.*

2. T*he optimal bargaining power γ^* depends negatively on the cost of exit δ and positively depends on the output target k.*

3. *The relationship between the optimal bargaining power γ^* and the output shock ϵ is U-shaped.*

The first statement of Result 2 is similar to that of Rogoff (1985), whose study shows that appointing a conservative central banker reduces inflationary bias. In our model, we could reduce inflationary bias by giving a higher bargaining power to the member H, who prefers lower inflation than L. In other words, inflationary bias always exists in a monetary union where the poorer country has a higher bargaining power.

The effect of the cost of exit on the optimal bargaining power, stated in the second line of Result 2, is caused by increasing the welfare loss of outside options. This effect relaxes the constraint 11 for member L, which causes agent H to propose lower inflation. Also, the optimal bargaining power increases as a reduction of the output target, since it hikes up the bliss inflations for both members.

The third statement in Result 2 reflects the U-shaped relationship between the inflation and output shock, which suggests that a higher bargaining power for richer member does not always lead with the most efficient outcome. When the members have a high output target, such that $\epsilon < k$, the committee cannot achieve the optimal policy since both of the members prefer positive inflation. When the level of the shock is high, on the other hand, the optimal policy $\pi^{union} = 0$ cannot prevent L's exit; hence any value of bargaining power cannot lead to the optimal policy.

3.3 Discussion

On what conditions is the optimal bargaining power balance satisfied in reality? One key factor is the composition of members in the monetary union. Let us interpret the model as each of H and L consisting of several identical countries. Then it would be natural to suppose that more countries within H will increase H's bargaining power in the committee. In this case, we might able to state that the monetary union could reduce the inflationary bias by increasing the number of potential H members, at the initial designing phase.[4] The discussion is similar to that of Alesina and Grilli (1993) who studied the majority voting game in a currency union and showed that the introduction of a new member influences the equilibrium policy via changing the median voter in the committee. By extending our model to a repeated bargaining problem, we might able to find the effect of an exit (as well as an entrances) on the power balance and the policies chosen in the equilibrium.

Additionally, while we have focused on the bargaining problem in an existing monetary union throughout the paper, it would be beneficial to discuss the other environments, i.e. the equilibria in which the members exit the currency union and in which no country enters the union at the beginning. The countries' entering decisions crucially depend on the bargaining power balance in the monetary union. If the power balance is the optimal one, countries form the monetary union since it will implement the optimal policy which cannot be achieved by itself. By contrast, if the power balance is inappropriate in such a way that one anticipates an exit of a member, the countries have no incentive to join it in the first place. Regarding the exit decisions, a country has an incentive to exit the monetary union if it decreases the social loss, i.e. $L_i^{out} < L_i^{union}$. In general, such a decision could happen if the members are too heterogeneous and the cost of exit is too low. In that case, there is no policy that satisfies the constraint 11 for both members, and so the monetary union would never reach a consensus; hence it would collapse.

It would be also important to consider other types of output shock. Let us consider the following general shock: $Z_i = \epsilon_i + C$, where C is the common shock among members, while ϵ_i represents the country-specific shocks which are supposed $\epsilon_H = -\epsilon_L$ as before. In this setting, an increase in the common shock decreases the bliss inflation for both members (See Eq.4), which induces the same effect as a hike in the output target k; hence the optimal bargaining power increases in general (See Fig.3-b). If the shocks are completely symmetrical, i.e. $\epsilon_H = \epsilon_L = 0$, the countries have exactly the same loss function. As a result, the equilibrium outcome would be the same as the discretionary policymaking in a single country and the inflationary bias certainly arises. If the common shock is extremely high, both members have negative bliss policies, and vice versa. Consequently, the inflationary bias will

[4] However, such a design could be possible if we know the output shock of each country at the beginning.

inevitably take place as well. Instead, if the absolute value of the common shock is relatively small, the monetary union with an appropriate value of γ could achieve the optimal policy, as we have shown.

4. Conclusion

We have studied the optimal monetary policy committee design in a currency union with exit options. We showed that the member which experiences higher output should have a higher bargaining power to reduce the inflationary bias. We also described that the higher bargaining power for richer member does not necessarily generate a lower inflationary bias, because of the U-shaped relationship between the optimal bargaining power and the heterogeneity in output shocks among members.

The model was made tractable by several assumptions such as the monetary union consists only of two members with the same measure, and they only differ in outcomes. Also, we did not take into account the effect of the other member's exit on a member. A similar approach could conceivably be used in more general models.

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