Notes On

Strategic Delegation in Monetary Unions

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Introduction

In this paper, we consider a Rogoff style model of the selection of central bankers when there is a monetary union. In contrast to Rogoff, there are then 2 separate strategic delegation problems. The first is the standard one present in Rogoff, that due to the commitment problem. The usual equilibrium response to this is for voters to optimally select central bankers that are more tough on inflation than them. This guarantees that even though the banker cannot commit himself to not inflate, ex post, his preferences are such that he will choose not to do so. This ‘strategic delegation’ of the inflation decision, allows for the efficient outcome overall.

When there is a monetary union, a new element is introduced to the picture. This is that the ex post choice of the inflation rate is done by a committee with a member from each member country. Potentially, then, this creates the existence of a public goods problem in the choice of member types. If country i selects a type that is tough on inflation, all member countries benefit. Thus, since country i does not receive the full benefits of its choice of type, there may be a tendency for under provision-- that is, the selection of types that are not sufficiently conservative.

The main point of this paper is to show that in an entirely conventional model of central banker decision making, strategic delegation leads to inefficient outcomes in a monetary union. We go on to show that if either wages are sufficiently flexible, or the countries have a strong enough direct economic linkage, the free rider problem disappears and the outcome is efficient. If there is some wage inflexibility and the direct economic links between the member countries are weak, countries have an incentive to ‘strategically delegate’ the inflation decision to representatives who are ‘soft’ on inflation, which, in equilibrium, leads to an inefficiently high level of inflation.

The critical modeling assumptions behind these results are first that the bargaining among committee members is first best given their types (i.e., ex post), the assumption that the output effects of inflation are asymmetric in recessions and booms (positive effect and no effect respectively) and the details of the assumptions about the shock distributions.

2. The Model

Consider a setting in which there are N counties, indexed by i, and N+2 states denoted by s, s = 0, 1, ..., N+1. We interpret the outcome, s = i, as the realization where country i is in a recession, while in the other countries, output is at its ‘normal’ level. In state, s = 0, none of the countries is in a recession, while in state s = N+1, all countries are in a recession simultaneously. We assume that inflation is common across all countries in every state, and hence, will denote the inflation rate in country i in state s as simply π(s) for all countries. Output in country i in state s is denoted by y_i(s), and we will use \( \bar{y} \) to denote the full employment, or ‘normal’ level of output in all countries. We will let p_0 denote the probability of state 0, p_2 the probability of state N+1, and define p_1 = 1 - p_0 - p_2. Finally, we assume that the countries are symmetric, in that P(s_i) = p_i/N.
for i = 1, ..., N.

We assume that preferences of voters in country i are given by:

$$U_i = \sum_{j=0}^{N+1} p(s_j) \left[ -\frac{1}{2} (y_i(s_j) - \bar{y})^2 - \frac{1}{2} \pi(s_j)^2 \right].$$

Country i chooses a representative of type $\theta_i$ to send as its member to the monetary union. At the time that the inflation rate is chosen, this representative has preferences given by:

$$U_i = \sum_{j=0}^{N+1} p(s_j) \left[ -\frac{\theta_i}{2} (y_i(s_j) - \bar{y})^2 - \frac{1}{2} \pi(s_j)^2 \right].$$

Thus, the lower is $\theta_i$, the more emphasis this representative places on inflation, and the choice of $\theta_i = 1$, corresponds to voters 'choosing themselves,' or no strategic delegation.

Suppose that output is given by the following:

$$y_j(s_i) = \bar{y} \text{ if } j \neq i, N+1, \text{ and } y_i(s_i) = \min \left[ \bar{y} + \pi(s_i), w - \delta, \bar{y} \right],$$

$$y_i(s_{N+1}) = \min \left[ \bar{y} + \pi(s_{N+1}), w - \delta, \bar{y} \right] \text{ for all } i.$$

Thus, if the state is $s = s_0$, $y_i = \bar{y}$ for all i, and if the state is $s = s_{N+1}$, output in all countries is $\bar{y} - \delta$ in the absence of any intervention. In the states, $s_i = 1, 2, ..., N$, output is $\bar{y} - \delta$ without intervention in country i, where there is a recession, and is $\bar{y}$ in all other countries.

Thus, $\delta$ is the size of the recession, if the monetary authority does nothing. We assume that the timing of the game is:

**Game Theoretic Structure of the Model**

Stage I: Simultaneous choice of $\theta_i$’s by all countries.

Stage II: Workers in each country simultaneously choose wage rates, $w_i$.

Stage III: The state, $s$, is realized.

Stage IV: The monetary authority chooses an inflation rate $\pi(s)$.

We assume that at Stage IV, the outcome is determined by a bargaining mechanism that
maximizes the sum of representative payoffs.

The strategies in this game are denoted as follows. The monetary authority’s strategy is denoted by \( \pi(s,0,w) \). The workers’ strategies are given by \( w(\theta) \), and the country’s each choose \( \theta_i, i = 1, 2, ..., N \). A subgame perfect equilibrium is defined in the usual way.

3. Characterization of the Equilibrium Strategies

We solve the game using backward induction. Consider first the situation in stage IV if the state is \( s_i, i = 1, 2, ..., N \).

Notice that, by construction, in these states, the output level in country \( i \) is independent of \( \pi \) if \( i \neq j \). It follows that up to constants, in state, \( s_i \), the function being maximized at the bargaining stage is given by:

\[
U = -\frac{\theta_i}{2}(y_i(s_i) - \bar{y})^2 - \frac{N}{2}\pi(s_i)^2
\]

After substitution, the first order condition for the choice of \( \pi \) is given by:

\[-\theta_i(\pi(s_i) - w - \delta) - N\pi(s_i) = 0.
\]

Thus, it follows that in equilibrium:

\[
\pi(s_i) = (w + \delta) \frac{\theta_i}{\theta_i + N}
\]

To simplify notation in what follows, we define

\[
\beta_i = \frac{\theta_i}{\theta_i + N} \quad \text{and let } \beta = \frac{1}{N} \sum_{j=1}^{N} \beta_j.
\]

Thus, \( \pi(s_i) = \beta_i (w + \delta) \).

If the state is \( s = s_0 \), it follows that \( y_i(s_0) = \bar{y} \) for all \( i \), independent of the choice of \( \pi \). Thus, for any choice of the \( \theta \)’s, it follows that the equilibrium choice of \( \pi \) is 0.
Finally, if the state is $s = s_{N+1}$, at the bargaining stage, the function being maximized is:

$$\text{Max}_\pi \sum_{j=1}^{N} \left[ -\frac{\theta_j}{2}(y_j(s_{N+1}) - \bar{y})^2 - \frac{1}{2}\pi(s_{N+1})^2 \right] = \sum_{j=1}^{N} \left[ -\frac{\theta_j}{2}(\pi(s_{N+1}) - w - \delta)^2 - \frac{1}{2}\pi(s_{N+1})^2 \right]$$

The first order condition for this problem is:

$$-\sum_{j=1}^{N} \left[ \theta_j(\pi - w - \delta) + \pi \right] = 0.$$ 

This can be written as:

$$\pi \sum_{j=1}^{N} (\theta_j + 1) = (w + \delta) \sum_{j=1}^{N} \theta_j.$$ 

It follows that

$$\pi(s_{N+1}) = (w + \delta) \frac{\sum_{j=1}^{N} \theta_i}{N + \sum_{j=1}^{N} \theta_j} = \pi \delta (w + \delta).$$

where

$$\hat{\beta} = \frac{\sum_{j=1}^{N} \theta_j}{N + \sum_{j=1}^{N} \theta_j} = \frac{\bar{\theta}}{1 + \bar{\theta}}.$$ 

We now turn to the equilibrium choice of wages by workers in Stage II, given the responses above for the Stage IV outcome. We think of there being a continuum of workers on the unit interval. The utility function of worker $j$, $j \in [0,1]$, is given by:

$$-(w_j - \pi)^2.$$ 

The interpretation is that workers have a target real wage, normalized to be zero. Optimal wage setting then implies that wages must solve the following fixed point problem:
\[ w(\theta) = \sum_{j=0}^{N+1} p(s_j) \pi(s_j, \theta, w(\theta)). \]

Substituting the expressions for \( \pi(s) \) from above gives:

\[ w = p_2 \hat{\beta} (w + \delta) + \frac{p_1}{N} \sum_{j=1}^{N} \beta_j (w + \delta) = (w + \delta) \left[ p_2 \hat{\beta} + p_1 \bar{\beta} \right]. \]

Thus, it follows that

\[ w = \delta \frac{\hat{\beta} p_2 + \bar{\beta} p_1}{1 - \hat{\beta} p_2 - \bar{\beta} p_1}. \]

It follows that

\[ w + \delta = \delta + \delta \frac{\hat{\beta} p_2 + \bar{\beta} p_1}{1 - \hat{\beta} p_2 - \bar{\beta} p_1} = \frac{\delta}{1 - \hat{\beta} p_2 - \bar{\beta} p_1}. \]

Thus, a summary of the state contingent inflation and output levels along the equilibrium path is:

If the state is \( s = s_0 \), \( y_i = \bar{y} \) for all \( i \), and \( \pi(s_0) = 0 \).

If the state is \( s = s_{N+1} \),

\[ \pi(s_{N+1}) = (w + \delta) \hat{\beta} = \frac{\delta \hat{\beta}}{1 - \hat{\beta} p_2 - \bar{\beta} p_1} \]

and,

\[ y_i(s_{N+1}) = \bar{y} + \pi(s_{N+1}) - (w + \delta) = \bar{y} + (w + \delta) \hat{\beta} - (w + \delta) = \bar{y} + (w + \delta) (\hat{\beta} - 1). \]

Thus,

\[ y_i(s_{N+1}) = \bar{y} + \frac{\delta (\hat{\beta} - 1)}{1 - \hat{\beta} p_2 - \bar{\beta} p_1} \text{ for all } i. \]
Finally, if the state is \( s_i \), \( i = 1, 2, \ldots, N \), we have:

\[
\pi(s_i) = (w + \delta) \beta_i = \frac{\delta \beta_i}{1 - \hat{\beta} p_2 - \hat{\beta} p_1}
\]

and,

\[
y_i(s_i) = \bar{y} + \pi(s_i) - (w + \delta) = \bar{y} + (w + \delta) \beta_i - (w + \delta) = \bar{y} + (w + \delta) (\beta_i - 1).
\]

Thus,

\[
y_i(s_i) = \bar{y} + \frac{\delta (\beta_i - 1)}{1 - \hat{\beta} p_2 - \hat{\beta} p_1}
\]

while, \( y_j(s_i) = \bar{y} \) for \( j \) different from \( i \).

Finally, we consider the Stage I choices of the representative types, \( \theta_i \). The problem for the voter in country \( i \), is:

\[
\text{Max}_{\theta_i} \frac{1}{N^2} \sum_{j=0}^{N-1} p(s_i) \left[ -\frac{1}{2} (y_i(s_j) - \bar{y})^2 - \frac{1}{2} \pi(s_j)^2 \right]
\]

where \( \theta_i \) enters the problem indirectly through the equilibrium choices of \( y_i(s) \) and \( \pi(s) \).

Since \( \beta_i = \theta_i / (N+\theta_i) \) is a monotone relationship, we can instead view the voters as choosing \( \beta_i \).

Noticing that \( y_i(s_0) = \bar{y} \), \( \pi(s_0) = 0 \), and \( y_i(s_j) = \bar{y} \) independent of the choice of \( \beta_i \), we can rewrite the voters problem as:

\[
\text{(VP)} \quad \text{Max}_{\beta_i} -\frac{1}{2} \left[ p_2 \left( \frac{\delta (\beta - 1)}{1 - \hat{\beta} p_2 - \hat{\beta} p_1} \right)^2 \right] - \frac{1}{2} \left[ p_1 \left( \frac{\delta (\beta_i - 1)}{1 - \hat{\beta} p_2 - \hat{\beta} p_1} \right)^2 \right] + \frac{1}{2} \left[ \sum_{j=1}^{N} \left( \frac{\delta \beta_j}{1 - \hat{\beta} p_2 - \hat{\beta} p_1} \right)^2 \right]
\]
Consider first the case in which \( p_1 = p_0 = 0 \). That is, every country is in a recession all of the time. In this case, the voters problem reduces to:

\[
\max_{\bar{\beta}} \frac{1}{2} \left[ \left( \frac{\delta (\bar{\beta} - 1)}{1 - \bar{\beta}} \right)^2 + \left( \frac{\delta \hat{\beta}}{1 - \bar{\beta}} \right)^2 \right] = \max_{\bar{\beta}} \frac{1}{2} \left[ \delta^2 + \left( \frac{\delta \hat{\beta}}{1 - \bar{\beta}} \right)^2 \right].
\]

The symmetric equilibrium in this case, is to set \( \bar{\beta} = 0 \), and hence, \( \theta_i = 0 \). It follows that in this case, \( \pi(s_{N+1}) = 0 \). Thus, it follows that \( w = 0 \), and hence, \( y_i(s_{N+1}) = \bar{y} - \delta \) for all \( i \).

This is the familiar Rogoff result, if there is no effect of discretionary policy (because it is perfectly countered by equilibrium wage setting), the only effect that the monetary authority can have is to increase the inflation rate over its unconditional optimal level of 0. To solve this strategic delegation problem of the commitment type, voters rationally select very conservative central bankers. The twist here is that this result continues to be true even in a monetary union. This is because, if all recessions are union wide, there is no conflict among the various members of the union about the type of the central bank, all members would unanimously prefer that they set \( \pi(s_{N+1}) = 0 \). This outcome can be guaranteed by having \( \theta_i = 0 \) for all \( i \).

Summarizing:

**Result 1:** If \( p_1 = p_0 = 0, \theta_i = 0 \) for all \( i \). This implies that \( \pi(s_{N+1}) = 0, w = 0, \) and \( y_i(s_{N+1}) = \bar{y} - \delta \) for all \( i \).

Next, consider the case in which \( p_1 = 0, \) but \( 0 < p_2 < 1 \). Again, recall that inflation is zero and output is \( \bar{y} \) in the no recession state. Because of this, the problem faced by voters is:

\[
\max_{\bar{\beta}} g(\hat{\beta}) = \frac{1}{2} \left[ \left( \frac{\delta (\bar{\beta} - 1)}{1 - p_2 \bar{\beta}} \right)^2 + \left( \frac{\delta \hat{\beta}}{1 - p_2 \bar{\beta}} \right)^2 \right].
\]

It can be shown that \( g \) has a strictly interior maximum at a \( \hat{\beta} \) which is strictly less than 1/2. This implies that in the symmetric equilibrium, \( \theta_i^* \) is strictly less than one. That is, the selected central banker is (strictly) more conservative than the voters themselves, but not as conservative as is obtained in the standard Rogoff formulation. In fact, one can show that
\[
\pi(s_{N+1}) = \frac{\delta(1-p_2)}{1 + (1-p_2)^2}
\]

and that this outcome is efficient. We demonstrate efficiency below.

**Result 2:** If \( p_1 = 0 \), but, \( p_0 > 0 \), \( 0 < \theta_i < 1 \) for all \( i \). This implies that \( \pi(s_{N+1}) > 0 \), \( w > 0 \), and \( y_i(s_{N+1}) > \bar{y} - \delta \) for all \( i \). This equilibrium choice of \( \theta_i \) gives rise to the efficient choice of inflation.

We turn now to the case of most interest here. This is the setting in which \( p_1 > 0 \), and hence, \( p_2 < 1 \). This implies that there is the possibility of country specific recessions, and hence the possibility of country by country disagreement about policy after the shock is realized.

For the analysis of this case, we restrict our attention to the case in which \( N \) is large. That is, we will assume that \( N \) is large enough so that the choice of the committee member by any individual country has only a negligible effect on the ‘average’ characteristics of the committee. Formally, we assume that

\[
\frac{\partial \hat{\beta}}{\partial \beta_i} = 0 \quad \text{and} \quad \frac{\partial \hat{\beta}}{\partial \beta_i} = 0.
\]

Using this assumption to simplify the voters problem and differentiating (VP), gives the following first order condition for the choice of representative type after some simplification:

\[
\delta (\beta_i - 1) + \delta \hat{\beta} = 0.
\]

It follows that \( \beta_i = \frac{1}{2} \) for all \( i \), and hence, \( \hat{\beta} = \beta_1 = \frac{1}{2} \) as well. It follows that, \( \theta_i = N \) for all \( i \), and hence,

\[
\hat{\beta} = \frac{\theta_i}{1 + \theta_i} = \frac{N}{N+1} \approx 1.
\]

Thus, in the no recession state, \( s = s_0 \), \( y_i = \bar{y} \) for all \( i \), and \( \pi = 0 \).

In the state in which all countries are in recessions, \( s = s_{N+1} \),

\[
y_i = \bar{y} + \frac{\delta(\hat{\beta} - 1)}{1 - p_2 \hat{\beta} - p_1 \hat{\beta}} \approx \bar{y} + \frac{\delta \times 0}{1 - p_2 - p_1 \hat{\beta}} = \bar{y}
\]

and
\[ \pi(s_{N+1}) = \frac{\delta \bar{\beta}}{1 - p_2 \bar{\beta} - p_1 \bar{\beta}} \approx \frac{\delta}{1 - (p_2 / 2 + p_2)} > 0. \]

In the states \( s = s_j, j = 1, 2, ..., N \), it follows that \( y_i(s_j) = \bar{y} \) if \( i \neq j \), and

\[ \pi(s_i) = \frac{\delta / 2}{1 - p_2 - p_1 / 2} > 0 \]

and

\[ y_i(s_i) = \bar{y} - \frac{\delta / 2}{1 - p_2 - p_1 / 2}. \]

Note that,

\[ \pi(s_{N+1}) \approx \frac{\delta}{1 - (p_1 / 2 + p_2)} > \frac{\delta / 2}{1 - (p_1 / 2 + p_2)} = \pi(s_i). \]

Notice from this that in the special case in which \( p_1 = 1 \), that is, there is always an individual recession somewhere, we can see that

\[ y_i(s_i) = \bar{y} - \tilde{\delta} \]

so that output is unaffected by monetary policy in equilibrium, but that

\[ \pi(s_i) = \tilde{\delta} > 0. \]

That is, the equilibrium choice of the representatives gives rise to inflation with no output effect whatsoever. This is something that would not happen in the one country case -- see Result 1 above-- and hence shows the effects of the public goods aspect of inflation fighting in a monetary union, and the resulting strategic delegation problem faced by voters. This is a special case of the inefficiency that is caused when there is a potential for disagreement among the members of the union. This inefficiency is discussed in more detail below.

We summarize this discussion as a Proposition:
**Proposition 1:** If $p_1 > 0$, and $N$ is large, then,

(i) $\theta_i = N$ for all $i$.

(ii) $\pi(s_0) = 0$, $\frac{\delta/2}{1 - (p_1/2 + p_2)} = \pi(s_i) < \pi(s_{N+1}) = \frac{\delta}{1 - (p_1/2 + p_2)}$ for all $i$.

(iii) $y_i(s_0) = \bar{y}$, $y_i(s_i) = \bar{y} - \frac{\delta/2}{1 - (p_1/2 + p_2)}$, $y_j(s_j)$ if $i \neq j$, and $y_j(s_{N+1}) = \bar{y}$ for all $i$.

(iv) If $p_1 = 1$, $y_i(s_i) = \bar{y} - \delta$, output is the same as if monetary policy was inactive, but $\pi(s_i) = \delta > 0$, for all $i$.

### 4. The Efficient Choice of Inflation Under Commitment

We turn now to the optimal choice of a state contingent plan for inflation when commitment is possible, but when wages optimally react to the choice of the policy. We will consider symmetric optima. In this case, we want to choose a function, $\pi(s)$ to maximize:

$$\sum_{i=1}^{N} U_i = \sum_{i=1}^{N} \sum_{j=0}^{N+1} p(s_j) \left[ -\frac{1}{2} (y_i(s_j) - \bar{y})^2 - \frac{1}{2} \pi(s_j)^2 \right]$$

subject to the constraint that $w = E(\pi)$.

Given the symmetry of the formulation, it follows that the inflation rate in all of the individual states are identical, $\pi(s_1) = \pi(s_2) = ... = \pi(s_N)$, let $\pi_1$ denote this common value. Similarly, let $\pi_0 = \pi(s_0)$, and let $\pi_2 = \pi(s_{N+1})$. Given this, we can rewrite the maximization problem as:

$$\text{Max}_{\pi_0, \pi_1, \pi_2} \sum_{j=1}^{N} U_i = -\frac{1}{2} \left[p_0 N \pi_0^2 + p_1 \left( (\pi_1 - w - \delta)^2 + N \pi_1^2 \right) + N p_2 \left( (\pi_2 - w - \delta)^2 + \pi_2^2 \right) \right]$$

subject to $w = p_0 \pi_0 + p_1 \pi_1 + p_2 \pi_2$.

The first order conditions for this maximization problem are:

$$w = p_0 \pi_0 + p_1 \pi_1 + p_2 \pi_2.$$
\[
\pi_1 \frac{N+1}{N} = \pi_0 + \frac{w + \delta}{N},
\]

\[
2 \pi_2 = \pi_0 + w + \delta, \text{ and}
\]

\[
\frac{p_1}{N} \pi_1 + p_2 \pi_2 = \pi_0 + \frac{p_1 + Np_2}{N} (w + \delta).
\]

When \( N \) is large these equations can simplified to read:

\[
w = p_0 \pi_0 + p_1 \pi_1 + p_2 \pi_2,
\]

\[
\pi_0 = \pi_1,
\]

\[
2 \pi_2 = \pi_0 + (w + \delta), \text{ and}
\]

\[
p_2 \pi_2 = \pi_0 + p_2 (w + \delta).
\]

The solution to this system is:

(i) \( w^* = 0 \),

(ii) \( \pi_0^* = \pi_1^* = -\frac{p_2 \delta}{2 - p_2} \), and

(iii) \( \pi_2^* = \frac{1 - p_2 \delta}{2 - p_2} \).

Comparing these inflation rates to those given in Proposition 1, it follows that strategic
delegation leads to higher inflation in every state than that in the commitment optimum. Notice
that inflation is negative in both the no recession and individual country recession states. This is
done to manipulate wage setting by keeping \( w^* \) smaller (i.e., 0).

Given the levels of inflation, calculating the commitment optimum levels of output is
straightforward. These are given by:

(i) \( y_i^*(s_0) = \bar{y}, \) for all \( i \),

(ii) \( y_i^*(s_j) = \bar{y}, \) if \( i \neq j, \ y_i^*(s_j) = \bar{y} + \pi_1 - w - \delta = \bar{y} - \frac{p_2 \delta}{2 - p_2} - \delta = \bar{y} - \delta \frac{2}{2 - p_2}. \)
There are two things to notice about these expressions for output.

First, since \( \frac{\delta}{2 - p_2} > \frac{1}{2 - p_2} \), it follows that under the commitment optimum, the size of the recession is bigger than \( \delta \) in the case of individual recessions, and smaller than \( \delta \) in the aggregate recession. Thus, the monetary authority optimally chooses to exaggerate the effect in the single country recessions to more effectively dampen the aggregate one. (That is, without making expected inflation too high.)

Second, it can be seen that

\[
y_i^* (s_{N,1}) = \bar{y} - \delta \frac{1}{2 - p_2} < \bar{y} = y_i(s_{N,1})
\]

That is, output is lower in the aggregate inflation state under the commitment optimum than it is with equilibrium strategic delegation. In the case of the individual recession states, whether output is higher under the commitment optimum or under equilibrium strategic delegation depends on the parameters of the model. That is,

\[
y_i^* (s_i) > y_i(s_i) \quad \Rightarrow \quad 2 < 2p_1 + 3p_2.
\]

Thus, if either \( p_1 \) or \( p_2 \) is large, then \( y_i^* (s_i) > y_i(s_i) \). On the other hand, if \( p_0 \) is large, so that both \( p_1 \) and \( p_2 \) are necessarily small, \( y_i^* (s_i) < y_i(s_i) \).

Summarizing,

**Proposition 2.** Under strategic delegation:

(i) **Inflation rates are higher in every state than under the commitment optimum,**

(ii) **Output is higher in the aggregate recession than in the commitment optimum,**

(iii) **Output in the individual recession states is higher than in the commitment optimum if and only if** \( 2 > 2p_1 + 3p_2 \).
Hence, the presence of the public goods problem in the provision of tough committee members gives rise to excessive inflation. Thus, of the two strategic delegation problems, it is the public goods one that ‘carries’ the weight, rather than the commitment one in this setting.

5. **Extensions and Notes**

Here, we discuss extensions and limitations to the results given above.

1) **The Timing of Wage Setting:** The assumption that workers set wages before the realization of the state is critical for the strategic delegation problems identified in this paper. For example, consider a version of the model in which wages are set after the realization of the state, but before the setting of $\pi$. In this case, equilibrium wage setting requires that $w(s) = \pi(s)$ for all $s$. It follows that there can be no equilibrium effect on output in any state. Because of this, it is optimal for all voters to set $\theta_i = 0$ in Stage I. It follows that inflation is 0 in all states. Thus, governments choose the types of their representatives solely to overcome commitment problems exactly like those present in the Rogoff, one country version of the model. Notice that there is no conflict among countries in the choices of representative types in this case.

2) **Full Risk Sharing and Real Linkages Across the Countries in the Union:** To see how the economic linkages between countries affect this result, we will consider an alternative extreme in the model in which all output risk is shared equally across all countries in the union. To simplify notation, we will assume that $\rho_i = 1$.

Maintaining our assumption that

$$y_i(s_j) = \bar{y} \text{ if } i \neq j, \text{ and } y_i(s_i) = \min [\bar{y} + \pi(s_i) - w - \delta, \bar{y}],$$

but assuming that consumption in country $i$ in state $s$ is the average output across countries, we have the same model as above except that

$$y_i(s_j) = \frac{N-1}{N} \bar{y} + \frac{1}{N} [\bar{y} + \pi(s_j) - w - \delta] \leq \bar{y} + \frac{1}{N} [\pi(s_j) - w - \delta].$$

In this case, at the bargaining stage, given the choices of $\theta_i$ by all countries, the maximization problem is:

$$\max_{\pi(s_j)} \sum_{i=1}^{N} -\frac{1}{2}(y_i(s_j) - \bar{y})^2 - \frac{N}{2} \pi(s_j)^2 = \sum_{i=1}^{N} -\frac{1}{2} \left[ \frac{1}{N} (\pi(s_j) - w - \delta)^2 \right] - \frac{N}{2} \pi(s_j)^2.$$
The first order condition for this problem is:

\[-\frac{\bar{\theta}}{N}[\pi(s_j) - w - \delta] = N\pi(s_j)\]

where \( \bar{\theta} = \frac{1}{N}\sum \theta_i. \)

It follows that

\[\pi(s_j) = \frac{\bar{\theta}[w + \delta]}{N + \frac{\bar{\theta}}{N}} \text{ for all } j.\]

Thus, it follows that

\[w = E(\pi(s_j)) = \pi(s_j) = \pi = \frac{\bar{\theta}[w + \delta]}{N + \frac{\bar{\theta}}{N}}.\]

It follows then that \( w \left[ N + \frac{\bar{\theta}}{N} \right] = \frac{\bar{\theta}}{N}[w + \delta]. \) Hence, \( w = \pi = \frac{\bar{\theta}}{N^2}\delta \) and \( \pi - w = 0 \) for all \( s. \)

Thus, the voters problem is given by:

\[ \text{Max}_{\theta_j} - \frac{1}{2} \sum_j \frac{1}{N} \left[ (y_j(s_j) - \bar{y})^2 + \pi(s_j)^2 \right], \]

where \( y_j(s_j) \) and \( \pi(s_j) \) depend on the vector of \( \theta \)'s chosen.

Since in this case, \( \pi(s_j) = \pi = w \) for all \( j, \) and

\[ y_j(s) = \frac{N-1}{N}\bar{y} + \frac{1}{N} \left[ \bar{y} + \pi(s_j) - w - \delta \right] = \bar{y} + \frac{1}{N} \left[ \pi(s_j) - w - \delta \right]. \]
it follows that \( y_i(s_j) = \bar{y} + \frac{1}{N} \delta \) for all \( i \) and \( j \).

Thus, in this case, the voters problem reduces to:

\[
\max_{\theta_j} -\frac{1}{2} \sum_j \frac{1}{N} \left[ (\bar{y} + \frac{1}{N} \delta - \bar{y})^2 + \pi(s_j)^2 \right] = -\frac{1}{2} \sum_j \frac{1}{N} \left[ \left( \frac{\delta}{N} \right)^2 + \pi(s_j)^2 \right].
\]

Here, the only place that \( \theta_j \) enters voter \( i \)'s problem is through his effect on inflation. It follows that since

\[
\pi(s_j) = \pi = \frac{\bar{\theta} [w + \delta]}{N + \frac{\bar{\theta}}{N}} \text{ for all } j,
\]

voter \( i \) chooses \( \theta_j \) to minimize \( \pi \) taking as given the other choices of \( \theta_j \). This is to set \( \theta_j = 0 \). Thus, in equilibrium, \( \theta_j = \bar{\theta} - 0 \) for all \( i \), and hence, \( \pi = w = 0 \) for all \( s \).

Thus, it follows that if the economies in the union are sufficiently linked economically, the Rogoff result obtains, the second form of strategic delegation does not arise and the outcome is optimal.

**References**

To be added.