Ministerial Weights and Government Formation: Estimation Using a Bargaining Model*

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February 19, 2004

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*Takanori Adachi and Yasutora Watanabe are Ph.D. candidates in the Department of Economics at the University of Pennsylvania. We are grateful to Antonio Merlo and Felix Oberholzer-Gee for guidance. We also thank Hülya Eraslan, Hiroshi Hirano, Yoichi Hizen, Yusaku Horiuchi, Claire Lim, Ryo Okui, Mari Sakudo and Masaki Taniguchi for invaluable comments. An earlier version of this paper was presented at the first meeting of the Association of Japanese Political Studies, the participants of which we thank. Of course, any remaining errors are our own.

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Abstract

This paper proposes a method to estimate relative ministerial weights in parliamentary democracies. Specifically, our method combines a bargaining model of government formation with maximum likelihood estimation. The data required for estimation are who formateurs are, what each party's voting weight is, and what ministerial seats each party obtains. We use variation of the data and the structure of the bargaining model to recover ministerial weights and other parameters. Additionally, the method can measure the effects of voting weights and formateur advantage. We apply our proposed method to the case of Japan. Our results statistically show that political players value pork-related posts (such as the Minister of Construction) more than prestigious ones (such as the Minister of Foreign Affairs). We also find that there is a significant formateur advantage, while voting weights do not have a significant scale effect. [139 words]

In parliamentary democracies parties bargain over ministerial seats when a new government is formed. Although allocations of seats to parties are observable, the number of posts each party obtains does not tell us how much the party actually gains, because ministerial seats may be of varying importance. Thus, we need to know the relative weights of ministers to understand how much each party gains in government formation. In this paper we propose a method to estimate relative weights of ministerial posts in a parliamentary democracy.

How important is the post of one minister compared with another? Despite the importance of this question, the literature provides no statistical method for estimating ministerial weights. As Ansolabehere, Snyder, Strauss, and Ting (2003, p.18) put it, "[t]his is a general problem in the study of coalition government." Ministerial weights not only reveal the actual gains of parties in government formations but are indicative of two intrinsic factors in a ministry: policy importance and pork-barrel spending. A ministry whose policy area is important to political parties may carry a high weight. Likewise a ministerial post which distributes or strongly influences pork-barrel spending may also be highly weighted. Thus, estimated ministerial weights may tell us which ministry are important to parties.

Other questions we try to answer through statistical estimation are 1) how voting weights translate into gains from allocated seats, i.e. the scale effect of party size, and 2) how large the advantage of being a formateur is. Does a bigger party gain more than their voting weights out of the government formation process? Does becoming a formateur provide a party with an extra share in the cabinet formation process? Gamson (1961) presents a hypothesis, often called "Gamson's Law," that the share of cabinet posts for a party is proportional to its relative size in the coalition. This has been one of the central questions in the empirical literature of government formation. One of the innovations in this paper is that we reconsider these questions allowing cabinet posts to have different levels of importance.

The method we present combines a bargaining model of government formation[1] with maximum likelihood estimation. The approach of combining a formal theory and estimation is often called *structural estimation*.[2] Compared to reduced-form estimation or simple regression, an advantage of this approach is that researchers can estimate and interpret the parameters as model primitives of formal theory. We use variation of the data and the structure of the bargaining model to recover ministerial weights and other parameters. The data required for estimation are who formateurs are, what each party's voting weight is, and what ministerial seats each party obtains, all publicly observable data resulting from politicians' behavior. We emphasize that in applying the proposed method researchers should employ a bargaining game which properly captures institutional and non-institutional features of government formation.

We then apply the method to the case of Japan. We estimate the model by employing a bargaining game based on the historical stylized facts. Our results statistically show that political players value pork-related posts (such as the Minister of Construction and the Minister of Transport) more highly than prestigious ones (such as the Ministers of Foreign Affairs and Justice). Our results also suggest that the scale effect is approximately zero, while formateur advantage is significant. This

[1] The existing literature has two distinctive approaches toward government formation. The first approach considers that the surplus from government formation depends on the cabinet post allocation and coalition (e.g., Austen-Smith and Banks (1988, 1990) and Laver and Shepsle (1990, 1998). On the other hand, the second approach assumes the surplus from government formation to be unchanged by cabinet post allocation and parties in the coalition (e.g., Baron (1991, 1993, 1998), Baron and Ferejohn (1989)). Following the second strand of the literature, the method in the present paper assumes the surplus does not change.

[2] See Keane and Wolpin (1997) for recent progress in structural estimation in applied microeconomics.

implies that how much each party obtains in a government formation is almost proportional to its size for non-formateur parties even in an ex post sense (that is, after a first proposer is decided), while formateur party gains more than their voting weights. This confirms Gamson's (1961) earlier predictions, which have been studied empirically with a strong assumption that all cabinet posts have the same weights such as Browne and Franklin (1973) and Browne and Frendreis (1980).[3] Warwick and Druckman (2001) employ the ranking of importance of ministers reported by Laver and Hunt (1992)[4] to reconsider the empirical relationship between cabinet post allocation and seat shares.

Recently, Ansolabehere, Snyder, Strauss and Ting (2003) offer a more comprehensive empirical analysis; they investigate the above relationship under two alternate assumptions (i.e. the assumption that all cabinet posts are equally valuable, and the one that the relative value of the Prime Minister is three times higher than those of other ministers). Although their data is taken from European countries, their result on the scale effect and formateur advantage is similar to ours with the Japanese data. Parties' gains are proportional to voting weights for non-formateur parties, and there is significant formateur advantage. Note that both Warwick and Druckman (2001) and Ansolabehere, Snyder, Strauss and Ting (2003) still make an *a priori* assumption on ministerial weights by assigning exogenously determined numbers to ministerial weights.

[3] For overviews of the empirical literature, see Browne and Dreijmanis (1982), Laver and Schofield (1990), Laver and Shepsle (1996), Strom (1990) and Warwick (1994).

[4] Laver and Hunt (1992) measure the ministerial values by surveying major politicians in European democracies. Similarly, Kato and Laver (1998) survey Japanese political scientists about the ministerial ranking (excluding the Prime Minister), where the Minister of Finance is judged the most important, followed by the Minister of Foreign Affairs. Our result reported in this paper does not necessarily contradict Kato and Laver's (1998) result. This is because they estimate the "importance" subjectively evaluated by scholars, who are not players in politics, while we estimate the values of cabinet posts by using only the publicly observable behavioral data.

Our contributions to the empirics of government formation are threefold. First, we present a new approach of finding the weights of ministers from the data of cabinet post allocations. The second contribution is that we study the scale effect of the voting weights and formateur advantage on the gain from government formation. Finally, we have constructed the data set on seat shares and cabinet posts of the Japanese government, while all existing studies uses data of Western European countries.

This paper is also related to political economics literature on structural estimation of theoretical models of politics, where there is relatively a small number of papers.[5] Merlo (1997) uses a stochastic multilateral bargaining model to study the duration of government formation and government stability, and the effect of deadline date for such variables. Diermeier, Eraslan and Merlo (2003) extend Merlo's (1997) approach, and identify the effects of constitutional features on the stability of governments using data from nine European countries. Our contribution to this literature is that we deal with the allocation issue in the bargaining model, while Merlo (1997) and Diermeier, Eraslan and Merlo (2003) have focused on other aspects: when and how coalition is formed.

In the next section, we present a general exposition of our estimation method. We then apply the method to the case of Japan and discuss the results. This paper ends with concluding remarks.

Estimation Using a Bargaining Model: A General Exposition

Bargaining Model

We consider government formation as a bargaining game $\Gamma(\theta)$, where θ is a vector of parameters of the game such as the time discount factor and voting weights of parties. The set of political parties is denoted by $I = \{1, ..., N\}$, and they are players of the game $\Gamma(\theta)$. Players bargain over the surplus

[5]For analyses of elections see Shachar and Nalebuff (1999) and Coate and Conlin (2002).

from government formation which is normalized to one.[6] An allocation to players is denoted by $y \in Y$, where Y is defined by $Y = \left\{ \{y_i(\theta)\}_{i=1}^N \left| 1 \geq \sum_{i=1}^n y_i(\theta),\ y_i(\theta) \in [0,1]\ \ \forall i \in I \right. \right\}$.

Players' preferences are expressed by the utility function $u_i(y) = y_i$, i.e. we assume transferrable utility. These features of the bargaining game $\Gamma(\theta)$ are common to standard bargaining models of government formation such as Baron and Ferejohn (1989), Diermeier, Eraslan, and Merlo (2003) and Ansolabehere, Snyder, Strauss and Ting (2003). Let the set of parties in the government be denoted by $I^g = \{1, ..., n\}$and the remaining parties, which are out of the government, by $I^o = \{n+1, ..., N\}$.We denote an equilibrium allocation by $y^*(\theta) = \{y_i^*(\theta)\}_{i=1}^N$.

Condition *The equilibrium allocation $y^*(\theta)$ of the bargaining game $\Gamma(\theta)$ is unique.*

The method we present here does not depend on the equilibrium concept applied to the game $\Gamma(\theta)$. Condition 1 requires that the equilibrium concept generates an unique equilibrium allocation.

Note that uniqueness of *equilibrium allocation* does not necessarily mean uniqueness of *equilibrium*. For example, although the sequential bargaining game by Baron and Ferejohn (1989) can have a continuum of equilibria in the class of stationary (that is, time and history independent) strategies, the equilibrium allocation is unique as shown by Eraslan (2002).

One of the parameters in θ whose effect is of particular interest in the literature is the voting weights of parties.[7] For notational convenience we will use the relative voting weights of the parties in the government[8] and denote them by $\omega = [\omega_1, ..., \omega_n]$, where $\sum_{i=1}^n \omega_i = 1$ holds. We will mea-

[6]If the size of the surplus changes across time, we normalize it in such a way that the surplus at the time of allocation is equal to one. That is, we normalize the surplus so that $\sum_{i=1}^n y_i(\theta) = 1$ holds.

[7]See e.g. Gamson (1961), Browne and Frendreis (1980) and Ansolabehere, Snyder, Strauss, and Ting (2003).

[8]We can use the voting weights in the legislature. The reason for using the relative weights among government parties is for notational simplicity. Our results will not be affected by this.

sure the effect of voting weights by parameter α of the function $h(\omega; a)$ and denote the parameters in θ other than ω and α by θ'. Now, $y_i^*(\theta)$ can be expressed $y_i^*(\theta) = y_i^*(\theta', h(\omega; \alpha))$, where $h(\omega; \alpha)$ represent the effect of voting weights. Note that we need ω as data.

Another issue of interest in the literature is the formateur advantage. In many models of government formation, a formateur is selected randomly if no party holds a majority of seats in the legislature. We can also incorporate this factor into our specification by making $y_i^*(\theta', h(\omega; \alpha))$ dependent on the realization of uncertainty. Denote the realization of being a formateur by $\gamma_i = 1$ and of not being one by $\gamma_i = 0$. We measure the effect of being a formateur by parameter γ of the function $g(\gamma; \delta)$ We can then denote the ex post payoff by $y_i^*(\theta) = y_i^*(\theta', h(\omega; \alpha), g(\gamma; \delta))$, where $g(\gamma; \delta)$ expresses the effect of being a formateur. We require the data of γ as well**,** i.e. the information on who the formateur is.

Specification and Estimation

Allocations we observe in the data are those of ministerial seats. As we will use only the data of parties in government, we focus on players $I^g = \{1, ..., n\}$. Let $K \equiv \{1, ..., k\}$ denote the set of ministerial posts, and let $x_i = [x_{i1,} ..., x_{ik}] \in \{0, 1\}^k$ denote an allocation of cabinet seats to party i, where $x_{ij} = 1$ means that party i obtained the post of Minister j and $x_{ij} = 0$ otherwise. The relative weights of ministers to be estimated is $\beta = [\beta_1, ..., \beta_k]' \in [0, 1]^k$. To keep our argument consistent with the normalization in $\Gamma(\theta)$, we normalize the sum of the weights to be one, i.e. $\sum_{j=1}^{k} \beta_j = 1$. Now, $x_i\beta$ represents the value of ministerial posts party i obtains. This value, however, can only take discrete values given β, while $y_i^*(\theta', h(\omega; \alpha), g(\gamma; \delta))$ should possibly take any value in [0, 1]. This is because the surplus over which players bargain should be considered as the "pie," i.e. we want to allow any division of the surplus. To do so, we assume that players can make and receive monetary side-payments to offset the difference between $x_i\beta$ and $y_i^*(\theta', h(\omega;\alpha), g(\gamma\,; gd))$. In other words, the role of side-payments is for the parties to "settle" the difference in payoff between the (discrete) value of allocated posts and the payoff they ought to receive. We denote the net amount of side-payments received by party i as ε_i. Then, we have $y_i^*(\theta', h(\omega;\alpha), g(\gamma\,;\delta)) \equiv x_i\beta + \varepsilon_i$. This is because the gain in the bargaining game must be equal to the gain from ministerial posts and side payments for any party. Side-payment ε_i is not observable and is determined exogenously by β and $\Gamma(\theta)$. As it seems there is no factor that systematically affects ε_i across parties and side-payments are not observable, we treat ε_i as a random variable drawn from an identical distribution.[9]

Side-payments across parties, however, are not independently distributed. This is because they add up to a constant value, giving $\{\varepsilon_i\}_{i=1}^n$ a correlation of negative one. In order to avoid technical difficulties, we assume that the side payments will add up to 0, i.e. there is no outside fund. Then, side-payments have to satisfy the budget balance $\sum_{l=1}^n \varepsilon_l = 0$ or $\sum_{j\neq i} \varepsilon_j = -\varepsilon_i$.

Hence, we have only $n-1$ degrees of freedom for n draws of ε_i. A party receives some side-payment which has a perfect negative correlation with the net side-payment of all the other parties in the government, while ε_is are independent among those parties.

We observe a similar feature in our data. The number of seats is fixed in each government formation, and each post is assigned to only one party. This implies that the information on the allocation of posts contained in the data for $n-1$ parties is equal to the information contained in that of n parties, i.e. the data $\{x_l\}_{l=1}^n$ has the following property: $\sum_{l=1}^n x_l = [1, ..., 1]$ or $\sum_{j\neq i} x_j =$

[9] One might argue that in government formaion political parties give and recieve side-payments strategically. We believe, however, that the allocation of ministerial seats is of more importance than side-payments in government formation and that "[g]overnment ministries are the most tangible manifestations of policy payoffs to governing parties" (Browne and Franklin (1973, p.454)).

$[1-x_{i1},...,1-x_{ik}]$. $\sum_{l=1}^{n} x_l = [1,...,1]$. In other words, information on the post allocation of one party is always redundant.

Similarly, the sum of the voting weights is fixed at 1, i.e., $\sum_{l=1}^{n} \omega_l = 1$ or $\sum_{j \neq i}^{n} \omega_j = 1 - \omega_i$.

We can find the voting weights of one party if we know the size of all the other parties. Thus, we can also ignore the information on the voting weights of one government party because it is redundant.

Following this reasoning, we ignore the data for one party and use only $n-1$ equations for each government formation. This enables us to ignore the correlation among ε_is. If we use only $n-1$ parties for estimation, ε_is are no longer correlated since they have $n-1$ degree of freedom. We denote the party to be ignored by l. Now, we have the following $n-1$ equations for a government formation: $y_i^*(\theta', h(\omega;\alpha), g(\gamma;\delta)) - x_i\beta = \varepsilon_i$ for party $i \in I^g \backslash \{l\}$.

Finally, we will estimate the model using the maximum likelihood method. As we have argued above, we have no reason to assume that the distributions of ε_is are dependent nor non-identical. Furthermore, we have no reason to assume that side-payments are systematically correlated among parties or across time.[10] Also, ε_is cannot take any value out of $[-1, 1]$. Hence, we assume that ε_i follows an i.i.d. Generalized Beta distribution with mean 0 and estimate the model using the maximum likelihood method.[11]

We number the name of the government with superscript $t \in \{1,...,T\}$, where T is the total number of governments in the data. The data in government formation t consists of how ministerial

[10] Remember that the correlation arising from the budget balance is eliminated, as descrived above.

[11] A Beta distributioin is employed because ε has a finite support. In fact, as the support is now $[-1, 1]$, the Beta distribution we employ is the one called the Generalized Beta of the first kind. For details see McDonald (1984). Our results are robust for the specification with Normal distribution.

posts are allocated to parties ($x^t = [x_1^t, ..., x_n^t]$) and how voting weights are distributed ($\omega^t = [\omega_1^t, ..., \omega_n^t]$). Now, the likelihood function can be written as

$$
\begin{aligned}
L(X \mid \alpha, \beta, \delta, \theta', \omega, \gamma) &= \prod_{t=1}^{T}\prod_{i=1}^{n-1} f(\varepsilon \mid x_i^t, \alpha, \beta, \delta, \theta', \omega^t, \gamma^t) \\
&= \prod_{t=1}^{T}\prod_{i=1}^{n-1} \frac{1}{2^{2a-1} Beta(\sigma, \sigma)} \left[1 + \left(y_i^*(\theta', h(\omega^t; \alpha), g\left(\gamma^t; \delta\right)) - x_i^t \beta\right)\right]^{\sigma - 1} \\
&\quad \times \left[1 - \left(y_i^*(\theta', h(\omega^t; \alpha), g\left(\gamma^t; \delta\right)) - x_i^t \beta\right)\right]^{\sigma - 1}.
\end{aligned}
$$

As we have ($x^1, ..., x^T$) and ($\omega^1, ..., \omega^T$) as observable data, we can obtain a Maximum Likelihood (ML) estimate by maximizing the log-likelihood function respect to α, β, δ, and θ', given the data. Standard errors can be obtained by the bootstrap method[12] as we demonstrate in the following application. In the rest of the paper, we provide an application of this methodology.

Application: Japanese Governments, 1958-1993

In this section we apply the method explained above to government formation in Japan during the period from 1958 to 1993. We have chosen to shed light on government formation in Japanese democracies, a topic which has not been statistically investigated in the literature. Note, however, that our method can be applied to other democracies as well, providing extensive possibilities for future research. First, we consider a multilateral sequential bargaining model of government formation based on the observations of the stylized facts explained in the Appendix 1. Then, we explain the data we use, and finally estimate the model.

We model the game of government formation as a bargaining model among the factions of the Liberal Democratic Party (hereafter, the LDP) since the government formation was a process among

[12] The bootstrap is a method for estimating the distribution of an estimator by resampling the data, and treat them *as if* they were the population. For a more explanatory account, see e.g. Horowitz (2001).

the LDP factions.[13] We employ the unanimity rule for agreement following the observations that the LDP maintained majority, that an LDP faction with a significant size obtained cabinet posts, that no faction have ever left the LDP, and that no vote of no-confidence was vote for by any LDP factions. We consider this game to be an alternating offer random proposer model. This is because factions could have rejected the offer and voted for a no-confidence resolution to choose the proposer again and restart the process.[14] The model is an extension of Baron and Ferejohn (1989). We generalize the recognition probability as a function of voting weights of the factions, and employ unanimity as the agreement rule instead of majority. For all these model assumptions, we argue the corresponding stylized facts in Appendix 1.

We assume that factions evaluate posts in an identical way. As we argue in Appendix 1, factions are understood to have little difference in policy interests. There is also no reason to assume that some factions value money differently, since they use it in the elections in a very similar way. Hence, we assume that values of cabinet seats are identical to all the factions.

At this point, it might be worth making explicit that we do not consider possible strategic relations between one government formation and another. This is because players' equilibrium payoffs are uniquely determined in the class of strategies we consider (stationary strategies) as will be explained in the latter part of this section (Preposition 2). There is no analytical gain to consider a "repeated game" of government formation because players' equilibrium payoffs of this extended game are just the discounted sum of equilibrium payoffs at each stage game under stationary strategies. Note that if we do not confine the class of strategies to stationary ones, then, as Proposition 1

[13]We conisider a faction in the LDP as a political player. See Appendix 1 for details.

[14]This has not happened in the history. In our model, this is off the equilibrium-path behavior, i.e. this should not happen in equilibrium.

below shows, any reasonable allocation can be an equilibrium even in each stage game of bargaining (and even under subgame perfection), meaning we cannot connect the model prediction to the data (or we have to connect the infinite possibilities of the real world to one observation, which is impossible).

The Bargaining Model

This game is a multilateral sequential infinite-horizon bargaining game with random proposers and with an unanimity rule. Throughout, we consider a complete information environment. Let the set of players be defined by $N = \{1, ..., n\}$ where $n \geq 2$. We see a faction as a player. Faction $i \in N$ has a relative voting weights(or proportion of seats) $\omega_i \in [0, 1]$ where $\sum_{i=1}^{n} \omega_i = 1$. The factions bargain over the seats of ministers, whose sum of weights are normalized to one.

The game proceeds as follows. In the first period, a faction i' is randomly recognized as a proposer with the probability of $h_{i'}(\omega) = \omega_{i'} \exp(\alpha\omega_{i'})/[\sum_{l=1}^{n} \omega_l \exp(\alpha\omega_l)]$.

The proposer offers an allocation of cabinet seats and side payments, which we represent in terms of payoff vector $y = (y_1, ..., y_n)$. After observing the offer, factions sequentially respond whether to accept or reject the offer. We assume that the unanimity agreement is necessary for government formation; if *all* the factions have accepted the offer, the offer is implemented as proposed, and a government is formed. If not, the game goes to the second stage, and faction i (which can coincide with the same i' in the previous period) is randomly recognized with the probability of

$$h_i(\omega) = \frac{\omega_i \exp(\alpha\omega_{i'})}{\sum_{l=1}^{n} \omega_l \exp(\alpha\omega_l)}.$$

This formulation enables us to test the scale effect of factions. If an estimated α is large, a larger faction is increasingly more probable to be recognized as a proposer. If α is equal to zero, it implies that $h_i(\omega) = \omega_i$, i.e. the probability is exactly proportional to the faction's voting weight.

The following procedure is exactly the same as in the first period, and the game continues until all the factions accept an offer of allocation υ. We assume that factions discount the future with a common discount factor $\delta \in (0, 1)$. If an allocation y is agreed in stage τ, faction i will obtain $\delta^{\tau-1} y_i$. Otherwise, all factions will have a payoff of 0.

A *history* is a specification of a finite sequence of the actions taken at each date in the sequence up to the point. A *strategy* for faction i is a sequence of actions which specifies what to do at every history where it must act, and a *strategy profile* is an n-tuple of strategies, one for each faction. A strategy profile is *subgame perfect* if and only if no faction can make itself strictly better off by deviating from its strategy at any single date.

Characterization of Equilibria

The model has multiple subgame perfect equilibria (SPE). In a similar class of multilateral bargaining models (see Sutton (1986) and Baron and Ferejohn (1989)), any individually rational payoff is shown to constitute an SPE outcome for δ close enough to one. Appendix 2 shows that this result applies to our model with the unanimity rule as well.

Facing this multiplicity of equilibrium and equilibrium payoff, the literature turned its focus on stationary SPE (SSPE), that is, SPE in the class of stationary strategies. A strategy profile is called stationary if it does not depend on the current date and past history. Eraslan (2002) recently showed that we can find a unique equilibrium *payoff* (there can be multiple SSPE though) by focusing on stationary strategies in a more general model with a q-quota majority agreement. The model here requires unanimity for agreement. In the following proposition, we obtain the closed form solution for the unique equilibrium payoffs of the model.

Proposition (Eraslan (2002)) *In SSPE, factions agree in the first period. The SSPE payoff is* *unique. The ex ante (before a proposer is chosen) payoff for a faction i is*

$$E(y_i^*(\alpha,\delta,\omega)) = \frac{\omega_i \exp(\alpha\omega_i)}{\sum_{l=1}^n \omega_l \exp(\alpha\omega_l)},$$

where E denotes an expectation operator. The ex post payoff for the proposer i and non-proposer j are respectively

$$y_i^*(\alpha,\delta,\omega,\gamma) = 1 - \sum_{j\neq i} \delta \frac{\omega_j \exp(\alpha\omega_j)}{\sum_{l=1}^n \omega_l \exp(\alpha\omega_l)}$$

and

$$y_j^*(\alpha,\delta,\omega,\gamma) = \delta \frac{\omega_j \exp(\alpha\omega_j)}{\sum_{l=1}^n \omega_l \exp(\alpha\omega_l)}.$$

Proof. Replace q-majority in Eraslan's (2002) proofs by unanimity and make discount factors equal for all players. ■

This characterization has a natural and intuitive meaning; a faction which is chosen as a proposer in the first period is making an offer so that any other faction does not make itself better off by rejecting that offer and going to the next stage. As a result, all the factions agree with that offer in the first period. To put it in another way, the proposer in the first stage can make as favorable an offer to it as possible, keeping other factions from being better off by rejecting the offer.

We use this equilibrium characterization for the estimation of the model in the next section. The implication of this characterization is as follows. The positive (negative) value of α implies increasing (decreasing) returns to the scale of the size of a faction, while $\alpha = 0$ implies constant returns to scale. The value of δ is low if formateur have an advantage in obtaining seats, while δ close to 1 implies little formateur advantage. Before turning to the empirical part of the paper, we make further arguments for employing this model.

Discussion of the Model

The SSPE of the model gives us further justification of employing this model. The first feature is about the timing of the agreement. The model predicts that the agreement is immediate. As discussed in Appendix 1, the Japanese government formation period was very short (at the longest, it took only three days after the Prime Minister-designate was selected in the Diet). Compared with other democracies, the bargaining period is exceptionally short. We can call this "immediate" when considering the time that is necessary for the Prime Minister-designate to make an offer. Hence, we can say that the model prediction exactly matches the historical observation that the cabinet formation had been immediate.

Another feature of the SSPE is that all the players have a positive payoff. This results from the assumption of unanimity. For example, if we employ majority rule for agreement, there should be a significant number of factions which cannot obtain a cabinet post. This equilibrium characterization made us to choose unanimity as a decision rule because the stylized facts presented in Appendix 1 shows that any faction of significant non-negligible voting weights obtained cabinet seats in most of the government.

Data

We use Japanese data for the period from 1958 to 1993.[15] We collected the data on the numbers of LDP seats in the lower house, the sizes of factions at the time of cabinet formation, and the

[15]The LDP was formed in 1955, and maintained majority until 1993 in the House of Representatives (see Section 3). The factions, however, were not clearly defined at the beginning of the LDP history. We are not able to collect reliable data of how large each faction was and of which faction each member was affiliated with during the period of 1955-1957.(See also Sato and Matsuzaki (1986).) Kohno (1992, p.371) also reports; "During the LDP presidential election in 1957, these leaders began to form alliances ..., and by the end of 1957 eight factions had emerged as distinct organizational features of the LDP."

allocations of cabinet seats to factions, including the identity of the prime minister's faction. We collected this information from Sato and Matsuzaki (1986) and Kitaoka (1995).[16] Table 1 presents the descriptive statistics of the data.

[Table 1 about here]

Forty four cabinets were formed during this period, and the LDP maintained a majority in the lower house throughout the period. Factions in the LDP changed across time, and the number of factions ranged between 5 to 12 with the average of 8.4 factions.[17] As we use data for each faction in each government, the total number of equations are 415, though the number of observations is 44.

Figures 1-3 present the main features of our data. Figure 1 depicts the histogram of the relative size of the factions. Factions bigger than 0.2 are very few, while those smaller than 0.2 are more prevalent at about the same proportion. Figure 2 shows the histogram of the faction size of the Prime Minister's faction. Comparing with the Figure 1, we find that they look different. The bigger the size of a faction, the more likely it will be chosen as a proposer. This assures our model setup which assumes that the probability to be recognized as a proposer is a function of the faction size.

[Figures 1 and 2 about here]

Figure 3 depicts the relationship between the proportion of cabinet posts (i.e. the number of cabinet posts one faction obtained out of all the cabinet posts) and the faction size. There seems to be

[16]We also referred to Asahi Shimbun (various issues), which is one of the leading daily newspapers in Japan, when information in Sato and Matsuzaki (1986) and Kitaoka (1995) were not consistent or were lacking.

[17]For the estimation, we treated legislators who did not belong to any faction as an independent faction. The average number of seats which independent legislators obatained in each government is 0.75. We define their size by 1/(number of LDP seats).

a positive correlation as a whole.[18] This, however, looks different if we look into it more carefully. The relationship is not clear for the faction with Prime Minister posts[19]. This also confirms our assumption that cabinet posts have different importance.

[Figure 3 about here]

No significant bureaucratic reform was implemented during the data period.[20] Numbers of cabinet posts are almost constant. Twenty-one cabinet posts were constant throughout this period. Minor changes occurred in the early 1970's when three new agencies were created (three posts are added accordingly), and in 1984 when one agency was closed.[21] There was no significant change in the electoral system during the data period.

[18]Browne and Frendreis (1980) study this relationship for 132 Eurpoean coalitional governments. We ran the same specification to obtain the following. (Numbers in blackets are standard errors)

$$\underset{R^2=0.663}{\%ofSeat} = \underset{(0.006)}{-0.158} \times Const + \underset{(0.043)}{1.147} \times RelativeSeatShare$$

[19]Dividing the data into factions with the Prime Minister's post and others, the result of regression is very different. For the Prime Minister's faction, the relationship is not very clear as the following high standard errors and low R^2 suggest.(Numbers in blackets are standard errors)

$$\underset{R^2=0.007}{\%ofSeat} = \underset{(0.053)}{-0.151} \times Const + \underset{(0.292)}{0.537} \times RelativeSeatShare$$

On the other hand, the relationship for non-Prime Minister factions is more robust.

$$\underset{R^2=0.6951}{\%ofSeat} = \underset{(0.005)}{-0.012} \times Const + \underset{(0.038)}{1.038} \times RelativeSeatShare$$

[20]The cabinet posts in this paper are different from the current ones due to a significant bureaucratic reform in 2001.

[21]The Director General of Environment Agency (1971), the Director General of the Okinawa Development Agency (1972), and the Director General of the National Land Agency (1974) are the three posts which were added during this period. The Director General of the Administration Management Agency is the post that was removed.

Specification of the Model

The multilateral bargaining model presented above specifies the unique SSPE payoff for each faction (see Proposition 2). As we have already presented the model, we now follow the general exposition we have presented earlier. Preposition 2 provides the expression for $y_i^*(\theta', h(\omega;\alpha), g(\gamma;\delta))$, thus

$$1 - \sum_{j \neq i} \delta \frac{\omega_j \exp(\alpha\omega_j)}{\sum_{l=1}^{n} \omega_l \exp(\alpha\omega_l)} = x_i\beta + \varepsilon_i$$

for proposer's faction i, and

$$\delta \frac{\omega_j \exp(\alpha\omega_j)}{\sum_{l=1}^{n} \omega_l \exp(\alpha\omega_l)} = x_j\beta + \varepsilon_j$$

for non-proposer $j \in N \backslash \{i\}$. Therefore, each government formation provides us with a system of n equations as above. As discussed previously, we ignore the data for one faction, and use only $n-1$ equations for each government formation for consistency. This enables us to ignore the correlation among ε_is. For convenience, we choose the faction of the proposer to be removed from our estimation.[22] Thus, we have the following $n-1$ equations for a government formation:

$$\delta \frac{\omega_j \exp(\alpha\omega_j)}{\sum_{l=1}^{n} \omega_l \exp(\alpha\omega_l)} - x_j\beta = \varepsilon_j$$

for any non-proposer factions $j \in N \backslash \{i\}$.

On this system of $n-1$ equations for each government, we have a trivial solution of $\delta = 0$, $\beta_1 = 1$ and $\beta_k = 0$ for $k \in K \backslash \{1\}$ if we ignore ε. When we estimate using the above specification, estimations always give values very close to $\delta = 0$, $\beta_1 = 1$ and $\beta_k = 0$.[23] This, however, cannot be

[22] Our results do not depend on the choice of faction we do not use. This is because the data for $n-1$ faction have exactly the same amount of information as that of n factions for the reasons discussed earlier.

[23] This is a trivial answer to the system of equations if we ignore ε. The answer is true for any values of ω and X.

a solution as weights of ministers other than prime minister is 0. We will avoid this trivial solution by dividing both sides of the equation by δ to prevent δ from being 0, i.e.,

$$\frac{\omega_j \exp(\alpha\omega_j)}{\sum_{l=1}^{n} \omega_l \exp(\alpha\omega_l)} - \frac{x_j\beta}{\delta} = \frac{\varepsilon_j}{\delta}.$$

Finally, we will estimate the model using the maximum likelihood method. The likelihood function can be written as[24]

$$\begin{aligned} L(X \mid \sigma, \alpha, \delta, \beta, \omega) &= \prod_{t=1}^{T}\prod_{i=1}^{n-1} f(\varepsilon \mid X^t, \pi) \\ &= \prod_{t=1}^{T}\prod_{i=1}^{n-1} \frac{1}{(2/\delta)^{2\sigma-1} Beta(\sigma,\sigma)} \left[\frac{1}{\delta} + \left(\frac{\omega_i^t \exp(\alpha\omega_i^t)}{\sum_{l=1}^{n} \omega_l^t \exp(\alpha\omega_l^t)} - \frac{x_i^t\beta}{\delta}\right)\right]^{\sigma-1} \\ &\quad \left[\frac{1}{\delta} - \left(\frac{\omega_i^t \exp(\alpha\omega_i^t)}{\sum_{l=1}^{n} \omega_l^t \exp(\alpha\omega_l^t)} - \frac{x_i^t\beta}{\delta}\right)\right]^{\sigma-1}. \end{aligned}$$

In the actual calculation, we have employed the bootstrapping method. We randomly drew observations from the original data without replacing the original data for the same number of times as the original number of observations. We repeated this process 500 times, and used the average as the point estimates and the standard deviations as the standard errors for the parameters.

Results

Estimates

The result is presented as Table 2 below. The reported standard error is obtained using the bootstrap method.

[Table 2 about here]

[24]Now, the Generalized Beta distribution of the first kind has support $[-1/\delta, 1/\delta]$ and mean 0.

The last column in Table 2 reports the result with an restriction that $\alpha = 0$. The result is almost the same as the one without this restriction. The likelihood decreases only by 0.22. The likelihood ratio test cannot reject a hypothesis $\alpha = 0$ even at 1% level. This is also clear from the robust standard error of α reported in Table 2. Hence, we cannot reject the hypothesis that there is no scale effect of the voting weights.

Discussion

The above results tell us a number of important things. First, we find that the post of the Prime Minister has by far the highest value. This should not be a peculiar result. The power of the Prime Minister results from many factors: 1) Constitutionally, he is the head of the cabinet, and all of the cabinet decisions need his signature. 2) The budget has to be signed by the Prime Minister before it is submitted to the legislature. 3) He can also control the legislative process by having the power to dissolve the legislature. In addition to these and many other factors, this high weight on the Prime Minister may also reflect the power to propose **a** ministerial seat allocation. Although we do not know how much each of these factors contributes, we are not surprised that the Prime Minister has the highest value.

The second observation is that the Ministers of Construction and Transport have the next highest values to the Prime Minister. These are alleged to be "dirty" posts. Ramseyer and Rosenbluth (1993) mention the Ministry of Construction as having been characterized as "a politically driven pork wagon" (p.124). There are many other academic as well as journalistic accounts for the claim that these two posts have strong influence on pork-barrel projects (see e.g. Woodall (1996)). The Ministry of Construction is in charge of the construction of dams, bridges and roads. The Ministry of Transport controls the procurement process of ports, airports, railways, and highways.

A third point, which is most clearly seen in the Ministers of Foreign Affairs, is that ministerial weights are not necessarily correlated with the seniority of the appointed politicians. The Ministers of Foreign Affairs are reported to be important (see e.g. Kato and Laver (1998)), and posts for a senior politician (see e.g. Sato and Matsuzaki (1986)). The value to the factions, however, is very low in our result. Our model focuses on the bargaining among factions and the values of ministers from the perspective of factions. The factions have politicians of diverse seniority, and our result tells that the seniority is only one of the factors for the allocation of the cabinet posts.

Fourth, $\delta = 0.806$ implies that there is a significant formateur advantage. If $\delta = 1$, there is no formateur advantage, and parties' gains are only dependent on their size. However, $\delta < 1$ implies that the proposer gains more than non-porposers even if their sizes are the same. For example, if a faction has size 0.2, then in the absence of scale effect, $\delta = 0.8$ implies that being a proposer will give the faction 0.36, while the gain is 0.16 if the faction is not a proposer.

Finally, $\alpha = 0$ cannot be statistically rejected at a conventional level. This implies that we cannot reject the hypothesis that there is no significant scale effect of faction sizes when bargaining over cabinet seats; i.e. cabinet post allocations are proportional to the size of factions. With the estimated $\alpha = 0$ and $\delta = 0.8$, the Gamson hypothesis applies to non-proposer factions, while the proposer gains more than their size. This result is consistent with Ansolabehere, Snyder, Strauss and Ting (2003) though their estimatation results are based on European data with exogenously determined ministerial weights.

Concluding Remarks

This paper has structurally estimated relative ministerial weights in parliamentary democracies. Specifically, we have combined a bargaining model of government formation with maximum likelihood estimation. The data required for estimation are who formateurs are, what each party's voting weight is, and what ministerial seats each party obtains. By using the Japanese data during the period of from 1958 to 1993, we find that the Ministers of Construction and Transport, which have been alleged to have a strong influence on pork-barrel spending, have high estimated values, while the estimates for the Ministers of Foreign Affairs and Justice have low weights though they are regarded as more prestigious ministers. We also find that voting weights do not have a significant effect on the returns to scale, i.e. their bargaining power is almost identical to their size. Finally, we observe an evidence of formateur advantage.

The present paper did not cover European cases. However, our method can easily be applied to European democracies by employing an appropriate bargaining game. One of the benefits of studying European parliamentary democracies is that one can conduct comparative analysis of ministerial weights, which may depend on some institutional and non-institutional features of each country. This and other interesting issues are left for future research.

Appendix 1: Government Formation in Japan, 1958-1993

In this part, we describe institutional and non-institutional features of government formation in Japan during the period of 1958-1993, which our formal model is based upon.

Japan employs a parliamentary regime with a bicameral legislature. The legislature is called the Diet, which consists of the House of Representatives and the House of Councilors. In the House of Representatives, single non-transferable voting (SNTV) in (mostly) three to five seat districts was used, while the members of the House of Councilors were chosen by proportional representation until 1993.[25] The Prime Minister is head of the cabinet, and is designated by the legislature. On

[25] More precisely, in the House of Councilors, until 1980, low-magnitude SNTV was used in the prefectural districts

designation, the House of Representatives can make a final decision if the two Houses disagree for ten days. Once designated, the Prime Minister-designate will select cabinet members; the majority of those selected must be legislators. After all the cabinet members are selected by the Prime Minister-designate, the Emperor will appoint him as the Prime Minister.

A member of the cabinet can be appointed to multiple posts, while each ministerial post can accommodate only one person. The Cabinet Law (Law No.5 of 1947) limits the maximum number of cabinet members. As the Prime Minister solely has the authority to appoint members of the cabinet, he can reshuffle it. The reshuffle process is the same as the formation of a new cabinet. The members of the cabinet must resign *en masse* once the House of Representatives passes a no-confidence resolution. In such a case, a new Prime Minister-designate will be chosen in the Diet in the same process as shown above.

Following facts during the period of 1958-1993 provide us with some details of the actual process of government formation in Japan.

1. The Liberal Democratic Party maintained majority in the House of Representatives,[26] and the Prime Minister-designates were always LDP presidents.

2. No LDP faction voted for a no-confidence resolution after government formation. No no-confidence resolution was passed in the Diet, except for one.[27]

along with national SNTV. Before the 1983 election, the prefectural districts were unchanged, but the national SNTV election was replaced by national closed-list PR.

[26]The LDP was not in a majority position from 1983 to 1986. It then formed a coalition with the New Liberal Club (NLC), which was a part of the LDP in substance, and merged with the LDP in 1986. The NLC was formed by a number of young LDP legislators who left the LDP after a corruption scandal in 1976. It stayed in opposition for six years (the LDP maintained majority during these six years) before forming a coalition with the LDP in 1983.

[27]In 1980, the Diet passed the no-confidence resolution with the absence of 69 LDP legislators. However, this was

3. LDP factions played the central role in government formation.

4. No LDP faction left the LDP, and LDP factions of significant size obtained cabinet posts in most of the cabinets.

5. All of the cabinets were formed within three days after a Prime Minister-designate had been designated.[28]

First, the LDP maintained a majority in the House of Representatives during the period of 1955-1993. This implies that the actual process of choosing a Prime Minister was an internal process of the LDP. The LDP candidates for Prime Minister, who were also the presidents of the LDP,[29] always won the vote of designation. The fact that the Prime Minister-designates were from the LDP and the fact that no LDP factions voted for a no-confidence resolution imply that the government formations (not only the choice of Prime Minister) were an internal process in the LDP. Hence, we think that *both the choice of the Prime Minister and the cabinet formation were internal processes in the LDP*.

Second, LDP factions have been the primary internal organizational unit of the LDP, and have played a central role in cabinet formation (see, e.g. Leiserson (1968), Sartori (1976), Kohno (1992) and Ramseyer and Rosenbluth (1993)). The LDP factions are said to have little difference on their preferences over policy issues. For example, Ramseyer and Rosenbluth (1993, p.77) say "Factions, in fact, have virtually no role outside of personnel matters. This is because each faction is more or

not related to government formation.

[28]During the period of 1958-1993, cabinets were formed within two days after the Prime Minister-designates were selected. One exception is that it took three days when the second Ohira cabinet was formed (November 6 to 9, 1979).

[29]The only exception took place in 1979, when the LDP had two candidates. Once designated, Prime Minister-designate Ohira allocated seats to all the factions with the significant size, including the ones who voted against him when he was approved in the diet.

less a microcosm of the entire party in terms of policy preference and expertise."[30] We observe that *the LDP factions had no significant difference in their preference over policy areas*.[31]

In the actual process, the Prime Minister offers a proposal of cabinet posts to all the factions. Factions respond to the offer by agreeing or by requesting more and/or different seats, and then the offer is revised. In case factions cannot agree with the revised offers, the factions could ask for a change of the LDP leadership or leave the LDP, and/or vote for the vote of no-confidence. Historically, none of these disagreements happened. The President of the LDP has never changed right after the designation of Prime Minister-designate. During the period of 1958 to 1993, no faction left the LDP and no vote of no-confidence was ever agreed upon by any LDP factions. We interpret these facts as follows: *the cabinet formation process was under unanimous agreement of all the factions*.[32] Another fact is that any faction of significant size obtained cabinet seats in most of the cabinets. This also supports our interpretation that the agreements were unanimous because non-unanimous agreements should (at least theoretically) always result in no cabinet seats for some factions.

Historically, no cabinet formation required more than three days. We interpret this as an *immediate agreement* for two reasons. First, the Prime Minister-designate will need time to form his offer to

[30] Ramseyer and Rosenbluth (1993, p.211) also cite an interview with one faction leader of the LDP, who says that factions are not distinguishable on policy areas.

[31] Not all the researchers agree with this point. See McCubbins and Thies (1997) for a different view.

[32] Factions may get frustrated with the cabinet formation. We, however, think that they still agreed upon even though they may have got frustrated. For example, Fukuda faction thought they were underrepresented in the formation of the Tanaka Cabinet in 1972, while they never really tried to form a hostile coalition nor called for a no-confidence resolution, even though they could have succeeded in it to restart the cabinet formation process. (Fukuda faction had 56 seats, and the opposition had 207 seat. Hence, vote for a no-confidence resolution could have won by 263-228.)

the factions carefully. Even still, the offer is agreed and the cabinet is formed within a short period of time. Second, the comparison with another country tells us that the agreement is immediate. Merlo (1997) provides data for government formation during post-war Italy. Compared with his data, in which the mean is 4.98 weeks and the maximum eighteen weeks, we interpret that the agreement within three days is immediate.

Appendix 2: Any Individually Rational Payoff Constitutes an SPE Outcome

Proposition *Any individually rational payoff can be supported as an SPE payoff for any* $\delta \in (0, 1)$.

Proof. We prove the proposition by construction. Fix an arbitrary feasible allocation $s \in S \equiv \{s \in R_+^n : \sum_{i=1}^n s_i \leq 1\}$. Denote an allocation for the punishing player j as $r^j = [r_1^j, ..., r_M^j]$ where $r_j^j = 0$ and $r_i^j = s_i + \dfrac{s_j}{M-1}$ for $i \neq j$. Similarly, denote an allocation for punishing players j and k as $r^{jk} = [r_1^{jk}, ..., r_M^{jk}]$ where $r_j^{jk} = r_k^{jk} = 0$ and $r_i^{jk} = s_i + \dfrac{s_j + s_k}{M-2}$ for $i \neq j, k$. In the same way, we define allocations for punishing more than two players by r^{jkl} and r^{jklm}.

Consider the following strategy profile: (1) In the first stage, a recognized proposer offers s, and all the players accept it. (2) If there is a deviation from (1) by player j, the proposer chosen in the next stage offers r^j, and all the other players (including j) accept it. (2') If there was a deviation from (2) by player j, repeat (2). (2") If there is a deviation from (2) by another player k, proposer offers r^{jk}, and all the other players (including j and k) accept it. (3) If there is a deviation from (2") by player j or k, repeat (2"). (3') If there is a deviation from (3) by another player l, the proposer offers r^{jkl}, and all the other players (including $j, k,$ and l) accept it. (4) For deviations by more players, construct the rest of the strategy in the same way.

With this profile, any deviation from this profile results in the continuation payoff of zero for the deviating player, while no deviation always produces a non-negative payoff to the player. This does not depend on what value δ takes. Thus, no faction cannot make itself strictly better off by deviation, and s is sustained as a subgame perfect equilibrium. ■

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Without individual	mean	std. dev.	min	max
number of faction	8.43	2.02	5	12
faction size (total of LDP seats=1)	0.114	0.067	0.007	0.281
number of cabinet posts by a faction	2.57	2.11	0	9
size of prime minister’s faction	0.178	0.039	0.090	0.281

Table 1: Descriptive Statistics

	(1)		(2)
Likelihood	623.1997		622.9786
σ	377.6122	(25.8698)	377.5116
α	-0.3572	(0.5592)	0.0000
δ	0.8060	(0.0488)	0.8056
Prime Minister	0.2630	(0.0529)	0.2594
Transport	0.0597	(0.0081)	0.0600
Construction	0.0583	(0.0102)	0.0587
Economic Planning	0.0532	(0.0094)	0.0533
Agriculture	0.0492	(0.0061)	0.0498
Defence	0.0460	(0.0071)	0.0461
Finance	0.0455	(0.0086)	0.0461
Labor	0.0433	(0.0072)	0.0428
International Trade and Industry	0.0409	(0.0076)	0.0411
Cabinet Secretary	0.0406	(0.0104)	0.0427
Health and Welfare	0.0397	(0.0070)	0.0399
Science and Technology	0.0378	(0.0083)	0.0379
Management and Coordination	0.0370	(0.0073)	0.0369
Home Affairs	0.0340	(0.0116)	0.0344
Education	0.0340	(0.0080)	0.0333
Post and Telecomunication	0.0309	(0.0067)	0.0311
Foreign Affairs	0.0281	(0.0067)	0.0275
Justice	0.0234	(0.0066)	0.0233
Hokkaido Development	0.0210	(0.0076)	0.0210
Public Safety	0.0144	(0.0115)	0.0147

Table 2: Estimates and Standard Errors. Standard Errors are in blackets. Ministers are in the order of weight. Ministers with weights higher than the average weight (excluding the Prime Minister) are in bold fonts. Column (2) corresponds to the case with the restriction $\alpha = 0$.

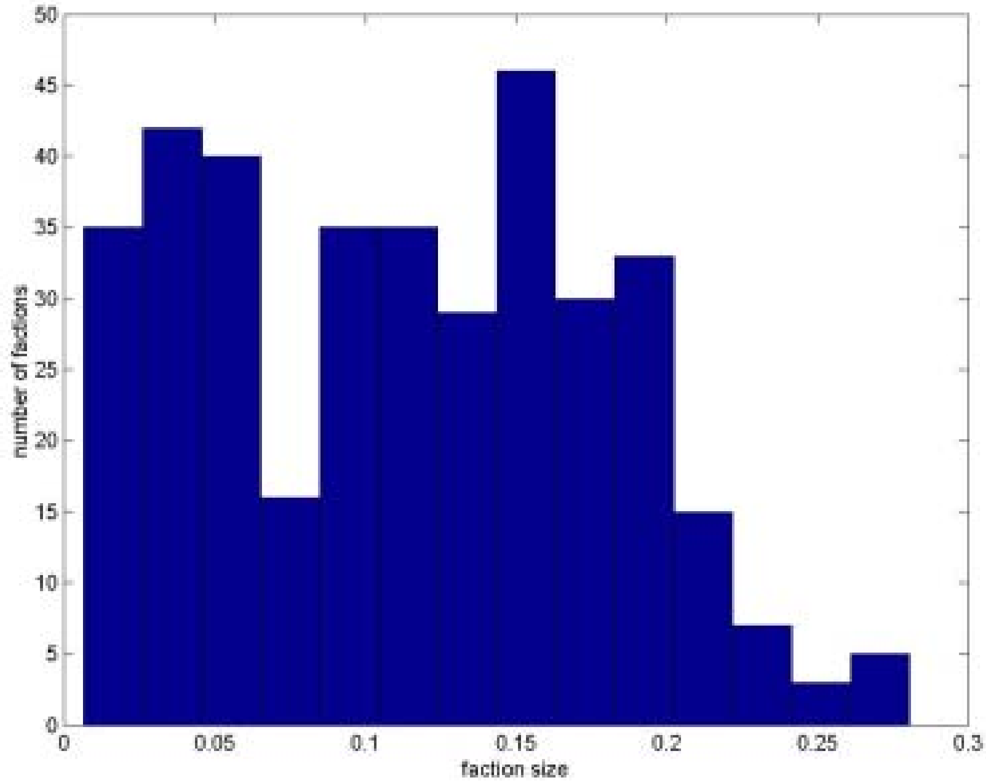

Figure 1: Histogram of Faction Size

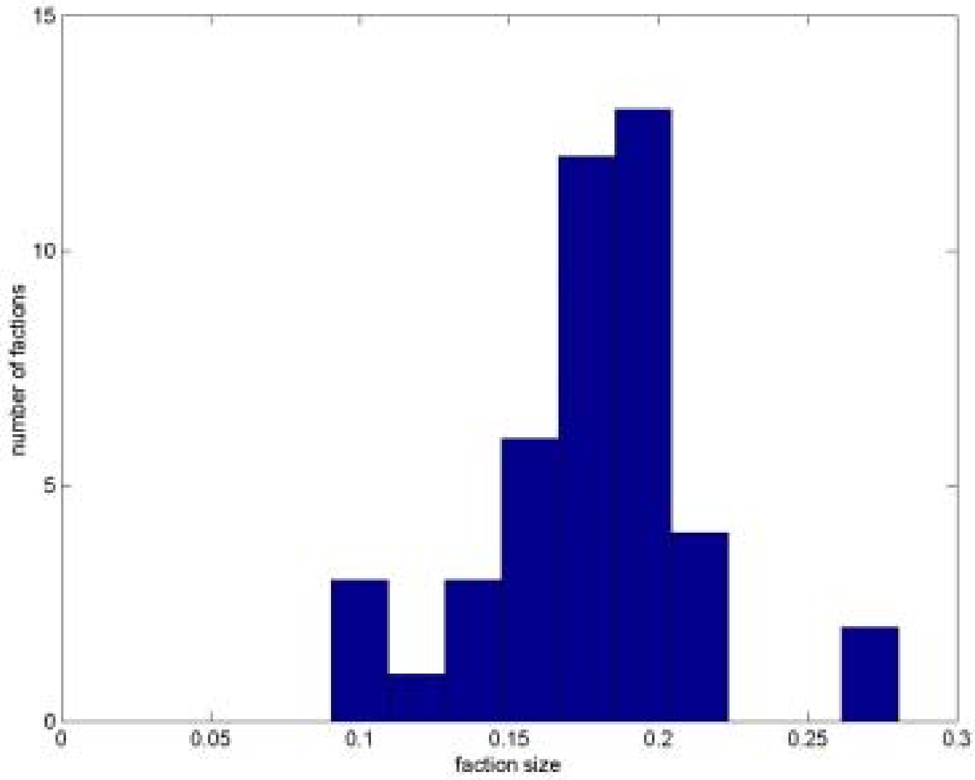

Figure 2: Histogram of Factions of Prime Ministers

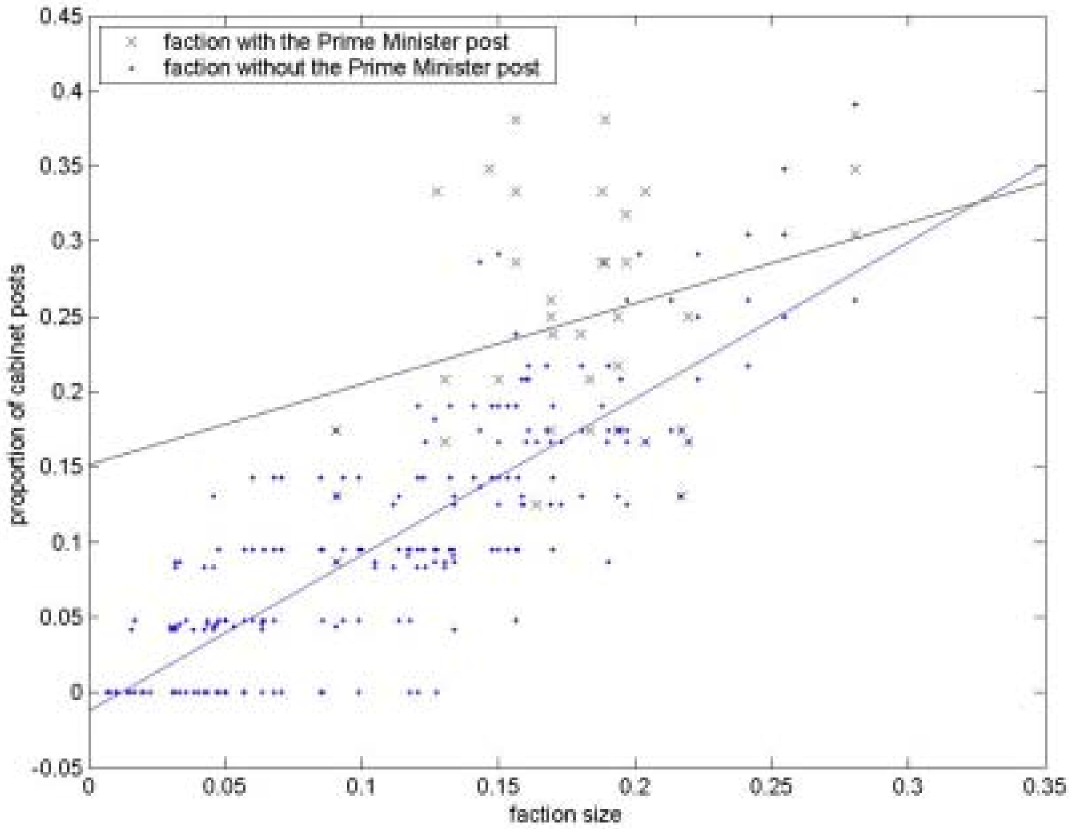

Figure 3: Proportion of Cabinet posts and Faction Size. Lines are OLS fitted lines for 1) Prime Minister's faction (line with steeper slope) and 2) factions without Prime Minister's Posts.