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DYNAMIC ANALYSIS OF STABILITY OF COALITION GOVERNMENTS IN JAPAN 1993

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Abstract This paper studies the stability of the coalition government formed in 1993 in Japan, called the Hosokawa government, by using a dynamic coalition formation model presented in Fukuda and Muto [2]. Ono and Muto [6] studied the stability of the same coalition government by applying the static coalition formation model of Hart and Kurz [4], which employed Owen's [7] coalition value to measure parties' power, and showed that the Hosokawa government was the unique stable coalition government. In this paper, we take into account a negotiation process when parties form a coalition government and apply the dynamic model of Fukuda and Muto [2]. We show that coalition governments that include the Liberal Democratic Party (LDP) could form as stable coalition structures if the LDP took the initiative in negotiation, and that the Hosokawa government was stable only when a minor party (other than the LDP) had the initiative in the negotiation.

Keywords: Game theory, coalition government, coalition value, stability

1. Introduction

In October 2007, the Liberal Democratic Party (LDP) and the Democratic Party of Japan (DPJ) tried to form a coalition government taking into account the fact that the DPJ became the leading party in the Upper House, though their attempt was not successful. Since the formation of the Hosokawa government in 1993, many coalition governments have formed one after another. Thus theoretical analysis of coalition formation among political parties should be an interesting and important topic.

In this paper, we thus go back to the starting point of recent movements of coalition governments, i.e., the Hosokawa government. As seen in the seat distribution after the Lower House election (Table 1), the LDP, which had held a majority in the Lower House for more than forty years, lost a majority. After negotiation among parties for a coalition government, an anti-LDP coalition government was formed. This first coalition government of Japanese parliament after 1955 was named the Hosokawa government (the Hosokawa cabinet), taking the name of its prime minister. We now note that the seat distribution in the Lower House before the birth of the Hosokawa government had the following features. The LDP can form a winning coalition with any one of the four parties: the SDPJ, the JRP, the Komei and the JNP (see Table 1). Furthermore all parties other than the LDP may form a winning coalition. See Table 1*. Through negotiations, the latter coalition, i.e., the anti-LDP coalition government formed.

Ono and Muto [6] analyzed formation of the Hosokawa government using the coalition formation game due to Hart and Kurz [4, 5]. The game is a simultaneous decision (static)

*The situation is similar to that of the apex game in which one strong player, like the LDP, exists. The exact definition of the apex game will be given in Section 2.

Table 1: Lower House seat distribution

Party	Seats
Liberal Democratic Party (LDP)	233
Social Democratic Party of Japan (SDPJ)	70
Japan Renewal Party (JRP)	55
Komei Party (Komei)	51
Japan New Party (JNP)	35
Democratic Socialist Party (DSP)	15
Japan Communist Party (JCP)	15
New Party Sakigake (Sak)	13
Social Democratic Federation (SDF)	4
Independents	20
Total	511
(Quota)	(256)

game and the payoffs to the parties were given by the coalition value defined by Owen [7]. They showed that the Hosokawa government was the unique coalition government produced as an equilibrium outcome of the game. The real negotiations among parties were, however, not static. They were carried out dynamically: one party proposed a coalition; then proposed parties accepted or rejected the offer; if some party rejected, then it offered a new coalition; and so on. Thus in this paper, we proceed a dynamic analysis of the parties' coalition formation. We use the dynamic coalition formation game of Fukuda and Muto [2], and study under what condition the Hosokawa government appeared as an equilibrium outcome. Principal findings are the following. (1) If the LDP took the initiative in negotiation, coalition governments appeared in equilibrium must have included the LDP. (2) The Hosokawa government appeared as an equilibrium outcome only when a party other than the LDP took the initiative. Even in this case, a coalition consisting only of the proposing party and the LDP might have formed in equilibria.

2. Models

In this section we review the definitions of a weighted majority game and Owen's coalition value, which will be used in the following analysis.

2.1. Weighted majority game and coalition value

The weighted majority game is given by the form $[q : w_1, w_2, ..., w_n]$ with players 1, 2, ..., n where q is the number of votes needed to win (called quota) and w_i is the number of votes that player i has (called i's weight). A coalition $S \subseteq N$ with $\sum_{i\in S} w_i \geq q$ is called winning. A coalition that is not winning is called losing. The coalitional form game representation of the weighted majority game is given by (N, v) where $N = \{1, 2, \ldots, n\}$ is the set of players and v is a real-valued function on 2^N such that for each $S \subseteq N$

$$v(S) = \begin{cases} 1 & \text{if } S \text{ is winning} \\ 0 & \text{if } S \text{ is losing.} \end{cases}$$

The coalition value due to Owen [7] is a generalized Shapley value (Shapley [8]) with *a priori* coalition structure. Let $\mathcal{B} = \{B_1, B_2, ..., B_m\}$ be a partition of the player set N, that is, $\cup_{k=1}^m B_k = N$ and $B_k \cap B_l = \emptyset$ for all $k, l \in M = \{1, \ldots, m\}, k \neq l$. In the following, we call $\mathcal{B}$ a coalition structure. For each coalitional form game (N, v) with coalition structure $\mathcal{B}$, the Shapley value is interpreted as the expected marginal contribution, over all orderings[†], of player i to the set of players who precede him, when we assume that all the players join a coalition one by one in each order. The coalition value $\psi_i(v, \mathcal{B})$ is the expected marginal contribution over not all orderings but orderings where players in the same coalition join together. Formally, for $B_j \in \mathcal{B}$ and $i \in B_j$,

$$\psi_i(v, \mathcal{B}) = \sum_{\substack{H:H\subseteq M\\ H\not\ni j}} \sum_{\substack{S:S\subseteq B_j\\ S\not\ni i}} \frac{|H|!(|M|-|H|-1)!|S|!(|B_j|-|S|-1)!}{|M|!|B_j|!} \times [v(\mathcal{Q}\cup S\cup i) - v(\mathcal{Q}\cup S)] \tag{1}$$

where $\mathcal{Q} = \cup_{k\in H} B_k$ and $|\cdot|$ denotes the cardinality of the set $\cdot$.

The following example illustrates how we calculate the Shapley value and the coalition value.

Example 1. Assume that $N = \{1, 2, 3\}$ and player 1 has 2 votes, each of players 2 and 3 has 1 vote, and the voting quota is 3. This situation can be formulated as a weighted majority game $(N, v) = [3; 2, 1, 1]$. All orderings on the player set N are 123, 132, 213, 231, 312 and 321. Player 1 here has contribution 1 to the predecessors if he is not the first in the order. That is, player 1 cannot pass any bill alone but he can pass a bill if player 2 or 3 has already voted for the bill. Thus the Shapley value of player 1 is 4/6. On the other hand, player 2 has contribution 1 only in the ordering 123; therefore his Shaley value is 1/6. As players 2 and 3 are symmetric, the Shapley value of this game is (4/6, 1/6, 1/6).

Let us assume that players 2 and 3 form a coalition, that is, coalition structure $\{\{1\}, \{2, 3\}\}$ is formed. In brief notation, we often write $\{\{1\}, \{2, 3\}\}$ by $[1\,|\,23]$. The possible orderings are now 123, 132, 231 and 321, because players 2 and 3 form a coalition and thus they behave as a block. In orderings 213 and 312, players 2 and 3 are separated by player 1. Thus the coalition value is $\psi(v, \{\{1\}, \{2, 3\}\}) = (2/4, 1/4, 1/4)$, and players 2 and 3 can be better off by forming coalition $\{2, 3\}$. For coalition structure $\{\{1, 2\}, \{3\}\}$, the possible orderings are 123, 213, 312 and 321, hence $\psi(v, \{\{1, 2\}, \{3\}\}) = (3/4, 1/4, 0)$.

Note that when no coalition with more than one member forms or only the grand coalition forms, the corresponding coalition value coincides with the Shapley value of game v; $\psi(v, \{\{1\}, \{2\}, \{3\}\}) = \psi(v, \{\{1, 2, 3\}\}) = (4/6, 1/6, 1/6)$ [‡].

2.2. Dynamic coalition formation game

We now review the extensive form game representation of coalition formation game used in Fukuda and Muto [2] to study coalition formation in the apex game. The game is a slight modification of the game due to Bloch [1].

The first proposer i is determined randomly and he starts the game by proposing to form a coalition S such that $i \in S$. When $S = \{i\}$, player i behaves by himself; that is, he wants to form no coalition with other player(s). Whenever $|S| > 1$, i.e., i wants to form a coalition with other player(s), the proposer must pay a cost c. As we explain it later, each player's utility is given by his power measured by the coalition value. Thus the cost here is an abstract negative factor caused by monetary or time expenditure for making a proposal that decreases a proposer's utility. To simplify the analysis, it is assumed that the cost c is common to all proposals. In the following, we say that a player takes the initiative in the negotiation if he is the first proposer and proposes to form a coalition S with $|S| > 1$. If player i chooses coalition $\{i\}$, we say that he withdraws from the negotiation.

[†]All orderings are equally likely.

[‡]The Shapley value of game v for player i is defined by $\varphi_i(v) = \sum_{S:i\in S\subseteq N} \frac{(|S|-1)!(n-|S|)!}{n!}[v(S) - v(S\backslash\{i\})]$.

Once a non-singleton coalition S is proposed, each player in $S\backslash\{i\}$ decides whether to accept or reject the proposal in an order predetermined randomly. The player who rejects the proposal first must in turn make a counteroffer and propose a coalition that contains him.

If all members of S accept, then coalition S is formed and all members of S withdraw from the game. Then the first proposer in $N\backslash S$ is chosen again randomly. Note that, in this procedure, once a coalition has been formed the game is only played among the remaining players. If the game continues infinitely[§], then all players receive payoffs of minus infinity. If not, a particular coalition structure is determined. Each player's utility is given by his coalition value under the coalition structure. Following usual analyses of dynamic negotiation models, we introduce the discount factor that discounts future utilities; and each player's payoff is given by the discounted coalition value minus the cost for making proposal(s).

Instead of giving the formal definition (for the formal definition, see Fukuda and Muto [2]) we will explain the details of the game using the following simple example.

Example 2. Let us consider again the game in Example 1. Let the first proposer be player 1. The game tree is illustrated in Figure 1.

In the top path in Figure 1, player 1 proposes $\{1\}$ and withdraws from the negotiation. Here it is assumed that the next proposer is player 2, who is randomly selected from the remainder $N\backslash\{1\}$. Player 2, in the top path, offers to form $\{2,3\}$ and player 3 accepts it. Thus $\mathcal{B} = \{\{1\},\{2,3\}\}$ is formed as the outcome of the negotiation, and players' payoffs are determined based on the coalition value $\psi(v,\{\{1\},\{2,3\}\})$. Here player 1 gains $\delta^3\psi_1(v,\{\{1\},\{2,3\}\}) = 2\delta^3/4$ where $\delta \in (0,1)$ is the discount factor and 3 is the number of edges in the path from the beginning to the end of the negotiation. Player 2 gains $\delta^3\psi_2(v,\{\{1\},\{2,3\}\}) - c = \delta^3/4 - c$, where c is the cost for each proposal. If a player proposes a non-singleton coalition k times then he must pay kc, the unit cost c times the number of proposals k. Then player 3's payoff is $\delta^3\psi_3(v,\{\{1\},\{2,3\}\}) = \delta^3/4$.

In the second path from the top, player 3 rejects the proposal and becomes the next proposer, where the dots mean that the game continues.

In the third-to-top path, after player 1 withdraws from the negotiation, player 2 also withdraws, thus $\mathcal{B} = \{\{1\},\{2\},\{3\}\}$ is formed as a result, and players 1, 2 and 3 gain $4\delta^2/6$, $\delta^2/6$ and $\delta^2/6$, respectively.

Finally, let us look at the fourth path. In the path, player 1 is the first proposer and proposes $\{1,2\}$ while paying cost c, i.e., he takes the initiative in the negotiation. Then player 2 included in $\{1,2\}$ accepts the proposal and $\{\{1,2\},\{3\}\}$ is formed. Player 1 thus gains $3\delta^2/4 - c$, player 2 gains $\delta^2/4$ and player 3 gets nothing.

We use the concept of subgame perfect equilibrium to analyze stable coalitions (for the formal definition, see Fukuda and Muto [2]).

Example 3. Let $N = \{1,2\}$ and $(N,w) = [2;1,1]$. Assume that the first proposer is player 1, and $\delta = 0.9$ and $c = 0.01$. Then the game tree of the coalition formation game and payoffs at each terminal node are as shown in Figure 2 (The first component of each vector is the payoff of player 1). The subgame perfect equilibrium of this game is that player 1 plays up, i.e., withdraws, and player 2 accepts if player 1 proposes N. Therefore, the dynamically stable coalition structure is the equilibrium outcome $\mathcal{B} = \{\{1\},\{2\}\}$.

Fukuda and Muto [2] applied the dynamic process of coalition formation to the apex

[§]In general, if proposals are rejected numerous times and no coalition structure is formed for a fairly long period, we say that the game continues infinitely.

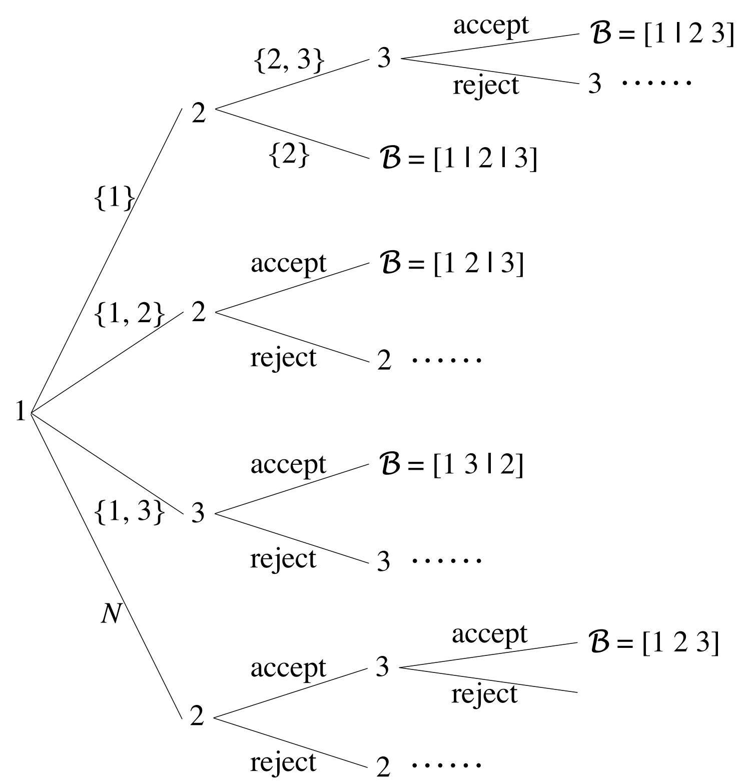

Figure 1: Game tree of Example 2

game. The apex game is a special class of voting games in which there are one player, called the apex, who possesses a large number of votes (formally, $q/2 - 1$ votes) and the others, called minor players, who are symmetric and have 1 vote each [¶]. Hart and Kurz [5] showed that, if $n \geq 5$, only the coalition structure that excludes the apex $[1|2 \ldots n]$ is statically stable in their static coalition formation model. That is, all of the minor players form a coalition excluding the apex. However, in the dynamic model of Fukuda and Muto [2], they showed that a coalition structure $[1j\,|\,2\,|\,\ldots\,|\,j-1\,|\,j+1\,|\,\ldots\,|\,n]$ is also stable. This coalition structure implies that the apex forms a coalition with one minor player and each of the other minor players plays independently. This result demonstrates that in the dynamic model the apex may form a coalition with one minor player.

On the other hand, Ono and Muto [6] studied the stability of the Hosokawa government by the use of Hart and Kurz's [4] static coalition formation model and showed that the Hosokawa government, in which the largest party was excluded from the majority coalition, was the unique stable coalition government.

In this paper, we apply the dynamic coalition formation model to the same situation and we see whether the largest party, the LDP, may form a majority coalition with other parties through dynamic negotiations. The main purpose of this paper is to study the stability of such coalition governments including the LDP as well as of the Hosokawa government, and to find conditions under which the Hosokawa government is dynamically stable.

[¶]Formally, the apex game is the coalitional form game (N, v) in which $v(S) = 1$ if and only if S includes coalitions $\{1, j\}$ $(j \in \{2, ..., n\})$ or $S = \{2, ..., n\}$.

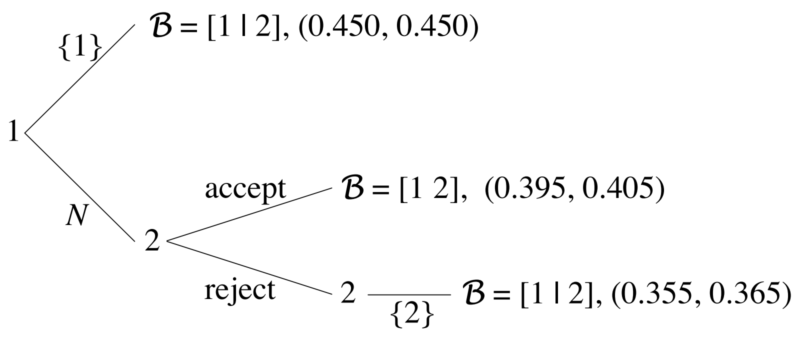

Figure 2: Game tree of Example 3

3. Stability of Coalition Governments

In this section, we apply the dynamic model above to formation of coalition governments. We analyze which coalition government would possibly arise after the 1993 general election if parties had negotiated according to the dynamic process given above. Then, we provide the conditions under which the Hosokawa government was a stable coalition structure.

Possible coalition structures are summarized in the first column of Table 2. Following Ono and Muto [6], we assume the following.

(i) The JCP never forms a coalition with other parties because its ideological position is far different from other parties or independents.
(ii) A coalition government should be a winning coalition.
(iii) A coalition government may not be a minimal winning coalition.

Although each non-independent member follows his party decision, each independent member makes his decision independently. Thus, this situation can be described as 29-person weighted majority game

$$(N, v) = [256; 233, 70, 55, 51, 35, 15, 15, 13, 4, 1, 1, ..., 1].$$

Coalition values for each party in coalitions are also given in Table 2. In the table, the number in a coalition government stands for the number of independents. For example, in F' (LDP + SDF + 19), there are 19 independents.

As for treatment of the independents, to save space, we only list coalition governments including all independents (F, Hosokawa, G, H, I and J) and minimal winning coalition governments (F', Anti-LDP (i), Anti-LDP (ii), G', H', I' and J'). Coalition governments in-between are omitted. Note that coalition governments F', I' and J' are more profitable both for the SDF and independents than F, I and J, respectively. G' and H' are profitable for independents than G and H, respectively. That is because F, G, H, I and J have superfluous members. Furthermore for coalition governments in-between, it is shown that the values for the SDF and independents decrease monotonically as the number of independents increases. On the other hand, the values for the large parties, such as the LDP, the SDPJ, the JRP, the Komei and the JNP, increase monotonically as the number of independents increases.

Let us apply the dynamic model and the stability concept given in Section 2. In this paper, we assume that the SDF or any independent is not allowed to make a proposal for forming a coalition. Because, in 1993, they were in fact not strong enough to take the

Table 2: Coalition values in Japan 1993

	coalition governments	seats	LDP 233	SDPJ 70	JRP 55	Komei 51	JNP 35	DSP 15	Sakigake 13	SDF 4	Indp. 1	JCP
	(Shapley value)	–	.6674	.0552	.0552	.0552	.0552	.0231	.0174	.0097	.0019	.0231
A	LDP + DSP + Sak	261	.8216					.0928	.0856			
B	LDP + JNP	268	.8225				.1775					
C	LDP + Komei	284	.8225			.1775						
D	LDP + JRP	288	.8225		.1775							
E	LDP + SDPJ	303	.8225	.1775								
F	LDP + SDF + 20	257	.7999							.0176	.0091	
F’	LDP + SDF + 19	256	.7996							.0196	.0095	
	Hosokawa(20 indp.)	263		.1775	.1775	.1775	.1775	.0995	.0882	.0236	.0041	
	Anti-LDP (i) (SDF + 13 indp.)	256		.1487	.1487	.1487	.1487	.0923	.0735	.0484	.0146	
	Anti-LDP (ii) (17 indp.)	256		.1443	.1443	.1443	.1443	.0916	.0704		.0153	
G	LDP + Sak + 20	266	.8003						.0282		.0085	
G’	LDP + Sak + 10	256	.7970						.0680		.0135	
H	LDP + DSP + 20	268	.7996					.0297			.0086	
H’	LDP + DSP + 8	256	.7970					.0916			.0139	
I	LDP + Sak + SDF + 20	270	.8498						.0666	.0136	.0035	
I’	LDP + Sak + SDF + 6	256	.8024						.0707	.0463	.0134	
J	LDP + DSP + SDF + 20	272	.8530					.0724		.0118	.0032	
J’	LDP + DSP + SDF + 4	256	.8216					.0911		.0468	.0146	
K	LDP + JNP + Sak	281	.8405				.1244		.0351			
L	LDP + Komei + Sak	297	.8405			.1244			.0351			
M	LDP + Komei + DSP	299	.8407			.1206		.0387				
N	LDP + Komei + JNP + Sak	332	.8645			.0569	.0569		.0218			

1) The values for Independents are per person.
2) F’, G’, H’, I’ and J’ are minimal winning coalition governments corresponding to F, G, H, I and J, respectively.

initiative in negotiations. We also assume that the discount factor δ is close enough to 1. This assumption is reasonable because there was no rush to form a coalition government. In fact, parties had a plenty of time for negotiation before the Diet was convened.

We classify cases according to who the first proposer is and the amount of cost for negotiations; then study which coalition government is dynamically stable in each case. See Tables 3 for details. In the cell marked – or †, particular coalition governments would not be obtained. In the cell marked –, the cost for proposal is so high for the small parties, such as the DSP and the Sakigake, that the first proposer withdraws from the negotiation. If the first proposer withdraws, stable coalition governments depend a great deal on the second proposer which is chosen randomly. In contrast, in the cell marked †, since the cost for proposal is small, every party can easily reject the other party's proposal and makes a counteroffer. Thus stable coalition governments depend on who the next mover is in the negotiation.

First we look at cases where the LDP has the initiative. The most preferable coalition government for the LDP is the type N (LDP + Komei + JNP + Sak), in which the LDP can get the coalition value 0.8645. If the cost is very high compared with power measured by the coalition value ($c > 0.1206$), all parties in the coalition will not reject the LDP's proposal since they never gain more rejecting the offer and making a new offer. Once the cost c is less than or equal to 0.1206, the Komei can reject the proposal and proposes to form the type C or the Hosokawa[‖], and thus N is not stable. Then, when $0.0271 < c \leq 0.1206$, the LDP proposes to form J instead of N. In this cost range, J is stable, because all members in J will not reject the proposal. Similarly, once c is below 0.0271, the DSP rejects the proposal and forms the Hosokawa government. The DSP gains more even if it pays the cost since $c \leq 0.0271$ means $0.0995 - c \geq 0.0724$. Thus, if $c \leq 0.0271$, J is not stable any more. As described above, if the negotiation cost is high, the LDP can form more preferable coalition government. However, even if the cost is smaller, every stable coalition structure contains the LDP. Thus we could claim that the LDP might form a coalition government in 1993, if it could have the initiative in negotiation.

Next, we consider cases in which an anti-LDP party is the first proposer. In most cases, it is observed that the Hosokawa government is formed as a dynamically stable coalition structure. As mentioned above, anti-LDP (i) and anti-LDP (ii) are better for the SDF and independents than the Hosokawa government. All other anti-LDP parties, however, prefer the Hosokawa government. Thus the anti-LDP coalition governments that include less than 20 independents would not be formed in equilibrium[**]. Note that in the actual event, the Hosokawa government which included 20 independents was formed.

It is notable that coalition governments including the LDP can be stable even if an anti-LDP party takes the initiative. However, for intermediate values of c ($0.0216 < c \leq 0.0305$), if the SDPJ, the JRP, the Komei, the JNP, the DSP or the Sakigake is the first proposer then only the Hosokawa government is stable. For example, let the SDPJ be the first proposer. If $c > 0.0305$, the type E and the Hosokawa are both stable. But if the cost is smaller ($0.0271 < c \leq 0.0305$), say $c = 0.0300$, the LDP would reject E and form J. Because the LDP wants to form J with paying the cost rather to form E with the SDPJ (i.e., $0.8530 - 0.0300 > 0.8225$). Similarly if $0.0216 < c \leq 0.0271$, the LDP wants to form I by rejecting E. When $c \leq 0.0216$, as seen from Table 3, only B, C, D and E are stable.

[‖]That is because the Komei wants to form C or the Hosokawa and earns 0.1775 even if it has to pay the negotiation cost (i.e., $0.1775 - c \geq 0.0569$).

[**]The SDF and independents have to accept the Hosokawa because otherwise they would withdraw from the negotiation and gain nothing.

Therefore if the LDP rejects E, it cannot form more preferable coalition such as J and I. Thus E is stable.

4. Conclusion

In this study, we have applied the dynamic coalition formation model to the Japanese coalition government in 1993, because negotiation among parties seemed to have played an essential role in forming the anti-LDP coalition government.

While Ono and Muto showed that the Hosokawa government was the unique stable coalition government using the static model, we found that stable coalition structures depended on (1) who has the initiative in a bargaining and (2) the cost for negotiation using the dynamic model. As shown in Table 3, the Hosokawa government is not necessarily the unique stable coalition structure.

We conclude that (I) coalition governments including the LDP could be formed as stable coalition structures if the LDP took the initiative in negotiation; (II) coalition governments including the LDP could be stable even if a minor party (other than the LDP) took the initiative; (III) the Hosokawa government was dynamically stable when the cost was in the middle range and a minor party had the initiative in the bargaining.

Also, we have shown that the Hosokawa government was the only stable coalition government in the following cases: (a) Parties smaller than the JNP were the first proposer and the parties considered that the cost for making a proposal was not so high; (b) the SDPJ, the JRP, the Komei or the JNP was the first proposer, and the cost was neither very high nor very low.

According to the fact that the Sakigake and the JNP actively proposed to form an anti-LDP coalition government just after the election in 1993, we would claim that the conclusion (III) reflects what actually happened.

As stated in the Introduction, after the Upper House election in 2007, negotiation took place between the LDP and the DPJ to form a coalition government but failed. Fukuda and Wakita [3] studied the stability of the current coalition government in 2008, namely the LDP-Komei coalition government, by applying the static coalition formation models by Hart and Kurz. As a future research, we plan to apply the dynamic model to the negotiation on coalition formation after the Upper House election in 2007 and analyze why the coalition government consisting of the LDP and the DPJ failed.

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Table 3: Stable coalition structures

<table>
<tr><th>First Proposer</th><th>LDP</th><th>SDPJ</th><th>JRP</th><th>Komei</th></tr>
<tr><td>$0.1206 < c$</td><td>N</td><td rowspan="4">E
Hosokawa</td><td rowspan="4">D
Hosokawa</td><td rowspan="4">C
Hosokawa</td></tr>
<tr><td>$0.0995 < c \leq 0.1206$</td><td rowspan="4">J</td></tr>
<tr><td>$0.0882 < c \leq 0.0995$</td></tr>
<tr><td>$0.0305 < c \leq 0.0882$</td></tr>
<tr><td>$0.0271 < c \leq 0.0305$</td><td rowspan="3">Hosokawa</td><td rowspan="3">Hosokawa</td><td rowspan="3">Hosokawa</td></tr>
<tr><td>$0.0236 < c \leq 0.0271$</td><td rowspan="2">I</td></tr>
<tr><td>$0.0216 < c \leq 0.0236$</td></tr>
<tr><td>$0.0091 < c \leq 0.0216$</td><td rowspan="3">B, C, D, E</td><td rowspan="3">E
Hosokawa</td><td rowspan="3">D
Hosokawa</td><td rowspan="3">B
Hosokawa</td></tr>
<tr><td>$0.0060 < c \leq 0.0091$</td></tr>
<tr><td>$0.0050 < c \leq 0.0060$</td></tr>
<tr><td>$c \leq 0.0050$</td><td>†</td><td>†</td><td>†</td><td>†</td></tr>
</table>

<table>
<tr><th>First Proposer</th><th>JNP</th><th>DSP</th><th>Sakigake</th></tr>
<tr><td>$0.1206 < c$</td><td rowspan="4">B
Hosokawa</td><td rowspan="2">–</td><td rowspan="3">–</td></tr>
<tr><td>$0.0995 < c \leq 0.1206$</td></tr>
<tr><td>$0.0882 < c \leq 0.0995$</td><td rowspan="8">Hosokawa</td></tr>
<tr><td>$0.0305 < c \leq 0.0882$</td><td rowspan="7">Hosokawa</td></tr>
<tr><td>s $0.0271 < c \leq 0.0305$</td><td rowspan="3">Hosokawa</td></tr>
<tr><td>$0.0236 < c \leq 0.0271$</td></tr>
<tr><td>$0.0216 < c \leq 0.0236$</td></tr>
<tr><td>$0.0091 < c \leq 0.0216$</td><td rowspan="3">B
Hosokawa</td></tr>
<tr><td>$0.0060 < c \leq 0.0091$</td></tr>
<tr><td>$0.0050 < c \leq 0.0060$</td></tr>
<tr><td>$c \leq 0.0050$</td><td>†</td><td>†</td><td>†</td></tr>
</table>

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