A Noncooperative Foundation for Political Parties*

Yoshifumi Yokota†

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Abstract

This paper will provide a microfoundation for political parties. Political parties play important roles in democratic political institutions. However, members' incentive to maintain the discipline of parties have not been analyzed enough. A party partition can be modeled as a coalition structure associated with the core of underlying simple games. Following the Nash program, we construct a game form whose equilibria coincide with the core from implementation theoretic perspective. We consider the simple legislative bargaining game widely used in political economics and political science. This game form will prove to be an inadequate noncooperative foundation. We propose a bidding mechanism, and show this mechanism implements the core in subgame perfect equilibrium. The bidding mechanism suggests that internal adjustments and competitions for the leadership are important to achieve cooperation within parties.

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†Graduate School of Political Science, Waseda University, 1-6-1, Nishi-Waseda, Shinjuku-ku, Tokyo, 169-8050, Japan. E-mail: yoshi-yo@asagi.waseda.jp.

1 Introduction

Political parties play central roles in analyzing strategic interactions in legislative bodies such as the formations of coalitional governments(see, for example, Austen-Smith and Banks (1988), Merlo (1997), Baron (1998), Baron and Diermeier (2001), and Diermeier, Eraslan, and Merlo (2003)). These models predict not only governing coalitions, but also policy outcomes. Although these models treat the political party as an unitary actor, the incentives for an individual member of parties to follow the discipline of parties and cooperate within parties are not analyzed in these papers. In other words, microfoundations for political parties are absent in these analysis. This paper tries to provide a microfoundation of political parties. In the following sections, we define a political party as a binding agreement. Thus, political parties are modeled as the partition of agents or so called "coalition structure" associated with the core of simple games. To analyze the incentive of members of political parties, we have to construct a game form whose equilibria coincide with the core. Therefore, this paper relates the literatures in game theory called Nash program initiated by Nash (1953). However, our approach is different from the traditional approach and based on implementation theory.

First, we consider a legislative bargaining protocol originating from Baron and Ferejohn (1989). We show this game form cannot provide a noncooperative foundation for political parties. Some of the element of the core are not realized as the equilibrium outcomes, and there are equilibria which is not in the core. Second, we construct a mechanism using a bidding for the status of the proposer or the leader of the legislature. This bidding mechanism prove to implement the core in subgame perfect equilibrium.

Our problem is also interesting from an empirical point of view. It is widely recognized that the effectiveness of political parties varies across countries. For example, in the parliamentary systems, political parties seem to have strong discipline and legislators vote along party lines on many occasions. In the presidential systems, however, it is not exceptional for a legislator from one party vote along with another parties' legislators on important bills. As I will mention in detail later, we can explain these differences by providing a microfoundation for political parties.

When members of a political parties have incentive to maintain the discipline of their parties and vote along party lines, this party can be said to be effective, or "self-enforceable". In the following sections, we provide a microfoundation for political parties. In other words, we search the conditions that political parties is self-enforceable.

The paper is organized as follows: Section 2 describes how we define political parties, section 3 summarizes related literatures, Section 4 sets the model and defines the underlying simple games and its core, Section 5 discusses a simple legislative bargaining protocol as a noncooperative foundation for political parties, Section 6 reinterpret the Nash program from the implementation theoretic perspective, Section 7 proposes a bidding mechanism to implement the core, Section 8 contains concluding remarks.

2 Political Parties as Binding Agreements and the Nash Program

Throughout this paper, we regard parties as binding agreements. In this section, we argue that political parties cannot be modeled effectively without assuming that they are binding agreements.

In a very influential article, Krehbiel (1993) insists we must distinguish the "party behavior" and the "party like behavior". Consider the following situation. There are two alternatives. The policy space is unidimensional, and alternatives can be ordered linearly. Suppose "left" legislators unanimously vote for an alternative and "right" legislators vote for the other one in equilibrium. This phenomenon seems to be a "party behavior", i.e. all individual members of a party follow the discipline. According to Krehbiel, however, this is a "party like behavior". This is because preferences of legislators naturally generate this voting pattern, which is independent of the existence of the parties. Thus, political parties have no effect on the decision making in this situation. His argument means "party behavior" is more than equilibrium phenomenon in noncooperative game theoretic models

To avoid the Krehbiel (1993)'s critique, we must assume that the agreements or contracts are binding within the political parties. Members of the parties coordinate their behavior because of the binding agreements. Hence, it is natural to formulate the games of party formation as cooperative games, which assume agreements among agents can be binding. A class of games called simple games plays important roles in political environments, so political parties can be described as coalitions associated with a solution concept of simple games.

However, cooperative games are inadequate to analyze how political parties can be self-enforceable because strategic interactions of agents are not explicit and we cannot understand how the cooperative solutions are realized in these models.

While members' incentives to follow the discipline of parties cannot be analyzed by cooperative games, the noncooperative models of party formation[1] cannot avoid the Krehbiel (1993)'s critique. This is partly because none of these models assume bindingness of agreements explicitly. However, if the equilibrium outcomes of the model are consistent with the outcomes of cooperative games[2], this model can avoid the Krehbiel (1993)'s critique. Unfortunately, the existing literatures fail to pass this criterion although they do not investigate the relationship between the equilibrium outcomes of their model and the cooperative solutions. These models are based on Baron and Ferejohn (1989)'s bargaining model. In the section 5, we show the equilibrium outcomes of this bargaining model are independent of the cooperative solution called "core" of simple games.

There is a notable exception. Jackson and Moselle (2002) develop the Krehbiel's argument, and regard political parties as binding agreements. They use legislative bargaining game based on Baron and Ferejohn (1989) in analyzing the formation of political parties. In their model, legislators gain from

[1]See, for example, Morelli (2004). We cited the models of the government formation in the introduction, and you can also consult these models. This is because the structure of models are same and we can interpret both models as the models of coalition formation in political environments.

[2]There is a long tradition in which the games of coalition formation are formulated as cooperative games. In political environments, Riker (1962) is the seminal work.

forming political parties relative to the payoff determined in the bargaining game and divide surplus in cooperative manner. They adopt the Nash bargaining solution and predict how parties are formed in a three legislators case. The difference between this paper and Jackson and Moselle (2002) is that they do not analyze the incentives of individual members of parties to cooperate.

Our next problem is which solution concept we adopt. To determine the solution concept, we have to consider stability of political parties. From my perspectives, there are two crucial features of the stable parties. If a political party is stable, no coalition of legislators has incentive to deviate from the current party system and create a new party. This is our first feature. It is worth noting this property also excludes any deviation of individual legislators. Second, all legislators vote along the party lines in the stable party system. The core, which is well known and the most popular solution concept, reflects these feature naturally. Therefore, we treat political parties as coalitions generated by the core of an underlying simple game.

We concentrate on the legislator's incentive to maintain the discipline of parties in the legislative decision making, and ignore the effect of elections. Cox (1986) argues, in the 19th century England, members of parliament became to vote along the party line in the parliament before party-oriented voting behaviors were established in elections(see also Cox (1987)). Historically, political parties emerged in the legislative bodies in many countries. Our analysis can be justified by this historical facts.

3 Related Literatures

As I mentioned in the previous section, economists and political scientists have taken political parties for granted when they analyze interactions in politics. A notable exception I cited earlier is Jackson and Moselle (2002). There are also other exceptions and these papers analyze the problem of party formation. Levy (2004) argues political parities increase the range of policies to which an individual candidate can commit in elections, and candidates use the party to propose her electoral platform in equilibrium when the policy space is multidimensional. Morelli (2004) also considers party formation in the electoral settings, and analyze effects of alternative electoral rules. Roemer (1999) considers the electoral competitions among political parties. Instead of assuming parties as unitary actors, he construct the model reflecting the fact that several fuctions conflict within parties. Roemer proposes the new equilibrium concept called party unanimity Nash equilibrium, and proves the existence of the equilibrium in the two dimensional electoral competitions.

The noncooperative foundations for the cooperative solutions of simple games have not investigated enough. However, Anesi (2010) shows markov perfect equilibria of the legislative bargaining game coincide with the von Neumann-Morgenstern stable sets of the underlying simple games.

Acemoglu, Egorov, and Sonin (2008) combines the axiomatic analysis and the noncooperative game theoretic model in analyzing coalition formations in nondemocratic political regimes. Their approach is similar to ours and inspire our analysis.

In economic environments, there are enormous articles investigating the noncooperative foundations for the core. Wilson (1978) formulates the process of exchange as a competitive bidding game and shows the Nash equilibrium of the game yields an allocation in the core. Chatterjee, Dutta, Ray, and Sengupta (1993) consider a n-person coalitional bargaining based on Rubinstein (1982). In their model, any payoff vector in the core is the outcome of some stationary subgame perfect equilibrium of the game, but there are other "inefficient" equilibria which is not in the core. Perry and Reny (1994) discuss the n-person coalitional bargaining game in continuous time and prove stationary subgame perfect equilibria of such game coincide with the core. From the implementation theoretic view, Serrano and Vohra (1997) propose a simple mechanism which implements the core in subgame perfect equilibrium. Evans (1997) construct the n-person coalitional bargaining procedure in which agents make bids to become a proposer, and show stationary subgame perfect equilibria of the game coincide with the core. A similar bidding mechanism is used by Pérez-Castrillo and Wettstein (2001) in order to implement the Shapley values in subgame perfect equilibrium.

4 The Environment

In the following sections, we will construct two game forms in the following environment.

4.1 Notations and Preferences

There are n agents(legislators). Let N denote the set of agents, $N = \{1, ..., i, ..., n\}$.

We consider general environments of the public decision making. Hence, we adopt the formulation of Jackson and Moselle (2002). There are two dimensions of decisions. One is "ideological" decision and the other is "distributive" decision. We can interpret the former as public goods provision and the latter as distribution of private goods or porks. Volden and Wiseman (2007) also adopt the same framework. Therefore, we can formulate the decision or outcome as a vector $(y, x_1, ..., x_n)$. The set of alternatives or outcomes is denoted by $A = [0, 1] \times \mathbb{R}^n_+$. y represents the decision on the ideological dimension. The set of feasible ideological decisions is $[0, Y]$, where $Y \in [0, 1]$. x_i represents the decision on the distributive dimension, where $x_i \geq 0$, $\Sigma_i x_i \leq X$, and $X \geq 0$. If $Y = 0$, the model simplifies to that of purely distributive model a là Baron and Ferejohn (1989). If $X = 0$, the model is the same as simple models of the public decision about one-dimensional public goods provision.

Preferences of each agents are represented by a utility function u_i: $[0, 1] \times \mathbb{R}_+ \to \mathbb{R}$. Thus, the utility function depends only on the public decision, y and her own component of the distributive decision, x_i. The utility function $u_i(y, x_i)$ is continuous, quasi-concave, strictly increasing at x_i for every y. We assume the preference of each agent i over the ideological dimension is separable from the distributive dimension[3]. In other words, for any $(y, (x_i)_{i \in N})$

[3]Even if we remove this assumption, the main result (our theorem) still holds. However, the assumption of separability seems reasonable in the political environment

and $(y', (x'_i)_{i \in N})$, $u_i(y, x_i) > u_i(y', x'_i)$ if and only if $u_i(y, x'_i) > u_i(y', x'_i)$. We also assume the preference of each agent over y is single peaked for every x_i. The peak is denoted $\hat{y}_i$. We denote the profile of the utility functions $\mathcal{U}$.

4.2 Simple Games and the Core

As an underlying structure, we consider the class of games called simple games[4]. This is because simple games, sometimes called voting games, have been widely used in analyzing voting since Shapley (1962).

We define the family of coalitions $\mathcal{N}$; $\mathcal{N} \equiv 2^N \setminus \emptyset$. Each element of $\mathcal{N}$ is referred to as a coalition. A simple game is represented by $(N, \mathcal{W})$, where $\mathcal{W}$ is the family of winning coalitions, $\mathcal{W} \subseteq \mathcal{N}$. For example, if we use the simple majority rule, for any $S \in \mathcal{W}$, $|S| \geq \frac{|N|+1}{2}$, where $|S|$ is the cardinality of the coalition S.

We impose the two standard assumptions in the literature. First, we assume a simple game is monotonic: For all $S \in \mathcal{W}$, if $S \subset T$, then $T \in \mathcal{W}$. A simple game is proper: If $S \in \mathcal{W}$, then $N \setminus S \notin \mathcal{W}$. In the following, we consider monotonic and proper simple games.

We can define political parties and partition of agents to parties as follows.

Definition 1. A party partition π is a (finite) partition of the agents N

$$\pi = (P_1, ..., P_m), P_k \in \mathcal{N}. \tag{1}$$

We denote the set of party partitions Π.

[4]Austen-Smith and Banks (2000) provides a comprehensive survey of the literature in their Chapter 3.

The party partition corresponds the coalition structure in the standard literatures of cooperative game theory. Hence, the feasible alternatives for the party P_k is defined as follow.

$$A_{P_k} = \begin{cases} A \ (P_k \in \mathcal{W}) \\ \emptyset \ (P_k \notin \mathcal{W}) \end{cases} \tag{2}$$

Parties or coalitions which is winning can impose any alternatives, but parties which is not in the family of winning coalitions can impose nothing.

Now, we can define the core of an underlying simple game. First we introduce the concept of a blocking party.

Definition 2. Party P_k blocks the alternative $(y(\pi^*), x_i(\pi^*)_{i\in N})$ if and only if there exists an alternative $(y'(P_k), (x'_i(P_k))_{i\in N}) \in A$,

$$u_i(y'(P_k), (x'_i(P_k))_{i\in N}) > u_i(y(\pi^*), x_i(\pi^*)_{i\in N}), \forall i \in P_k \tag{3}$$

The Party P_k is called a blocking party.

The core of the simple game $(N, \mathcal{W})$ is defined as alternatives which no parties in the family of winning coalitions $\mathcal{W}$ blocks. A formal definition is as following.

Definition 3. The core of a simple game $(N, \mathcal{W})$ is $C(N, \mathcal{W})$ such that,

$$C(N, \mathcal{W}) = \{((y(\pi^*), x_i(\pi^*)_{i\in N}) \in A| \ \nexists P_k \in \mathcal{W} \text{ blocking } (y(\pi^*), x_i(\pi^*)_{i\in N})\} \tag{4}$$

Notice that for each alternatives in the core, there exists a party partition yielding this alternative, where one party is a winning coalition and supports the alternative, but other parties are not winning and do not support the alternative. Thus, for any alternatives in $C(N, \mathcal{W})$, there exists a corresponding party partition. Hence, we denoted $(y(\pi^*), (x_i(\pi^*))_{i \in N})$ in the previous. It is worth noting that the core is a straightforward formulation of our definitions of the stable parties.

5 The Legislative Bargaining

At first, we consider a bargaining protocol so called “legislative bargaining”. This protocol is proposed by Baron and Ferejohn (1989). They call the protocol “the closed rule”. In the literature investigating the legislative decision making, the closed rule is simply referred as the legislative bargaining. There are two reasons to adopt the legislative bargaining protocol. The legislative bargaining games are widely used in political economics and political science since Baron and Ferejohn (1989). The second reason is the bargaining protocols provide natural stories behind the core(see Perry and Reny (1994)).

Baron and Ferejohn applied an alternating-offer bargaining model initiated by Rubinstein (1982) to the n-person decision making in legislatures. Jackson and Moselle (2002) and Volden and Wiseman (2007) establish the existence of equilibrium, and analyze the equilibrium outcomes(i.e. the level of provision of public goods in equilibrium, or division of private goods or porks in equilibrium) in the environment similar to ours. In the paper investigating a noncooperative foundation for von Neumann-Morgenstern stable sets of simple games, Anesi (2010) shows equilibria of the legislative bargaining game coincide with von Neumann-Morgenstern stable sets.

The legislative bargaining protocol is described as follow. (i) In each period $t = \{1, 2, ...\}$, an agent i is "recognized" and selected as a proposer with the probability $\rho_i > 0$. This agent i makes a proposal $(y, (x_i)_{i \in N}) \in A$. (the proposal stage) (ii) All agents vote simultaneously on the proposal. If all agents in some winning coalition vote "yes" to the proposal, the proposal will be the outcome and the game ends. If all agents in any winning coalition vote "no", the game continues to the next period. (the voting stage) (iii) The bargaining game is repeated infinitely.

Let {yes} denote the vote to approve a proposal, {no} the vote to reject the proposal. Let

$$P = \{(y, (x_i)_{i \in N}) | y \in [0, Y], \Sigma_{i \in N} x_i \leq X\} \tag{5}$$

denote the set of feasible proposals.

A *history* h, up to the period t is a n-tuple functions $h = (h_1, h_2, ..., h_n)$ where for each i, h_i: $(0, 1, ..., t-1, t) \rightarrow P \cup \{\text{yes}, \text{no}\}$. $h(t)$ stands for the history of the game up to the period t, the set of all actions taken by agents before period t. $H(t)$ denote the set of all histories up to the period t. $H = \cup_{t=0}^{\infty} H(t)$ is the set of all histories. Let $p(h) \in P$ denote the current proposal according to h.

Probability of "recognition": For each agent i, ρ_i is positive($\rho_i > 0$). $\rho = (\rho_1, \rho_2, ..., \rho_n) \in \Delta$, the unit simplex in $\mathbb{R}^n$. $\Sigma_{i \in N} \rho_i \leq 1$.

Payoffs: When a proposal $(y, (x_i)_{i \in N})$ is approved by all agents in some winning coalition, each agent receives $u_i(y, x_i)$. If all members in any winning coalition doesn't reach agreement, each agent receives the zero payoff($u_i(y, x_i) = 0$). Agents discount the utilities they receive in future using a common discount factor δ, where $\delta \in [0, 1]$. Therefore, agent i's continuation value V_i can be written by $V_i = \delta \Sigma_{j \in N} \rho_j u_i(y, x_i)$ for each period.

Strategies: A strategy m_i: $H \rightarrow P \cup \{\text{yes}, \text{no}\}$ specifies agent i's action for each history. Let $\mathcal{M}_i$ denote the set of admissible strategies for agent i. We can write $m_i = (p_i, v_i)$, where $p_i \in A$ stands for a strategy in the proposal stage, $v_i = \{\text{yes}, \text{no}\}$ is a strategy in the voting stage. m denotes a strategy profile of all agents. $\mathcal{M}$ denotes the set of all admissible strategy profiles.

Now, we can define the legislative bargaining game Γ as $\Gamma = (N, A, \mathcal{M}, \mathcal{U}, H)$. We consider stationary subgame perfect equilibrium of Γ. Let $SSPE(\Gamma)$ denote the set of stationary subgame perfect equilibrium outcomes of Γ.

Definition 4. A strategy profile $m^* = (m_1^*, m_2^*, ..., m_n^*)$ is a stationary subgame perfect equilibrium if

(1) Subgame perfection: For all $i \in N$ and for all $h \in H$

$$u_i(m^*|h) \geq u_i(m_i, m_{-i}^*|h) \text{ for all } m \in \mathcal{M} \tag{6}$$

(2) Stationarity of strategies: Let h and h' be two distinct histories. Regardless of the histories, agents adopt the same strategy when the current proposal is same, $p(h) = p(h')$, the set of agents who may be choosen to propose in the next period is same, the strategy set of agents is same, $\mathcal{M}_i(h) = \mathcal{M}_i(h')$ for all i.

Baron and Ferejohn (1989) discuss why the stationarity is important in the infinitely repeated legislative bargaining games. Hart and Mas-Colell

(1996) provide more precise arguments about stationary strategies in the infinitely repeated bargaining games.

To provide the noncooperative foundation of the underlying simple games, we have to show $SSPE(\Gamma) = C(N, \mathcal{W})$. However the legislative bargaining protocol does not provide the noncooperative foundation as stated in the following proposition.

Remark 1. $SSPE(\Gamma)$ is logically independent of $C(N, \mathcal{W})$

We show this remarks by making the following two remarks and showing two counterexamples.

Remark 2. Not every allocation in the core can be supported as a stationary subgame perfect equilibrium outcomes of the legislative bargaining game Γ. $((y, (x_i)_{i \in N}) \in C(N, \mathcal{W}) \not\Rightarrow (y, (x_i)_{i \in N}) \in SSPE(\Gamma))$

Example 1. [5] *Let* $X = 1$, $Y = 0$, $N = \{1, 2\}$, $|S| = 2$, $\forall S \in \mathcal{W}$ *and* $\rho_i = \frac{1}{2}$, $i = 1, 2$. *Consider an allocation (or alternative)* $(x_1, x_2) = (1, 0)$. *We show* $(1, 0) \in C(N, \mathcal{W})$. *Under the unanimity rule, there is no winning coalition (or party) which blocks* $(1, 0)$. *In other words, no alternative can improve the payoff of two agents simultaneously. Then* $(1, 0) \in C(N, \mathcal{W})$ *by definition.*

Now we consider the bargaining protocol. The bargaining protocol is the same as Rubinstein (1982)'s two person alternating offer bargaining. Agent i approve the current proposal (x_1, x_2) *if the payoff from the proposal is larger than the continuation values. That is,*

$$u_i(x_i) \geq V_i \tag{7}$$

[5] This example is suggested by Tsuyoshi Adachi.

According to Rubinstein (1982), the continuation value V_i is $\frac{1}{2}\delta$. Suppose the current proposal $(x_1, x_2) = (1, 0)$. By the argument above, agent 2's optimal strategy is rejecting the proposal. Thus, an allocation $(1, 0)$ cannot be an outcome of stationary subgame perfect equilibrium.

Remark 3. Not every stationary subgame perfect equilibrium outcome of the legislative bargaining game Γ is in the core. $((y, (x_i)_{i \in N}) \in SSPE(\Gamma) \not\Rightarrow (y, (x_i)_{i \in N}) \in C(N, \mathcal{W}))$

Example 2. *Let $X = 1$, $Y = 0$, $N = \{1, 2, 3\}$, $|S| \geq 2$, $\forall S \in \mathcal{W}$ and $\rho_i = \frac{1}{3}$, $\forall i \in N$. Therefore, we use the majority rule, and our bargaining protocol is the same as Baron and Ferejohn (1989)'s "closed rule". Baron and Ferejohn (1989) show an allocation $(1 - \frac{\delta}{3}, \frac{\delta}{3}, 0)$ can be supported as a stationary subgame perfect equilibrium. In this equilibrium, the proposer distribute $\frac{\delta}{3}$ to agent 2, the rest of the good to herself, and nothing to agent 3. This allocation can be sustained as equilibrium outcome because the continuation value for each agent $V_i = \frac{\delta}{3}$ and approval of majority of agents (two agents) is sufficient. However, the allocation $(1 - \frac{\delta}{3}, \frac{\delta}{3}, 0)$ is blocked by $(0, 1 - \epsilon, \epsilon)$, $\epsilon < \frac{\delta}{3}$ and a winning coalition (party) $P_k = \{2, 3\}$. In the new allocation, agents who are distributed nothing in equilibrium receive ϵ and agent 2 receive $1 - \epsilon > \frac{\delta}{3}$. This new allocation improve the payoff of all agents in P_k (agent 2 and agent 3), and $|P_k| = 2$. Thus, P_k blocks the equilibrium outcome and $(1 - \frac{\delta}{3}, \frac{\delta}{3}, 0) \notin C(N, \mathcal{W})$.*

Volden and Wiseman (2007)[6] shows equilibrium of the legislative bargaining game always exists. Proposition 2. in Jackson and Moselle (2002)

[6]The utility function is more specific in their model. However, their utility function satisfies the same assumption we impose in this paper.

also tells us equilibrium of Γ exists in broad environments. On the other hand, the core of underlying simple games may not exist. Dummett and Farquharson (1961) and Plott (1967) show the conditions for the game to have a non-empty core under the majority rule.

The legislative bargaining protocol cannot provide noncooperative foundation for political parties because there are core allocations which are not supported as the equilibrium outcomes. More importantly, there are equilibrium outcomes which are not the element of the core of underlying simple games. In other words, the legislative bargaining game has equilibria in which individual members of given political parties do not maintain the discipline of parties and cooperate.

6 The Nash Program and the Implementation Theoretic Approach

The purpose of the Nash program is to construct a game form whose equilibria coincide with a given cooperative solution. Implementation theory[7] seems to share this purpose because it attempts to construct a game form which achieve socially desirable outcomes represented by social choice correspondences as noncooperative equilibrium outcomes. However, the traditional approach taken by the literature in the Nash program is different from that of implementation theory. In the traditional literature, noncooperative game

[7]Implementation theory is initiated by Hurwicz (1972), Hurwicz (1973), Dasgupta, Hammond, and Maskin (1979), and Maskin (1999). Moore (1992), Jackson (2001), Maskin and Sjöström (2002), and Serrano (2004) provide the excellent survey of the implementation theory.

theoretic models are built directly on the coalitional functions, which assign payoff vectors to the members of given coalitions. That is, these papers construct the game forms whose equilibrium outcomes agree with the payoff vector in a given cooperative solution. Thus, their results depend on the preferences of agents.

If our purpose is providing the credible noncooperative foundations, it is better to construct the game forms whose equilibrium outcomes coincide with cooperative solutions independently of the individual preferences, that is, for all individual preferences. There are several papers which argue that implementation theory is the best way to achieve the goal of the Nash program. Their arguments are as follow. To achieve the purpose, we have to explicitly model physical outcomes and individual preferences at first. Instead of the payoff vectors, cooperative solutions must be defined in terms of outcomes. In other words, cooperative solutions are regarded as a kind of social choice correspondences, which is the mapping from the profile of individual preferences to the set of alternatives. Finally, we have to construct the game form which is independent of individual preferences, and implements a given cooperative solution. Serrano (1997), Bergin and Duggan (1999), and Trockel (2002) consider the implementation theoretic approach in detail.

We have already adopted the implementation theoretic approach in the previous sections [8]. Our method of modeling satisfies the features of the implementation theoretic approach described above.

Our ultimate goal is to construct a game form fully implementing the

[8]In Section 3, we use an infinitely repeated game. Kalai and Ledyard (1998) and Jackson and Palfrey (2001) precisely discuss about the implementation using repeated game forms. See also Jackson and Palfrey (1998).

core of simple games. We have to investigate not only the implementability of the core, but also the stories behind the core. Since the core conceptualize the negotiation or bargaining among the agents, we have to model the process of negotiation explicitly. This process involves a dynamic aspect, that is, an action of one agent or set of agents and the counter-action of other agents. Therefore, we will construct the mechainsm(i.e. game form) which implements the core in subgame perfect equilibrium[9]. In the next section, we propose the mechanism combining the bidding for the status of the proposer and voting, and show this mechanism fully implements the core in subgame perfect equilibrium.

7 The Bidding Mechanism

Our bidding mechanism is an extensive form mechanism. An extensive form mechanism is an array $\bar{\Gamma} = (N, \mathcal{M}, K, P, U, C, g)$. N is the set of agents as previous. $\mathcal{M}$ is the set of all admissible strategy profiles of agents. K stands for the game tree or the set of nodes with the initial node n_0. The set of non-terminal nodes is denoted by T. P, U, and C are the player, the information and the choice partition, which assign to each non-terminal node $t \in T$ the player who move, the information set, and the possible choice respectively. Let Z denote the set of the terminal nodes. g is a function from Z into A, that is, g is the outcome function which associates the outcome to each

[9]Moore and Repullo (1988) and Abreu and Sen (1990) are the pioneering articles about the implementation in subgame perfect equilibrium. These papers investigate the implementation of social choice correspondences in general, and search the condition under which social choice correspondences are implementable. Vartiainen (2007) fully characterize the social choice correspondences implementable in subgame perfect equilibrium, that is, find a necessary and sufficient condition for implementability.

terminal node or each pass through the game tree.

We can define the bidding mechanism $\bar{\Gamma}$ as follow. The mechanism consists of three stages.

Stage 1: Each agent $i \in N$ makes bids. $b^i = (b^i_1, ..., b^i_{i-i}, b^i_{i+1}, ..., b^i_n) \in \mathbb{R}^{n-1}$. For each $i \in N$, let $B^i = \Sigma_{j \neq i} b^i_j - \Sigma_{j \neq i} b^j_i$. Let $k = \arg\max_i(B^i)$. This agent k become the proposer. In other words, an agent whose net bids are highest are chosen as the proposer. Once chosen, agent k pay b^k_i to every player $i \neq k$. If several agents make the highest net bids, an agent k is randomly chosen as the chairman among them. At the same time, each agent reveals one alternative $(y^i, (x^i_j)_{j \in N})$ from A. To simplify the notation, let $(y^i, (x^i_j)_{j \in N}) = (y^i, x^i)$ in the following. Thus, the admissible strategy set for each agent is $A \times \mathbb{R}^{n-1}$ in this stage. If there exist distinct agents i, j such that $(y^i, x^i) \neq (y^j, x^j)$ in all winning coalitions, the game ends and the negotiation collapses. In this outcome, there is no public goods provision and nothing is allocated to the agents. The payoff from this outcome becomes zero (i.e. $u_i(g(m)) = 0$ for all i). Hence, proposer k receives $-\Sigma_{i \neq k} b^k_i$, and each agent $i \neq k$ receives b^k_i when the bid of the proposer $\Sigma_{i \neq k} b^k_i \neq 0$ $(b^k \neq (0, ..., 0))$. When $\Sigma_{i \neq k} b^k_i = 0$, i.e. $b^k = (0, ..., 0)$, proposer k pays ϵ for the other agents. Thus, k receives $-\epsilon$, and each agent i receives $\frac{\epsilon}{n-1}$. If $(y^i, x^i) = (y^j, x^j) = (y^*, (x^*_i)_{i \in N})$ for each i, j in some winning coalition, proceed to the stage 2.

Stage 2: An agent chosen as the chairman, k, propose an alternative $(\hat{y}, (\hat{x}_i)_{i \in N})$ Thus, the set of admissible strategy in this stage is A.

Stage 3: Every agent votes on the proposal. If every agent in some winning coalition S approve the proposal, the proposal will be the outcome and the game ends. That is, the final outcome is $(\hat{y}, (\hat{x}_i)_{i \in N})$. If some agent in all winning coalitions opposes the proposal, the outcome become $(y^*, (x_i^*)_{i \in N})$, and the game ends. Thus, each agent $i \neq k$ receives $x_i - b_i^k$ while agent k receives $x_k + \Sigma_{i \neq k} b_i^k$ in this stage.

This mechanism determines a proposer endogenously by using the bidding stage. Based on the well-known divide-and-choose procedure, Crawford (1979) also uses a bidding stage to determine a divider and shows his procedure generates Pareto efficient and egalitarian equivalent allocations. Evans (1997) and Pérez-Castrillo and Wettstein (2001) use a similar bidding stage to construct the game form whose equilibria coincide with given cooperative solutions.

Our mechanism imposes a punishment on the proposer when revelations of agents are not same in all winning coalitions and the proposer k makes zero bid (i.e. $b^k = (0, ..., 0)$). This punishment can be interpreted as follow. When legislators fail to coordinate agendas, the proposer, regarded as the chairman or the leader, takes the blame and must pay some small amounts of money to other legislators. This is a natural interpretation. In fact, if the proposer makes positive bids and agents fail to coordinate agendas, the agent chosen as the proposer have to pay promised bid to other agents. This transfer can be interpreted as a punishment.

Now define $\Gamma^2 = (\bar{\Gamma}, \mathcal{U})$ to be the bidding game. We consider subgame perfect equilibrium of Γ^2.

Definition 5. A subgame perfect equilibrium of a game Γ^2 is a strategy profile $m^* \in \mathcal{M}$ such that for all $t \in T$ and for all $i \in N$,

$$u_i(g(m^*); t) \geq u_i(g(m'_i, m^*_{-i}); t)$$

for all $m'_i \in \mathcal{M}_i$.

Let $SPE(\Gamma^2)$ the set of all subgame perfect equilibria of Γ^2.

We will show the equilibria of Γ^2 coincide with the core of underlying simple games.

Theorem 1. *The bidding mechanism* $\bar{\Gamma}$ *implements the core* $C(N, \mathcal{W})$ *in subgame perfect equilibrium.*

Proof. It is sufficient to show $SPE(\Gamma^2) = C(N, \mathcal{W})$. First, we will prove if some alternative $(y^*, (x^*)_{i \in N}) \in C(N, \mathcal{W})$, then $(y^*, (x^*)_{i \in N}) \in SPE(\Gamma^2)$.

Consider the following strategy profile $m^* \in \mathcal{M}$.

(i) Every agent i reveals $(y^*, (x^*_i)_{i \in N})$ and makes zero bids(i.e. $b^i = (0, ..., 0)$) in the stage 1

(ii) An agent k who is chosen as the proposer propose $(y^*, (x^*)_{i \in N})$ in the stage 2

(iii) Every agent i votes $\{\text{yes}\}$ on the proposal (y', x'_i) if and only if $u_i(y', x'_i) > u_i(y^*, x^*_i)$ and votes $\{\text{no}\}$ otherwise in the stage 3.

It is easy to check m^* always generates $g(m^*) = (y^*, (x^*_i)_{i \in N}) \in C(N, \mathcal{W})$. We have to check m^* constitutes subgame perfect equilibrium.

It is easy to check m^* is the best response in the stage 3, that is, m^* conforms to subgame perfection in all subgame starting at a node where a proposal has to be responded to. Since $(y^*, (x^*_i)_{i \in N}) \in C(N, \mathcal{W})$, no agent can propose an objection to $(y^*, (x_i^*)_{i\in N})$ in the stage 2. In other words, consider deviation from m^* in the stage 2 and a proposer propose some $(y', x_i') \notin C(N, \mathcal{W})$. This proposal cannot be accepted in the following stage by the definition of the core. Thus, the final outcome is (y^*, x_i^*). Therefore, the deviation from m^* is not profitable. Hence, m^* conforms to subgame perfection in all subgame starting at a node where an agent has to make a proposal. Finally, no agent can gain from revealing $(y', x_i') \neq (y^*, x_i^*)$. If an agent who is a member of the winning coalition supporting (y^*, x_i^*) deviates from m^*, the deviation generates the outcome in which the negotiation collapses and the proposer i receives $-\epsilon$ and the other agents receive $\frac{\epsilon}{n}$. Because $(y^*, x_i^*) \in C(N, \mathcal{W})$ and ϵ is arbitrary small, this deviation is not profitable. For all agents who is not a member of the winning coalition, the final outcome is (y^*, x_i^*) whatever her revelation is. Thus, the deviation is not profitable for all agents. Changing the amount of bids is not also profitable. If an agent i increases her bids, she can be the proposer. However, the final outcome is (y^*, x_i^*) whatever her proposal is. Therefore, m^* is subgame perfect equilibrium and $g(m^*) = (y^*, x_i^*) \in C(N, \mathcal{W})$. Then $(y^*, x_i^*) \in C(N, \mathcal{W}) \Rightarrow (y^*, x_i^*) \in SPE(\Gamma^2)$

We proceed to show that if any strategy profile $\bar{m} \in \mathcal{M}$ is subgame perfect equilibrium of Γ^2, then $g(\bar{m})$ is in the core of underlying simple games. Let $g(\bar{m}) = (\bar{y}, (\bar{x}_i)_{i\in N})$. Let $(y^i, (x_j^i)_{j\in N}, b^i) = (y^i, x^i, b^i)$ denote the strategy of agent i in the stage 1. We prove by series of claims:

Claim 1. $(y^i, x^i) = (\tilde{y}^i, \tilde{x}^i)$ for all i in some winning coalition and $B^i = B^j$ for all i, j (i.e. $B^i = 0$ for all i).

Proof of Claim 1. Suppose to the contrary, $(y^i, x^i) \neq (y^j, x^j)$ for distinct

i, j in all winning coalitions or $B^i \neq 0$ for some agent i. There are three cases.

Case 1. $(y^i, x^i) \neq (y^j, x^j)$ for distinct i, j in all winning coalitions and $B^i \neq 0$ for some agent i. Let $\bar{B}$ denote the highest net bids, and $N(\bar{B})$ denote the corresponding set of agent. In other words, $N(\bar{B}) = \{i \in N | B^i = \max_j(B_j)\}$. Some agent $i \in N(\bar{B})$ is chosen as a proposer randomly, and her final payoff is $u_i(-\Sigma_{j\neq i} b^i_j)$. Thus, any agent $i \in N(\bar{B})$ can improve her payoff without changing the set $N(\bar{B})$ by reducing the total amount of her bids as follow. Let agent $i \in N(\bar{B})$ change her strategy by making bids $b'^i_k = b^i_k + \epsilon$ for all $k \in N(\bar{B})$, $b'^i_j = b^i_j - |N(\bar{B})|\epsilon$ for some $j \notin N(\bar{B})$, and $b'^i_l = b^i_l$ for all $l \notin N(\bar{B})$ and $l \neq j$. The net bids become $B'^i = B^i - \epsilon$, $B'^k = B^k - \epsilon$ for all $k \in N(\bar{B})$ and $k \neq i$, $B'^j = B^j + |N(\bar{B})|\epsilon$, and $B'^l = B^l$ for all $l \notin N(\bar{B})$ and $l \neq j$. Since ϵ is small enough, so that $B^j + |N(\bar{B})| < B^i - \epsilon$, $B'^l < B'^i = B'^k$ for all $l \notin N(\bar{B})$ including j and for all $k \in N(\bar{B})$. Therefore, $N(\bar{B})$ does not alternate and $\Sigma_{j\neq i} b^i_j - \epsilon < \Sigma_{j\neq i} b^i_j$. Thus, any agent $i \in N(\bar{B})$ can obtain the higher expected utilities while the probability to be a proposer is the same, which contradicts the hypothesis that $\bar{m}$ is subgame perfect equilibrium

Case 2. $(y^i, x^i) \neq (y^j, x^j)$ for distinct i, j in all winning coalitions and $B^i = 0$ for all i. Some agent i is randomly chosen as a proposer. When the bid of the proposer , $\Sigma_{j\neq i} b^i_j \neq 0$ $(b^i \neq (0, ..., 0))$, payoffs of agents are $u_j(b^i_j)$ for all $j \neq i$, and $u_i(-\Sigma_{j\neq i} b^i_j)$ for agent i. However, i can improve her payoff by reducing the amount of bids as follow. Let agent i change her strategy by changing making bids $\Sigma_{j\neq i} b^i_j - \epsilon$. Since $B^i = 0$ for all i, this change makes another agent k a new proposer. Thus her change generates new final payoff $u_i(b^k_i)$. When $\Sigma_{j\neq i} b^i_j = 0$ $(b^i = (0, ..., 0))$, agent i's payoff is $u_i(-\epsilon)$. Because the utility function u_i is strictly increasing at x_i, she can improve her payoff by bidding $\Sigma_{j\neq i}b^i_j = \delta < \epsilon$. By bidding $\delta > 0$, she becomes the proposer for sure and her final payoff is $u_i(-\delta) > u_i(-\epsilon)$. These deviations are profitable for any agent who is chosen as the chairman randomly, which contradicts the hypothesis that $\bar{m}$ is subgame perfect equilibrium.

Case 3. $(y^i, x^i) = (y^j, x^j)$ for all i, j in some winning coalition and $B^i \neq 0$ for some agent i. If $B^i = 0$ for all $i \in N$, it is obvious that $N(\bar{B}) = N$. If $N(\bar{B}) = N$, the claim is satisfied since $\Sigma_{i\in N}B^i = 0$. Thus, we need to show $N(\bar{B}) = N$. Suppose, to the contrary, $N(\bar{B}) \subset N$. As is the case of Case 1, any agent $i \in N(\bar{B})$ can reducing the amount of bids without changing the probability of being the proposer. If agent i's bid is b^i, the new amount of her bid can be $\Sigma_{j\neq i}b^i_j - \epsilon < \Sigma_{j\neq i}b^i_j$ and $N(\bar{B})$ does not alternate as we have proven in the Case 1. In other words agent i receives higher expected utility through this change. This contradicts the hypothesis that m^* is subgame perfect equilibrium and $N(\bar{B})$ must be equivalent with N.

Claim 2. $u_i(\bar{y}, \bar{x}_i) \geq u_i(\tilde{y}, \tilde{x}_i)$ for all i in some winning coalition S.

Proof of Claim 2. The final outcome $(\bar{y}, (\bar{x}_i)_{i\in N})$ is either $(\tilde{y}, (\tilde{x}_i)_{i\in N})$ or what is proposed in the stage 2. Since $(\bar{y}, (\bar{x}_i)_{i\in N}) \in SPE(\Gamma^2)$, the claim follows.

Claim 3. Let t be a node of any subgame in which an agent has to respond $(\tilde{y}, (\tilde{x}_i)_{i\in N})$ and a proposal $(y, (x_i)_{i\in N})$ made by i. If $u_j(y, x_j) > u_j(\tilde{y}, \tilde{x}_j)$ for all $j \neq i$, $j \in \mathcal{W}$, then $g(\bar{m}, t) = (y, (x_i)_{i\in N})$.

Proof of Claim 3. Since $\bar{m}$ is subgame perfect equilibrium, agent must accept any proposal which she prefers to $(\tilde{y}, (\tilde{x})_{i\in N})$. That is, the claim is a straightforward consequence of subgame perfection.

To complete the proof, suppose $g(\bar{m}) = (\bar{y}, (\bar{x}_i)_{i\in N}) \notin C(N, \mathcal{W})$ with positive probabilities. Thus, there exists an alternative $(y', (x'_i)_{i\in N})$ which blocks $(\bar{y}, (\bar{x}_i)_{i\in N})$. In other words, for all i in some winning coalition S, $u_i(y', x'_i) > u_i(\bar{y}, \bar{x}_i)$. Since, by claim 2, $u_i(\bar{y}, \bar{x}_i) \geq u_i(\tilde{y}, \tilde{x}_i)$, it follows that $u_i(y' x'_i) > u_i(\tilde{y}, \tilde{x}_i)$. By claim 3, in every subgame following the proposal $(y', (x'_i)_{i\in N})$, the equilibrium outcome is $(y', (x'_i)_{i\in N})$. Since $u_i(y', x'_i) > u_i(g(\bar{m}))$ for all i in the winning coalition S_k, an agent $j \in S_k$ can improve her payoff by increasing her bid to become the proposer with probability one and proposing $(y', (x'_i)_{i\in N})$. This contradicts the hypothesis that m is a subgame perfect equilibrium and completes the proof that $g(\bar{m}) \in C(N, \mathcal{W})$. $\square$

8 Concluding Remarks

We show the legislative bargaining protocol has the equilibria in which members of political parties do not maintain the discipline of the parties. In other words, under the legislative bargaining protocol, political parties may not be effective. We also construct the mechanism whose equilibria coincide with the core of underlying simple games. Thus, members of political parties maintain the discipline and cooperate each other in any equilibrium of our bidding game. In other words, we can explain the incentive of legislators to sustain cooperations within the party.

We investigated noncooperative foundations for the core of simple games in the general environment. Hence, our analysis is a part of the Nash program in game theory. As the core describes stability in voting game, We can specify the strategic interaction and procedure through which a stable state of voting environment realizes.

However, the conditions for existence of the core are not clear in this paper. Nakamura (1979) specifies the condition imposed on the number of alternatives, which is known as the Nakamura number. If the number of alternatives is less than the Nakamura number, the core of simple games always exists. For example, under the majority rule the Nakamura number is three. When the number of alternative is less than or equal to two, the core exists under the majority rule. While the condition imposed on the number of alternatives is quite clear, the condition imposed on individual preferences is not found. Although Plott (1967) formulates the condition under the majority rule, the condition under the general environment, which is parallel to the Nakamura number, have not been discovered. More investigations about the core of simple games are required to solve this problem.

Before we conclude this paper, we go back to the empirical issue we mentioned in the section 1.

In the introduction of this paper, we confirmed the fact that the effectiveness of the political parties varies across countries. We also indicate our attempt to provide microfoundations for political parties suggests implications to understand the difference. In fact, we can gain some implications from comparing the two mechanism we considered in this paper. The bidding mechanism endogenize the selection of a proposer while this process is exogenous in the legislative bargaining protocol. In other words, agents can choose whether to be a proposer by deciding the amount of bids. As we show in the proof of the Theorem, This process is important to exclude the equilibria in which members of parties do not cooperate each other. The bidding stage can be interpreted as the competitions among agents for the chairmanship or the leadership of the legislature. Our analysis suggests such competitions may be important to achieve a cooperation within political parties. The stage 1 of our bidding mechanism represents the process of internal adjustments in the legislature. Hence, the process or institution to adjust agendas and proceedings may be also important. Although we can derive some implications from our analysis, further investigations of theoretical models which reflects the existing legislative procedures and empirical analysis are needed to answer the empirical question precisely.

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