

The Use of Structural Models in Coalition Politics

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Abstract

We discuss the role and implementation of the structural approach in empirical research and institutional analysis, with a particular focus on coalition politics. We use Diermeier, Eraslan and Merlo (2003) as a primary example to illustrate the thought process for the structural approach, the basic steps involved, especially in studying coalition politics, and the advantages of the model-based approach in analysing political phenomena and institutions. We also offer our views on the future of the structural analysis of coalition politics.

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1 Introduction

Structural models, which closely integrate theoretical framework and empirical analysis, have had a long tradition in economics. The structural approach in economics can be traced back to Cowles Foundation’s mission to link theory and empirical work tightly, as advocated by Tjalling Koopmans, Jacob Marschak and Trygve Haavelmo.¹ While structural models have been widely used in economics, especially in the fields of industrial organization and labor economics, their utilization in political science has been relatively limited.² In coalition politics the exceptions are Merlo (1997), Diermeier, Eraslan and Merlo (2003), Diermeier, Eraslan and Merlo (2007) and Adachi and Watanabe (2008). This paucity of models in coalition politics is particularly surprising as this area of political science is characterized by both a rich empirical and well-developed theoretical literature.³

Given the relative scarcity of the structural approach in political science, the goal of this paper is to discuss the role of the structural approach in empirical analysis and institutional evaluation and how it can be used to study political phenomena, especially when strategic interactions among players (e.g. coalition formation) are important.

¹See Rust (2014) for an insightful review and discussion of development of the structural approach in economics.

²For examples see Diermeier, Kean and Merlo (2005) and Iaryczower, Lopez-Moctezuma and Meirowitz (2024) for the structural analysis of congressional careers, Francois, Rainer and Trebbi (2015) for using the structural approach in studying power sharing in Africa, Bombardini and Trebbi (2011) for structural estimation of the relationship between the size of interest groups and the interest group’s campaign contributions to politicians, Gowrisankaran, Mitchell and Moro (2008) for studying the causes of incumbency advantage in the US Senate and their implications on the electoral design, Deltas, Herrera and Polborn (2015) for analysing the trade-off between learning and coordination among voters in the U.S. presidential election primary system, Sieg and Yoon (2017) for analysing the impact of term limits on electoral outcomes and voters’ welfare in US gubernatorial elections, Kang (2016) for using the structural approach to quantify the extent to which lobbying influence public policy, Iaryczower, Katz and Saiegh (2013) for estimating a structural model of voting in Congress to quantify the value of information dispersed among legislators and Zhao (2022) for quantifying the effects of campaign spending on electoral outcomes.

³See Diermeier, Eraslan and Merlo (2003) for a discussion of this point and Diermeier (2006) for an overview.

A structural model is an econometric model closely derived from theory, which defines how outcomes are related to preferences and other factors in the underlying environment. The assumptions on the model include those on the underlying mechanism that determines the outcomes such as preferences and game forms including information sets, as well as on the statistical process.⁴ A key feature of the structural model is the deep model primitives, which are usually represented by the so called structural parameters, which can be of finite dimension (parametric), or infinite dimension (nonparametric), or both (semiparametric).

In coalition politics, the underlying model has been modelled as a non-cooperative game, as in Diermeier, Eraslan and Merlo (2003). Structural modelling then assumes that agents rationally interact in a game-form and end up in equilibrium which generates the distributions of data that the researcher observes. In that sense, the assumed model is complete; there is no need for any additional assumptions.⁵

We then need to estimate the structural parameters from the data. Once the parameters are estimated, they can then be used to conduct counterfactual experiments and to quantify effects on the outcomes of interest. For example, in the context of government formation, Merlo (1997) estimates a structural model of government formation in postwar Italy and uses the structural estimates to quantify the impacts of changes in the bargaining procedure on negotiation delays and government stability. Diermeier, Eraslan and Merlo (2003) estimate a bargaining model that extends the one developed in Merlo (1997) to endogenize both the selection of the proto-coalition formateur and the proto-coalition formation and use the structural estimates to conduct counterfactual experiments. Specifically, they evaluate the impact of constitutional features on bargaining outcomes, including which coalition forms

⁴When discussing his view on what a structural model is, Sims (1980) states that “A structure is defined (by me, following Hurwicz 1962 and Koopmans and Bausch 1959) as something which remains fixed when we undertake a policy change, and the structure is identified if we can estimate it from the given data.”

⁵The underlying model does not have to be a non-cooperative game. Diermeier, Keane and Merlo (2005) posit a single-person stochastic dynamic programming model and older structural models used supply and demand equilibria from price theory. Dellavigna, List, Malmendier and Rao (2017) estimate a structural behavioral model of voting. The key feature, common in all structural models, is that, whatever the specific model, it is sufficiently specified to serve as the data generating mechanism.

the government, how many attempts it takes to form the government and the duration and stability of the government.⁶

Since the structural approach relies on the theory that makes a set of assumptions under which the model primitives are identified, or equivalently, consistently estimated, special attention is needed in validating the model including the set of modeling assumptions. Validation of the structural model that is used to analyse the data and study political phenomena is crucially important in building confidence in the model and the structural estimates as well as the counterfactual results. As pointed out in Keane (2010), validation exercises should aim to answer the following two questions: First, does the model do a reasonably good job of fitting important dimensions of the data that it was estimated on? Second, does the model do a reasonably good job at out-of-sample prediction? For example, Diermeier, Eraslan and Merlo (2003) perform both in-sample and out-of-sample prediction tests to evaluate the goodness-of-fit of their structural model and find that the model fits the data well.⁷

Historically, there has been active, sometimes heated, debate among empirical economists on the model-based structural approach vs. the reduced-form approach that attempts to identify causal effects through natural or quasi-random experiments or/and instrumental vari-

⁶Diermeier, Eraslan, and Merlo (2007) analyse the effect of governmental bicameralism on coalition formation and duration.

⁷In the case where there are competing structural models under consideration, one needs to evaluate which model fits data better by answering these two questions. For example, Li, Zhang, Zhao and Zheng (2023) study tournament data using both a structural model with complete information (Lazear and Rosen (1981)) and a structural model with incomplete information (Moldovanu and Sela (2001)). These two models have different model predictions on the outcome and also different policy implications. They establish nonparametric identification of both models, based on which they estimate the model primitives nonparametrically. Then they conduct the Kolmogorov–Smirnov test to compare the empirical distribution of the observed performance and that of the predicted performance from both models. They find the model with complete information is better supported by the data. Using data from Texas liquor referenda, Coate and Conlin (2004) find that a structural voter turnout model using a group rule-utilitarian approach outperforms a simple expressive model, while Coate, Conlin and Moro (2008) find that expressive voting explains vote behavior better than a more sophisticated pivotal-voter model. Transitivity of explanations, however, does not apply, since the two papers test for different assumptions.

ables.⁸ In the political science literature, a large body of the empirical work has employed the instrumental variable approach to address the endogeneity issue arising from the correlation between some independent variables and the unobserved determinants of the dependent variable in a reduced-form regression.⁹

In coalition politics, however, the instrumental variables approach has not made any inroads, even though problems with existing empirical methodologies have long been known. For example, since Strøm (1985), the empirical literature on cabinet stability has used the reduced-form method by regressing government duration on a set of covariates that include constitutional features as well as cabinet type, i.e. whether the ruling cabinet is a minimum winning, minority or surplus majority coalition. This approach, however, is problematic since while constitutional features can be considered as exogenous, the cabinet types or the proto-coalition features are generally correlated with the unobserved determinants of government duration and are thus endogenous. Intuitively, during the negotiations on government formation, party leaders will naturally consider the expected cabinet duration of various coalition types. For example, if minority governments are typically of shorter duration than majority governments, party leaders may prefer to make various compromises during the negotiations to put together a majority cabinet. Cabinet type and expected cabinet duration are thus jointly determined in equilibrium, which creates endogeneity problems leading to biased and inconsistent estimates. However, finding a valid instrument for the endogenous cabinet type variables is challenging, and no satisfactory solution has yet been found.

These problems are particularly acute, if we are interested in isolating the effects of constitutional variables. Here, it is almost impossible to find a natural or quasi-random experiment that would allow a researcher to identify causal effects, and no valid instrument for proto-coalition types has been proposed. In fact, for the large empirical literature using the

⁸See e.g. Keane (2010), and Low and Meghir (2017) for insightful discussions on advantages/disadvantages of both approaches and how they can be complementary with each other.

⁹See Sovey and Green (2010) for a comprehensive review of the use of the instrumental variable method in political science and insightful discussion on the importance of justifying the validity of the instrumental variable in the context of the application.

reduced-form approach to study government formation and termination as well as stability, no satisfactory answers are provided for these questions and only stylized facts based on correlations are established.

Diermeier, Eraslan and Merlo (2003) bridge the gap between the theory and empirical analysis by proposing a sequential bargaining model that captures the essential features of a complex process of coalition formation. This approach avoids the methodological problems of reduced form methods and provides answers on the impact of constitutional rules for coalition formation and government stability. Once a structural model is estimated, it can be used to conduct counterfactual experiments where various combinations of key parameters are used to predict coalition outcomes. Importantly, this allows researchers to assess the impact of institutional features that have not yet occurred in existing cases. The results can be used to predict the consequences of constitutional reform on government coalitions.

The main disadvantage of the structural approach is the difficulty of designing and estimating the model. Our goal here is to explain the construction of such model in sufficient detail, so that the interested reader can follow each step.

This paper is organized as follows. In Section 2, we provide a detailed discussion on the structural approach, using Diermeier, Eraslan and Merlo (2003) as a primary example to demonstrate the key steps taken in conducting a structural analysis in coalition politics. In Section 3, we discuss the future of the structural approach in coalition politics. Section 4 provides a brief conclusion.

2 The Structural Approach

Generally speaking, a structural model is constructed through making assumptions about an agent's objectives, the agent's economic or political environment and information set. The model needs to specify how an agent's choices are made as a solution to the agent's optimization problem, consistent with the agent's objectives. Through the model, the agent's choice is derived as a function of the information set and the economic or political environment.

In addition to the deep model primitives that are invariant to any institutional changes, a number of stochastic unobservables need to be added so that a joint density for the observed outcomes can be derived.¹⁰

The goal of Diermeier, Eraslan and Merlo (2003) is to study the impacts of constitutional features on the duration of the government formation process and government stability using the data from parliamentary democracies in nine Western European countries (namely, Belgium, Denmark, Finland, Germany, Iceland, Italy, Netherlands, Norway and Sweden). The government formation process is defined as follows. First, after the resignation of an incumbent government, the head of state chooses a party represented in the parliament to try to form a new government. This party is called the *formateur*. The formateur then chooses a set of parties from those represented in the parliament, called *proto-coalition*, whose members agree to negotiate with each other to form a government together. This initiates bargaining over the formation of a new government, which determines the allocation of government portfolios among the proto-coalition members. If the formateur's proposal is accepted by all the proto-coalition members, then the government is formed; otherwise, a proposer from the proto-coalition is selected to make government proposal and the bargaining process continues until some proposed allocation is unanimously accepted by the members in the proto-coalition.

While all the nine countries follow essentially the same government formation process, they differ with respect to their constitution rules that govern how their government forms and dissolved. In the context of coalition formation, these constitutional rules can be considered as exogenous. They include whether the government needs an actual vote by parliament to legally assume office, which is called the *investiture vote*; whether the government needs to maintain the active support from a parliament majority, which is called *positive parliamentarism*; whether tabling a vote of no-confidence requires an alternative to be prespecified, which is called *constructive vote of no-confidence*; and whether there is a so called *fixed*

¹⁰See e.g. Reiss and Wolak (2007) for detailed discussion on the concrete steps involved in structural econometric modelling and the choices that structural modellers make.

interelection period, where elections have to be held at predetermined intervals.

The outcomes of primary interest in Diermeier, Eraslan and Merlo (2003) are the selection of the original formateur, the proto-coalition selected by the formateur, the sequence of proposers for each attempt if the formateur does not succeed in forming the government at the first attempt, the number of attempts to form a new government and the duration of the formed government. These outcomes not only vary within a country over time, but also, importantly, differ significantly across different countries with different constitutional features. For their empirical analysis, Diermeier, Eraslan and Merlo (2003) collect data from nine Western European countries over the period 1947-1999. In addition to the data on all these outcomes, they also collect the data on the institutional characteristics, the time horizon to the next election, the set of parties represented in the parliament, the vector of their relative seat shares and the party of the former prime minister, all of which constitute the political environment and information set which forms the basis of their analysis.

The sequential and interconnected nature of these outcomes, arising from the complex coalition formation process, makes it almost impossible to conduct a meaningful reduced-form analysis to identify some causal effects of the institutional features on these outcomes. Yet, it can be analysed in a structural framework with a bargaining model of government formation.

Since the constitutions of all nine countries under consideration are all silent about how a formateur is selected, Diermeier, Eraslan and Merlo (2003) assume that the selection of a formateur is nonpartisan and nonstrategic and use a logit model to specify the selection probability taking into account the two key factors: first, there may be an incumbency advantage or bias, and second, if a party has an absolute parliament majority, it must be selected to be the formateur.¹¹ The probability of party $i \in N$ being selected as a formateur

¹¹For a reduced-form empirical analysis on the rules of selection of a formateur, see Diermeier and Merlo (2004).

is

$$p_i(\pi, k_{-1}) = \begin{cases} 1 & \text{if } \pi_i \geq 0.5 \\ \frac{\exp(\alpha_0 \pi_i + \alpha_1 I_i)}{\sum_{j \in N} \exp(\alpha_0 \pi_j + \alpha_1 I_j)} & \text{if } \pi_j < 0.5, \forall j \in N \\ 0 & \text{if } \exists j \neq i : \pi_j \geq 0.5, \end{cases} \quad (1)$$

where $k_{-1} \in N$ represents the party of the former prime minister and I_i is equal to 1 if $k_{-1} = i$ and zero otherwise.

Then the bargaining process for the proto-coalition chosen by the formateur is modeled as a stochastic bargaining game following Merlo and Wilson (1995, 1998), Merlo (1997) and Diermeier and Merlo (2000). A key feature of this model is that the parties in a proto-coalition bargains over a fixed “cake”, which decreases at a constant discounted rate that can be interpreted as a political discount factor. Diermeier, Eraslan and Merlo (2003) consider the cake as the expected value of the government duration (conditional on the information set and also the current state of the world, which summarizes the current political and economic situation). Specifically, the cake $y^D(s, \bar{T}, Q, \pi^D) \equiv E[T^D | s, \bar{T}, Q, \pi^D]$, where s denotes the current state of the world, \bar{T} denotes the time horizon to the next scheduled election, Q denotes the set of (exogenous) institutional characteristics that possibly affect government duration and $\pi^D = \sum_{i \in D} \pi_i$, with π_i being party i 's relative share in the parliament.

Since the researchers do not observe the state of the world, s , assuming it is i.i.d., one can integrate it out from the conditional distribution of y^D conditional on (s, \bar{T}, Q, π^D) and thus directly deal with the conditional distribution of y^D on (\bar{T}, Q, π^D) , denoted as $F_y(y^D | \bar{T}, Q, \pi^D)$, with conditional density $f_y(\cdot | \bar{T}, Q, \pi^D)$. Let $F_T(t^D | y^D; \bar{T}, Q, \pi^D)$ denote the conditional distribution of government duration with conditional density $f_T(\cdot | y^D; \bar{T}, Q, \pi^D)$, conditional on y^D and (\bar{T}, Q, π^D) , where $F_T(\cdot | y^D; \bar{T}, Q, \pi^D)$ satisfies the restriction $E[T^D | \bar{T}, Q, \pi^D] = y^D$. As a result, the density of T^D conditional on (\bar{T}, Q, π^D) can be derived as $f_T(\cdot | \bar{T}, Q, \pi^D) = \int_0^{\bar{y}} f_T(\cdot | y^D; \bar{T}, Q, \pi^D) f_y(y^D | \bar{T}, Q, \pi^D) dy^D$, where $\bar{y} < \bar{T}$ is the upper bound on the expectations over the government duration. A key result in the stochastic bargaining model used in Diermeier, Eraslan and Merlo (2003) is that the unique stationary subgame perfect equilibrium has a *reservation property*: coalition D agrees if and only if $y^D(\bar{T}, Q, \pi^D) \geq$

$y^*(D, \bar{T}, Q, \pi^D)$, where $y^*(D, \bar{T}, Q, \pi^D)$ solves

$$\begin{aligned} y^* &= \beta \int \max\{y^D, y^*\} dF_y(y^D | \bar{T}, Q, \pi^D) \\ &= \beta (E[y^D | \bar{T}, Q, \pi^D] + \int_0^{y^*} (y^* - y^D) dF_y(y^D | \bar{T}, Q, \pi^D)), \end{aligned} \quad (2)$$

where β is a discount factor. Intuitively, this means that the coalition members only agree to form a government if its expected government duration exceeds a certain threshold. Otherwise, they delay forming a government.

Another important equilibrium property is the *separation principle*, which postulates that any equilibrium payoff vector must be Pareto efficient, and the set of states where parties agree are independent of the proposer's identity.

An important implication of this is for any possible proto-coalition, agreement is reached within a finite amount of time, and if a D is chosen as the proto-coalition, then it forms the government. Furthermore, for any formateur $k \in N$, the equilibrium proto-coalition choice $D_k \in \Delta_k$ is given by

$$D_k = \arg \max_{D \in \Delta_k} \left[\frac{1 - \beta(1 - \tilde{p}_k(\pi, D))}{\beta} y^*(D, \bar{T}, Q, \pi^D) + \varepsilon_k^D \right], \quad (3)$$

where ε_k^D denotes the formateur's tastes for its coalition partners and $\tilde{p}_i(\pi, D)$ represents the probability of party $i \in D$ being selected as a proposer in the event of the failure of negotiation in the proto-coalition

$$\tilde{p}_i(\pi, D) = \begin{cases} 1 & \\ \frac{\exp(\alpha_2 \pi_i)}{\sum_{j \in D} \exp(\alpha_2 \pi_j)} & \text{if } \pi_i \geq 0.5 \\ 0 & \end{cases} \quad (4)$$

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Assuming that ε_k^D , $D \in \Delta_k$, are i.i.d. following a type I extreme value distribution with standard deviation ρ , the probability of formateur k choosing a particular proto-coalition $D_k \in \Delta_k$ to form the government can be derived as

$$\Pr(D_k) = \frac{\exp\left(\frac{[1 - \beta(1 - \tilde{p}_k(\pi, D_k))] y^*(D_k, \bar{T}, Q, \pi^{D_k})}{\beta \rho}\right)}{\sum_{D \in \Delta_k} \exp\left(\frac{[1 - \beta(1 - \tilde{p}_k(\pi, D))] y^*(D, \bar{T}, Q, \pi^D)}{\beta \rho}\right)}. \quad (5)$$

The remaining outcomes to be modeled are τ , the rounds of how long a negotiation lasts and t , the government duration (after it forms). For the former, the probability of a negotiation lasting τ rounds is the probability that the first $\tau - 1$ cakes are smaller than $y^*(D, \bar{T}, Q, \pi^D)$ and the cake in round τ is larger than or equal to $y^*(D, \bar{T}, Q, \pi^D)$ and thus can be expressed as

$$\Pr(\tau) = [F_y(y^*(\cdot)|\bar{T}, Q, \pi^D)]^{\tau-1} [1 - F_y(y^*(\cdot)|\bar{T}, Q, \pi^D)]. \quad (6)$$

The distribution of government duration t following an agreement after τ rounds of negotiation is

$$\Pr(t|\tau) = \frac{\Pr(t|y^D \geq y^*(D, \bar{T}, Q, \pi^D)) \int_{y^*(\cdot)}^{\bar{y}} f_T(t|y^D; \bar{T}, Q, \pi^D) dF_y(y^D|\bar{T}, Q, \pi^D)}{1 - F_y(y^*(\cdot)|\bar{T}, Q, \pi^D)}. \quad (7)$$

Note that the threshold $y^*(D, \bar{T}, Q, \pi^D)$ plays a crucial role in determining proto-coalition D_k , the round of negotiation τ , and government duration t , as can be clearly seen from (5), (6) and (7), respectively, making it the key source of endogeneity of these three.¹² Thus, the type of government coalition, the length of the government formation process and the cabinet duration are all jointly determined in equilibrium. Simply regressing cabinet duration on variables measuring government process duration and coalition type would result in biased and inconsistent estimates.

Finally, the joint likelihood of the (equilibrium) outcomes (conditional on the vector of exogenous characteristics $Z = (\bar{T}, Q, \pi^D, \pi, k_{-1})$), which constitutes the joint density of the

¹²This threshold is not observed by the researcher. Thus, in a reduced-form regression of government duration on a set of covariates including exogenous institutional characteristics and the proto-coalition types, the challenge is to find an instrumental variable that is correlated with the threshold but not correlated with other unobserved determinants of government duration.

observed outcomes, can be expressed as

$$\begin{aligned}
& \Pr(k, D_k, \tau^{D_k}, \ell_2, \dots, \ell_{\tau^{D_k}}, t^{D_k} | Z) & (8) \\
= & \Pr(k | Z) \Pr(D_k | k, Z) \Pr(\tau^{D_k} | D^k, k, Z) \\
& \times \Pr(\ell_2, \dots, \ell_{\tau^{D_k}} | \tau^{D_k}, D^k, k, Z) \Pr(t^{D_k} | \tau^{D_k}, D^k, k, Z),
\end{aligned}$$

where $\Pr(k | Z)$, $\Pr(D_k | k, Z)$, $\Pr(\tau^{D_k} | D^k, k, Z)$ and $\Pr(t^{D_k} | \tau^{D_k}, D^k, k, Z)$ are from (1), (5), (6) and (7), respectively, while

$$\Pr(\ell_2, \dots, \ell_{\tau^{D_k}} | \tau^{D_k}, D^k, k, Z) = \prod_{j=2}^{\tau^{D_k}} \tilde{p}_i(\pi, D_k).$$

The resulting structural model for the bargaining process and government formation as well as duration has the following model primitives: the discount factor, the formateur selection probability in (1), the proposer selection probability in (4), the distribution of formateur's tastes for its coalition members, which is specified as a type I extreme value distribution, the conditional distribution of cakes (conditional on the information set and the proto-coalition size) $F_y(\cdot | \bar{T}, Q, \pi^D)$, the conditional distribution of government duration (conditional on y^D , the information set and the proto-coalition size) $F_T(\cdot | y^D, \bar{T}, Q, \pi^D)$, both of which are assumed to belong to the family of beta distributions. A conditional maximum likelihood estimation is then conducted based on the joint likelihood in (8).

The structural approach offers a rich set of possibilities to study causal effects, quantify the impacts of some important features and test the underlying theory. Having estimated the structural parameters, Diermeier, Eraslan and Merlo (2003) conduct a series of analyses to answer some important questions regarding the government formation process. First, with regard to the selection of formateur, they find that they cannot reject a proportionality hypothesis, that is if the size of one party increases by 1%, then this party's probability of being selected as the formatuer also increases by 1%. This is indeed a desirable property of a formateur selection rule as it means that, as discussed in Diermeier, Eraslan and Merlo (2003), a party cannot increase its chance of becoming a formateur by splitting, and two parties cannot increase their chances by merging. They also quantify the incumbency premium in

the formateur selection process and find that controlling for size, on average a nonincumbent party is 18% less likely to be selected as formateur than an incumbent.

Second, to interpret the other parameters in the model, primarily those in the bargaining model, Diermeier, Eraslan and Merlo (2003) use the estimates of these parameters to conduct several thought experiments, to gain further insight on the coalition formation process. For example, they find that the mean expected government duration for a minimum winning coalition that controls 58% of the parliamentary seats in a system with a constructive vote of no-confidence is 1.3 times its mean expected government duration in a similar system but without a constructive vote of no-confidence. Various other thought experiments can be conducted for any combination of parameter values.

In light of this, Diermeier, Eraslan and Merlo (2003) use the structural estimates to evaluate the selection effects on expected government duration and find that the selection effect as a consequence of the delay in forming a government can be substantial, and the types of coalition and their institutional features play key roles in determining the extent of the selection effect. The paper also uses the structural estimates to evaluate how different institutional environments affect the choice of a coalition by the formateur.

The ability to generate these results and findings is one of the important advantages of the structural approach. Yet, perhaps the biggest payoff in using the structural approach is that it enables a researcher to go beyond what a conventional reduced-form analysis can offer by providing a framework to conduct counterfactual experiments. In the context of Diermeier, Eraslan and Merlo (2003), who are motivated by the question of the effects of specific institutional features on the formation and stability of coalition government, the structural approach allows them to conduct a series of counterfactual experiments. Specifically, they consider an artificial parliamentary democracy with five parties and set the time horizon to the next election at 1000 days. They simulate the outcomes of 5,000 elections by randomly drawing vectors on the party seat shares in parliament from a uniform distribution. Then for each possible configuration of the aforementioned four institutional features, they use the structural estimates to compute the predicted distributions of the outcomes of interest, such

as negotiation duration, government duration, government size and government type for each electoral outcome, and then report the average across all draws. They find that the most stable political system that has the shortest government formation duration and the longest government duration has a positive form of parliamentarism with the constructive vote of no-confidence, no investiture vote and a fixed interelection period. The least stable political system that has the longest government formation duration and the shortest government duration has a positive form of parliamentarism, lacks a constructive vote of no-confidence, has an investiture vote and no fixed interelection period. They also study the propensity of different political systems to generate different types of government coalition and evaluate the effects of changing the length of the interelection period on the formation and stability of governments. Lastly, they conduct the counterfactual analysis to assess the impacts of changing the formateur selection process, such as if the largest party is required to be selected as formateur.

There are various ways of conducting counterfactual experiments in the coalition politics setting. One way, as in Diermeier, Eraslan and Merlo (2003), who consider an artificial parliamentary democracy with five parties, is to simulate the counterfactual outcomes for the artificial parliamentary democracy with different institutional features. The other way is to simulate the counterfactual outcomes for some or all the individuals in the data (the nine countries in Diermeier, Eraslan and Merlo (2003)) with a different hypothetical institutional feature. For example, Diermeier, Eraslan and Merlo (2007) use the structural model in Diermeier, Eraslan and Merlo (2003) to study the effect of bicameralism on government formation using the data on Belgian governments over the period 1945-1995, as 1995 was the year when Belgium eliminated “dual responsibility” as a form of bicameralism. In one of their counterfactual experiments, they analyse the counterfactual outcomes from assuming that Belgium abandoned bicameralism in 1945. In addition, they also do an out-of-sample policy experiment by predicting what would happen to Denmark which shared most of the constitutional features with pre-post 1995 Belgium but without dual responsibility.

Lastly, model validation is an integral part of the structural analysis, as it provides as-

assessment on the fit of the model. Only through validation exercises can one gain confidence in the estimated structural model and the interpretations of the results including the findings from the counterfactual experiments. Diermeier, Eraslan and Merlo (2003) provide detailed model validation analysis by conducting both in-sample and out-of-sample goodness-of-fit tests on the outcomes.

Diermeier, Eraslan and Merlo (2003, 2007) assume government termination as exogenous. Diermeier, Li, Li and Zhao (2024) extend the approach in Diermeier, Eraslan and Merlo (2003, 2007) to model both government formation and termination. Here the termination process is modelled as correlated competing risks with dissolution and replacement as the two features of termination.¹³ In the case of dissolution, the parliament is dissolved and new elections are held. In the case of replacement, a new cabinet assumes office without an election. They then analyse the effects of bicameralism and the other institutional features on dissolution and replacement, respectively.

We have used Diermeier, Eraslan and Merlo (2003) as an example to demonstrate the steps that are usually taken in adopting the structural approach to analyze coalition politics. The structural framework developed in Diermeier, Eraslan and Merlo (2003) offers a systematic way of using game-theoretic models to address the quantitative issues related to evaluating the performance of democratic institutions in an equilibrium framework.

2.1 Challenges in Using the Structural Approach

The model-based structural approach offers considerable advantages and benefits in providing a unified framework to analyze the data, evaluate causal effects, test theory and simulate counterfactuals, especially in dealing with problems as complex as those in coalition politics. On the other hand, when a structural model is used to deal with complex problems, a key challenge is to strike a balance between having a parsimonious structural model that is tractable and at the same time capturing the essential features of the underlying environment.

¹³For studying dissolution and replacement as competing risks in a reduced form framework, see Diermeier and Stevenson (1999, 2000) and Chiba, Martin and Stevenson (2015).

In fact, we view this challenge as the main reason why the structural approach has not been widely used in political science in general, and in studying coalition politics in particular.

Diermeier, Eraslan and Merlo (2003), for example, have to choose what to model and not to model, which choices and outcomes to include and which to leave out, without rendering their results questionable or irrelevant. While their equilibrium model can be viewed as a general equilibrium model within the context of the outcomes they consider, it would not be a general equilibrium model if the election process were viewed as endogenous.¹⁴

In practice, a good structural analysis based on an empirical equilibrium model should focus on some key features of the equilibrium but abstract from the others. This is essential for addressing the particular empirical question while keeping the model tractable and salient. For example, the multilateral sequential bargaining model with complete information used in Diermeier, Eraslan and Merlo (2003) is parsimonious enough to be tractable as it yields a unique stationary subgame perfect equilibrium that is characterized as a solution to a fixed point problem, yet it can rationalize delay as an equilibrium outcome as implied by its reservation property. Yet, it rules out perpetual disagreement and predicts that proto-coalition agreement is reached with a finite amount of time due to its separation principle. Other coalition bargaining models, while intuitively plausible, may lack such features.

Another challenge in using the structural approach, which is also related to tractability and feasibility of the structural model, is computational burden. Most of the structural models involve nonlinear estimation, as is the case in Diermeier, Eraslan and Merlo (2003), who use the conditional maximum likelihood estimation method. Furthermore, in many structural models, especially in empirical equilibrium models, estimation involves multiple loops, as in Diermeier, Eraslan and Merlo (2003), where the inner loop of the estimation involves solving a fixed point problem for the unobserved threshold as defined in (2) and the outer loop is maximizing the likelihood function in (8). As a result, estimation of a

¹⁴This would be the case, for example, if voters in parliamentary elections under proportional representation vote strategically and take into account the possible coalitions that may form as a consequence of election results as in Baron and Diermeier (2001).

structural (equilibrium) model in coalition politics can be computationally intensive and time-consuming.¹⁵ Nevertheless, there have been significant advances in both computation methods and computing power in the past two decades since Diermeier, Eraslan and Merlo (2003), which makes it promising in addressing the computational challenges when using structural models in coalition politics.

3 The Future of the Use of Structural Models in Coalition Politics

The structural framework developed in Diermeier, Eraslan and Merlo (2003) offers a versatile approach that can be extended to study issues arising from coalition politics in general and to evaluate performance of political institutions in particular. The structural approach along this line, however, has not been frequently used in studying coalition formation since then. The only exceptions, to the best of our knowledge, are Diermeier, Eraslan and Merlo (2007) who use the structural model in Diermeier, Eraslan and Merlo (2003) to study the effects on bicameralism of government formation and stability and Adachi and Watanabe (2008) who estimate a bargaining model in parliamentary democracies to evaluate the relative importance of ministerial positions, the impact of voting weights and the advantage of being a formateur. On the other hand, over the past two decades, the structural approach has found tremendous applicability in microeconomics, which has also helped advance greatly methodological progress. Notable advances include, just to name a few, identification and estimation of dynamic discrete choice models/games (see e.g. Aguirregabiria and Mira (2007)), demand estimation (see e.g. Berry and Haile (2014) and more recent developments discussed in Berry and Haile (2021)), nonparametric identification and estimation of auction models (see e.g. Guerre, Perrigne and Vuong (2000), Li, Perrigne and Vuong (2000, 2002) and Athey and Haile (2002, 2007)). There also has been a large literature in economics studying identification and

¹⁵As discussed in Diermeier, Eraslan and Merlo (2003), another computational burden is that one has to enumerate all possible proto-coalitions and solve all possible bargaining games a formateur chooses to play.

estimation of games with complete or incomplete information. See, for example, Merlo and Tang (2012, 2019) for nonparametric identification in bargaining games that have been used in Merlo (1997) and Diermeier, Eraslan and Merlo (2003). The most important methodological breakthrough on this front is the partial identification approach in dealing with models when point identification of model primitives cannot be attained. The main driving force for the development of the partial identification approach in structural econometrics is the multiple equilibria problem in entry games.¹⁶ The core of the multiple equilibria problem is, if a researcher is agnostic about the equilibrium selection rules, then even in a parametric framework, the structural parameters cannot be consistently estimated, or, in other words, point identified. The key insight of the partial identification approach is to provide informative bounds of the structural parameters derived from the moment inequalities that hold for all the possible equilibria under consideration without specifying equilibrium selection rules.¹⁷

While all the recent advances can and will find applications in the use of structural models in coalition politics, the partial identification approach may turn out to be the most useful one in studying coalition formation. This is because when using bargaining models to model coalition formation, it is often the case that there are multiple equilibria, given the complexity of the bargaining process the model tries to capture.¹⁸

¹⁶See Ciliberto and Tamer (2009), for example, and Molinari (2020) and Kline and Tamer (2023) for recent surveys on the partial identification approach.

¹⁷There are other scenarios in the structural approach that may render point identification unattainable thus warrant a partial identification approach. These scenarios include, but not limited to, incomplete models with weaker behavior assumptions (e.g. Haile and Tamer (2003) for incomplete model of English auctions) and models with general information structures but lack of observed information (e.g., Gentry and Li (2014) and Chen, Gentry, Li and Lu (2020) for auctions with selective entry that allows arbitrary dependence between signals and valuations with the former for the risk neutral case, and the latter for the risk averse case), among others.

¹⁸The partial identification approach has been used in Iaryczower, Shi and Shum (2018) to deal with the multiple equilibria problem arising from a model to study the effect of deliberation in collective decision making in US appellate courts, and in Kawai and Watanabe (2013) in quantifying the effects of strategic voting on election outcomes.

Indeed, the prevalence of multiple equilibria in coalition bargaining games may have contributed to the lack of the structural work in coalition politics. Diermeier, Eraslan and Merlo (2003) consider the case where a formateur chooses a coalition and then the bargaining over the allocation of and eventual formation of a government is among this same coalition. As a result, there is a unique stationary subgame perfect equilibrium, which yields the Pareto efficient equilibrium payoff, as a result of the separation principle. An extension of Diermeier, Eraslan and Merlo (2003) may likely encounter the multiple equilibria problem. The partial identification method not only makes the structural approach feasible but also robust in dealing with the multiple equilibria problems in coalition formation.

4 Conclusions

In this chapter, we have focused on the use of structural models in analysing coalition politics, which offers a powerful methodology to take fundamental game-theoretic models of government formation to the data. It provides useful tools to conduct institutional analyses, which would not be possible with a reduced form approach, given the complexity of coalition politics. Given the relatively limited use of the structural approach in political science in general, and in coalition politics in particular, our survey is didactic in nature as we have focused on Diermeier, Eraslan and Merlo (2003) as a primary example to illustrate the thought process for the structural approach, the basic steps involved (especially in studying coalition politics) and the advantages of the model-based approach in analyzing political phenomena and constitutional design. We have emphasized the importance of balancing between having a tractable structural model and capturing the essential features of the underlying environment. We also discussed that, with the further development of both theory and econometric methods, more progress can be made toward relaxing some strong assumptions made in the previous work and providing more robust institutional analysis from an equilibrium-based model that has as much general equilibrium characteristics as possible. Take Diermeier, Eraslan and Merlo (2003) as an example once again. Diermeier, Li, Li and Zhao (2024)

construct a structural bargaining model for government formation and termination to endogenize the termination process, which is treated as exogenous in Diermeier, Eraslan and Merlo (2003). Another possible extension of Diermeier, Eraslan and Merlo (2003) is to model the duration of government formation processes.¹⁹ Lastly, and probably most ambitious as well as most challenging, would be the development of a full life cycle, general equilibrium, structural model starting with elections, followed by government formation and ending with government termination.

¹⁹See e.g. Diermeier and van Roozendaal (1998) and Martin and Vanberg (2003) for the importance of studying the delay (measured in the amount of time) in coalition formation.

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