Coalition Formation as Emergent Phenomenon in Intergovernmental Negotiations

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Abstract

Coalition formation is an emergent phenomenon which is often observed in intergovernmental negotiations. Theories of intergovernmental negotiations are often very restricted with their assumptions on coalition formation. Most often these theories simply assume the formation of coalitions in the negotiation space. In these models, coalition formation does not emerge from the interaction of the governments, rather, it is a strict consequence of the model assumptions. This is obviously a heroic assumption which may be removed and replaced by theories in which coalitions emerge. In this paper, we present a new approach, peer coordination in intergovernmental policy networks, in which coalitions may emerge and their number may vary. In order to test our theory we have implemented a simulation model which we apply to a multilateral, multiple issue, multi-stage and multi-level negotiation system, the EU Intergovernmental Conference of 1996 which led to the Amsterdam treaty.

Keywords: Intergovernmental negotiations, bargaining theory, policy networks, coalition formation, EU

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1. Introduction

How can states economize on transaction costs in intergovernmental negotiations that span over months and years and include many governments? Coalition formation is an emergent phenomenon which is often observed in intergovernmental negotiations. Theories of intergovernmental negotiations are often very restricted with their assumptions on coalition formation. Most often they simply assume the formation of coalitions in the negotiation space. In these theories, coalition formation does not emerge from the interaction of the governments, rather, it is a strict consequence of the model assumptions. This is obviously a heroic assumption which may be removed and replaced by models in which coalitions emerge.

In this paper, we present an alternative approach in which coalitions may emerge and their number may vary. We give a dynamical description of how a group of players change their negotiation positions through repeated interactions with neighbours in their social network. Players are assumed to have groups of peers whose negotiation positions are observed and evaluated. Players make concessions into the direction of their peers given that a quorum of selected peers have a different opinion in the same direction. In this model, pair interactions are assumed and coalitions may emerge. Players economize on transaction costs because they only consider the negotiation positions of their peers. It is our *hypothesis* that this model, that economizes on transaction costs and lets efficient negotiation structures emerge, will ultimately prove better at predicting for negotiation outcomes of multilateral, multi-issue negotiations than alternative models. Our approach is supposed to contribute to positive bargaining theory.

Our paper is organized as follows. In section 2, we describe how traditional bargaining theory deals with negotiations involving multiple parties. We show that coalition formation does not emerge from the interaction of the governments, rather, it is a strict consequence of the model assumptions (sections 2.1 and 2.2). Next, we develop our alternative approach in which coalitions may emerge or not. Coalition formation is conceived as one extreme type of coordinated action in bargaining processes. At the other extreme, there is uncoordinated action. However, in between, there is a type of coordinated action that does not automatically imply coalition formation: peer coordination in intergovernmental policy networks. We develop the peer coordination type of multilateral bargaining relying on two lines of theory: theories of interorganizational network formation and the policy network approach. The

theoretical model is then further specified as a formal model, based on the opinion formation model and the adaptive play framework (section 2.3).

In section 3, we present our empirical case, the EU Intergovernmental Conference of 1996 which was a multilateral, multiple issue, multi-stage and multi-level negotiation system that led to the Amsterdam treaty.

In section 4, we develop a simulation model of the EU Intergovernmental Conference of 1996 that is derived from our formal model of peer coordination in intergovernmental policy networks. We give a dynamic description of how a group of agents change their negotiation positions through repeated interactions with peers in their policy network. In our case, the 15 EU member states are represented as agents who have one of a number of discrete preferences with respect to the outcome of 46 issues which are negotiated in parallel.

In order to evaluate the appropriateness of our simulation model we have calculated goodness of fit parameters (section 5). These parameters are based on the correlation between the empirical outcome - the Amsterdam treaty, which has been operationalized – and the simulation model's prediction of the negotiation outcomes. We also test the robustness of our model by systematically changing parameter values and seeing how model outcome changes. Finally, we compare these goodness of fit parameters with those of alternative theoretical models (the median voter-model, and the extended Zeuthen-Harsanyi-model).

We conclude with a discussion of shortcomings of our approach and perspectives for further research.

2. Theory

2.1 Negotiations involving multiple parties

Traditionally, bargaining theory analyses bilateral bargaining situations, i.e. bargaining between two agents – individuals, firms, governments, etc. – who have a common interest in cooperating, but who have conflicting interests concerning the particular way of doing so (for an overview see Napel 2002). Whereas the sophistication of game-theoretic models has increased enormously during the last decade, their model setup remains highly stylized. The identification of necessary assumptions for a sequential two-player game immediately ending in a unique equilibrium is ingenious and instructive. However, reaching a decision becomes harder the more agents are involved. Once we move out of the bilateral setting, many different constellations with many negotiation parties can be considered: a) a group of separate,

individual negotiators, b) bilateral negotiations with multiple participants on each side, c) a group of advisers preparing one side for negotiations, d) a permanent decision-making or advisory group, or e) an ad hoc decision-making or advisory group (Raiffa/Richardson/Metcalfe 2002: 385). These constellations share a core of similar difficulties, e.g. cognitive overload, poor coordination, poor communication, and poor motivation. In these multilateral settings, formal models run up against the barriers imposed by mathematical tractability more than ever before. The standard game-theoretical solution to this problem is offered by Harsanyi (1977: 196). The multilateral bargaining equilibrium among n players is defined by the requirement that there should be bilateral bargaining equilibrium between any two players i and j. As a consequence, in order to define the solution of a given n-person simple bargaining game, one has to consider the various two-person bargaining subgames in which two particular players i and j bargain with each other about their final payoffs on the assumption that the final payoffs of all other players $k \neq i,j$ are given.

Harsanyi ignores that a multilateral setting is not just the sum of many bilateral settings. In his game-theoretical approach, he ignores the transaction costs that are related to any negotiations. A linear increase in the number of players does not only increase transaction costs in a linear way. Instead, transaction costs increase in a non-linear way. E.g., in a multilateral bargaining situation of 15 governments, each government would have to negotiate with 14 governments. Imagine a constellation with 15 negotiation parties, each consisting of internal factions, varying internal decision rules and more or less defined organizational boundaries, bargaining over multiple issues over more than one sequence. Obviously, even the government with the best resource endowment will think about how this bargaining process could be organized in a more efficient way. How can states economize on transaction costs in intergovernmental negotiations that span over months and years and include many governments? Coalition formation is an emergent phenomenon which is often observed in intergovernmental negotiations. Coalition formation changes the whole interaction structure of negotiations.

A theory of n-person bargaining games that considers coalition formation can proceed in two ways: either, coalition formation is an independent process that takes place prior to the negotiation game, or coalition formation is an endogenous process that is influenced by the ongoing negotiations and influences the ongoing negotiations. Holler (1992: 102) has pointed out that this is not a trivial alternative. A theory of the coalition formation process should explain the number of coalitions that emerge, as well as their members, the distribution of

negotiation power within the coalitions, as well as the goals of each coalition and of each member of a coalition. However, coalition formation is a strategic action. Governments – or individuals, or firms - will join (and might change) a coalition because they expect certain negotiation outcomes from the constellation of coalitions throughout the negotiation process. In other words, players cannot decide to join a coalition independent of their assumptions on the negotiation process. This means that there is no theory of the coalition formation process outside – i.e. independent of - bargaining theory.

2.2 Coalition formation as emergent political phenomenon

A coalition shall be defined as "an agreement on the part of two or more players to coordinate their actions so as to bring about an outcome that is more advantageous to members of the coalition than the outcome that prevails from uncoordinated action" (Ordeshook 1992: 258). There is a well-established tradition in political science of studying coalition formation from a game-theoretic point of view (Riker 1962, Axelrod 1970, De Swaan 1973, Peleg 1980, 1981, Deemen 1997). There are four main questions that theories of coalition formation should answer: What coalition structure is likely to prevail – which players will coordinate their actions and with whom will they coordinate? What will be the extent of this coordination – will they agree to coordinate on all decisions or on only some subset of decisions? What will be the specific intent of coordination – what outcomes will they seek to realize or avoid? How will the members of a coalition enforce the agreements they reach?

Coalition formation theories formulated within the game-theoretic tradition may be classified with respect to the assumptions they make on the players' preferences:

a) *The player as agent with one preference*: these models start from the assumption of agents who have individual preferences for payoff structures. They have no preferences with respect to coalitions, not even with respect to coalitions that may be formed in order to get as much payoff as possible. The preferences are supposed to be exogenously given. This is the perspective of *n*-person cooperative game theory (Riker 1962, Peleg 1980, 1981). The theory is payoff-oriented and it is not designed to predict coalitions (Ordeshook 1986: 408). The theory simply investigates what players gain when joining a coalition. In order to predict coalitions, other theories must be constructed in which additional concepts and assumptions of cooperative game theory are incorporated. Since game theory starts from the assumption of rational agents, i.e. agents who choose alternatives which are best according to their

preferences, this ignorance is remarkable. One reason for this ignorance may be that models that assume agents with two preferences seem too complex (Deemen 1997: 6).

b) *The player as agent with two preferences*: these models start from the assumption of agents who have individual preferences for payoff structures and individual preferences for coalitions (Deemen 1997, Saam/Thurner/Arndt 2004). Both types of preferences will interact with each other. The formation of a coalition is a mean to realize an outcome. Therefore, a player's preference for a coalition is more or less induced by his preference concerning the outcomes. As a consequence, payoff preferences are seen as exogenously given while coalition preferences have to be determined endogenously. Coalition formation is described as a collective choice process guided by the preference of the players for coalitions whereby these coalition preferences are supposed to be determined by the payoff preferences of the players.

Both approaches to coalition formation are very restricted with their assumptions on coalition formation. Coalitions do not emerge from the interaction of the governments, rather, coalition formation is a strict consequence of the model assumptions. This is obviously a heroic assumption which may be removed and replaced by models in which coalitions emerge. Governments that want to bring about a certain prefered outcome need not necessarily form coalitions. Their concession behavior need not be based on an agreement on the part of two or more players to coordinate their actions. Particularly, in multilateral negotiations with many issues it seems unplausible that multiple coalitions form in an explicit way. Either, there would be overlapping memberships in many issue-specific coalitions. Or, there would be only a few coalitions that spread over several issues with several governments outside the coalitions. Both alternatives make bargaining rather more than less difficult.

In the following, we suggest an alternative approach in which coalitions may emerge or not. Coalition formation is conceived as one extreme type of coordinated action in bargaining processes. At the other extreme, there is uncoordinated action. However, in between, there is a type of coordinated action that does not imply coalition formation (see figure 1):

Here Figure 1: Uncoordinated and coordinated action in multilateral bargaining

2.3 Peer coordination in intergovernmental policy networks

In the following we develop the peer coordination type of multilateral bargaining by relying on two lines of theory: First we introduce concepts from theories of interorganizational

network formation, particularly the concepts of interorganizational network, networking, mutual adjustment type of coordination, calculus of interorganizatonal cooperation, and the concept of peers. Second, we relate these concepts to concepts in the policy network line of argument in political science.

Theories of interorganizational network formation

Relying on sociology of organizations, we perceive policy networks as a special type of interorganizational networks (Alter/Hage 1993). Alter and Hage define networks as the basic social form that permit interorganizational interactions in exchange, concerted action, and joint production. Networks are unbounded or bounded clusters of organizations that, by definition, are nonhierarchical collectives of legally separate units. Networking is defined as the act of creating and / or maintaining a cluster of organizations for the purpose of exchanging, acting, or producing among the member organizations (Alter/Hage 1993: 46).

Whetton (1987) has classified the extremly broad concept of coordination that ranges from simple ad hoc agreements to participation in formally organized coordination councils into three types: mutual adjustment, corporate, and alliance. They vary in intensity, form of social power, formalization, and scope of coordination activity. Mutual adjustment is the weakest form of coordination, while corporate is the strongest. Coalitions are an example of the alliance type of coordination. We will focus our attention on the mutual adjustment type of coordination. This type – which may also be interpreted as a strategy of interaction – provides the narrowest range of benefits but also the fewest costs. Complete authority is retained by the participating organizations. Interaction rules are developed as the need arises in the process of interaction. Their violation is not regarded as severely as in other coordination strategies, nor are the types of sanctions for violation as severe. There is no central unit to monitor or detect violations. As a consequence, there are almost no sanctions. The group of organizations that interact in a mutual adjustment type of coordination is refered to as a system of peers (Whetton 1987: 244). Attempts to change the balance of power among organizations tend to be resisted. Social power is based on influence. Coordination is achieved by mutual adjustment. Differences of opinions regarding goals can be resolved only through negotiation between participants. The main difference to the alliance type of coordination is that in the latter power is exercised both by the system and by the members. Alliances are based on a written accord.

Interorganizational cooperation has both costs and benefits. The participation in interorganizational cooperation is based on a rational decision that has been described as "calculus of interorganizatonal cooperation" (Alter/Hage 1993: 35f.). Organizations calculate that the benefit outweigh the losses before they concert their efforts with others. Examples of costs are loss of ressources – e.g., time, money, information -, loss of reputation, loss of autonomy and ability to unilaterally controll outcomes, conflict over goals, and delays in solutions due to problems in coordination. Examples of benefits are opportunities to learn and adapt, gain of ressources, gain of influence over domain, and gain of mutual support.

Policy networks

The term policy network has been used in different ways, e.g. as concept that describes negotiation relations between a plurality of state and private organizational actors that reach a collective decision in a common problem (Héritier et al. 1996), or as a quantitative sociological branch that stresses the relations between actors which are mapped as graphs or digraphs (Laumann/Knoke 1987). Following Pappi/Henning (1998: 554) we refer to policy networks as social choice systems. A policy network denotes the relations between the actors in a policy domain, i.e. the social structural aspect of the domain. A policy domain is defined as the set of actors with major concerns about the substantive area, whose preferences and actions on policy events must be taken into account by other domain participants (Laumann/Knoke 1987: 10). Policy domains are purposefully created by political actors.

Policy networks among member states prior to negotiations are ex-post interpreted as influence networks. Influence is conceptualized as an exchange of resources (Pappi/Henning 1998: 558). Participation in policy networks presupposes the possession of ressources on the side of the actors. Exchanges of resources are continuous in policy domain networks. It is the goal of the actors to bring specific policy decisions closer to their prefered outcome. It is important to note, that not all network members are mobilized for all decisions (Pappi/Henning 1998: 563).

An integrated perspective

Perceiving policy networks as a special type of interorganizational networks, we now relate both lines of theory. Peer coordination in intergovernmental policy networks is reconstructed as a mutual adjustment type of coordination in which governments which belong to a policy domain mobilize their peers in order to bring specific policy decisions closer to their prefered

outcome. Peer coordination is a behavioral strategy of rational governments which are involved in multilateral bargaining. We hypothesize that governments optimize peer coordination in order to bring specific policy decisions closer to their prefered outcome.

In order to explain peer coordination in intergovernmental policy networks the following questions have to be answered: What determines that a government acts as a focal government? What determines that a government is perceived as a peer by a focal government? How many peers does a focal government on average relate to? How often is a peer mobilized in a process of multilateral bargaining by a focal government? What is exchanged in the pair-interactions between peer and focal government? What is the influence that peers have on the focal government? What kind of concession behavior is related to mutual adjustment?

In this paper, we can only hint to the answers to these questions. Originally, the concept of peers refered to the group of people of the same age. People of the same age were assumed to be exposed to and influenced by the same socio-economic and socio-cultural situation, as opposed to people of another age. This concept has been generalized and transferred. Today, it applies to individuals as well as organizations or governments. Government peer selection has to be explained by several determinants, notably all forms of homophily between governments like the preference for the same negotiation outcome, the same political ideology of the political party in government, the same socio-economic and socio-cultural situation of the society, historical ties that relate to common historical experiences, etc. The really crucial question is whether a potential peer is selected if that government shares only some of these determinants with the focal government, while it differs in the others. There is not only a calculus of interorganizational cooperation, but also a calculus of peer selection. Governments with no position on an issue, i.e. governments that do not declare a preference for a position at the beginning of the negotiations, are not selected as peers. Furthermore, governments with no position on an issue never act as a focal government with respect to that issue.

Many peers cause high transaction costs to the focal government. They also bring cognitive overload. As a consequence, focal governments have to economize on peers. On the other side, a focal government has to relate to enough peers in order to get important information and support. We assume that not only the number of peers has to be optimized but also the frequency of interactions to each peer. Too many interactions will cause costs, but will not bring further information and support. However, losses in information and support may result from too few interactions.

In the pair-interactions between peer and focal government both exchange information, particularly, they exchange their present bargaining position. The bargaining positions will change throughout the negotiation process due to concessions of the governments. However, as concessions need not be declared in public they may be private knowledge. Private knowledge will be exchanged in the pair-interactions between peer and focal government. After a focal government has contacted several peers it has information on all present bargaining positions of its peers.

We assume that the focal government is not forced by the peer governments to move to the positions of the peers. Within the mutual adjustment type of coordination they do not have the power to induce concessions. Rather, focal governments describe and explain their view, and discuss and try to convince their peers. Concessions depend on the peers' positions and on the national interest of a focal government with respect to an issue under negotiation (salience, Coleman 1966). The greater the national interest the less likely the nation is to be swayed by the opinion of others.

Each of these peers is also a focal government with specific peers. Altogether, the governments of a policy domain interact in partail networks of focal government and peer governments, which we call peer networks. The peer networks overlap. Particularly in multilateral, multiple issue, multi-stage and multi-level negotiation systems it is very improbable that there is any peer network that does not overlap with at least one other peer network. Concession behavior in these overlapping peer networks is described as mutual adjustment. Focal governments adjust to their peers (and only to them). Adjusting to peers may be reconstructed as rational behavior. Rather than loosing face on conceding to opponents, focal governments will increase their reputation among peers when adjusting to the present positions of the peers. The overall outcome of such a system of overlapping peer networks results from many incremental adjustment processes within the peer networks. An agreement is achieved when these incremental adjustment processes finally converge as a result of overlapping memberships of governments in many peer networks. If they do not converge the negotiations have failed. In this subsection, we just hinted at the action theoretical foundation of our approach. It has to be further elaborated.

Although from the analytical point of view, individual bargaining, peer coordination, and coalition formation may be looked upon as ideal types, from an empirical perspective the dichotomy between uncoordinated and coordinated action in multilateral bargaining may be interpreted as a continuum. Then, individual bargaining may develop into peer coordination

when focal governments start to realize that they have (or once have had) peers, and peer coordination may develop into coalition formation when governments realize that they and their peers have extremely overlapping memberships and that they could benefit from binding themselves into a more formalized mode of coordination, namely coalitions. In other words, coalitions may emerge out of peer cooperation. However, they need not do so. This is the charm of the peer coordination model in intergovernmental policy networks.

A comparison with the *player as agent with two preferences*-model of coalition formation shows some common features. Both models assume governments which have preferences for payoff structures and preferences for governments to coordinate. Both models assume that these types of preferences will interact with each other. Preferences for governments are supposed to be determined by the payoff preferences of the governments.

3. The EU intergovernmental conference 1996

The Intergovernmental Conference 1996 constituted another step – like Maastricht or Nice – of an institutional reform contributing to the constitutionalization of the European integration. Hitherto, EU constitution building proceeds gradually, i.e. member states consented on voluntarily incomplete contracts. The Amsterdam conference took place from April 1996 to June 16/17, 1997. The Intergovernmental Conference 1996 had the purpose of fulfilling Political Union, of (re-) balancing the division of power, but especially of preparing the institutional setting for an EU enlargement. Already the Maastricht Treaty contained provisions for the amendment of the constitutional framework of the EU. These provisions included the date of reconvening as well as particular issues to be negotiated.

During prenegotiations within the so-called Westendorp reflection group, an intergovernmental preparation of the Intergovernmental Conference 1996 took place from June 1995 to December 1995. This group of delegates of the member states reached an agreement on the agenda, i.e. with regard to the issues to be negotiated. The report of the Westendorp group provided a set of roughly formulated issues, i.e. it delivered broad political goals and guidelines. The Service Juridique of the Council of the European Union processed these global issues into 30 precise issues with hard legal options. Each issue included an explicit status quo with indications on its legal status. Legal options were ordinally arrayed going from the least integrationist to the most far-reaching option. This prestructuring of issues and options demonstrates the enormous institutionalization of this negotiation system.

National delegations negotiated during 16 months in Brussels. They tried to find out each other's ranges of maneuver and their discretionary leeways in order to maximize their own governments' expected utility of a negotiation outcome taking into account the implied internal and intergovernmental transaction costs. Through bilateral and multilateral communication, negotiators tried to find out simultaneously their domestic as well as their external restrictions (Thurner et al. 2003, Thurner 2004). This process led to a preliminary settlement of a part of the issues in the Dublin II report (December 1996). The final game reached its climax at the Amsterdam summit. The resulting Amsterdam Treaty was formally implemented through a ratification process under specific constitutional provisions in each member state. [1]

3.1 Further backgrounds of theorizing

Our empirical example requires that we consider another branch of theory. In order to identify the players we need a theory that describes who these players are. It turns out that the players are determined by the decision rule on constitutional reforms of the European Union.

Intergovernmental Negotiations under unanimity rule

Negotiations involving multiple parties take place under different decision rules. Parlamentary negotiations are often governed by voting rules, with simple majorities, two-thirds majorities, or even more complicated double-criteria. In intergovernmental negotiations, simple majority rule may apply. However, we also find unanimity rule very often. E.g. in the European Union, unanimity is necessary for decisions on constitutional reforms. Unanimous decisions are supposed to be efficient and to lead to an optimal aggregation of preferences (Buchanan and Tullock 1997; Rae 1975). However, with increasing number of agents the process of decision-making becomes more and more difficult. In recent years, the efficiency of unanimity rule has been questionned (Colomer 1999; Guttman 1998).

Liberal intergovernmentalism

Following liberal intergovernmentalism (Moravcsik/Nikolaïdis 1999), we view European integration as a sequence of intergovernmental bargains on treaties with the governments continuing to be the 'Masters of the Treaty'. We do not rely to the multi-level governance

[1] An exhaustive identification of formal ex-post ratification requirements as well as discretionary agenda setting powers of all involved EU member states is provided by Stoiber/Thurner (2004).

approach (Hooghe/Marks 2001) that proposes to take into account both domestic interests and institutions as well as international and supranational constellations. Our basic argument is that only the member states have a right to vote on constitutional reforms of the European Union.

3.2 Empirical data

We use a data set on the EU Intergovernmental Conference of 1996 (Thurner/Pappi/Stoiber 2002).[2] Data collection combined analysis of documents and standardized interviews of top-level bureaucrats in EU member states. The survey is centered around 30 documents, so called fiches, (CONF 3801/96 to CONF 3830/96) as prepared by top lawyers of the Council's Service Juridique. The documents are conceived as constituting a multi-dimensional issue space. Each of these issues is considered to constitute a one-dimensional negotiation space with ordinally arrayed options.

The data set includes quantitative data on preferences of the involved governmental actors prior to negotiations, transnational networks among governmental actors as well as negotiation outcomes. Especially, we use data on: (1) the status quo, negotiation options, and empirical negotiation outcome on each issue; (2) the national interest of each member state with respect to each issue (derived from the answers of the ministry of foreign affairs); (3) weights that measure the connectedness of each member state with each other during the pre-negotiation phase (based on how often actors of one member state have addressed actors of another member state; see Thurner/Pappi/Stoiber 2002: 149-158). Policy networks among member states prior to negotiations are ex-post interpreted as influence networks.

4. Structure of the model

Our formal model of peer coordination is based on the theoretical model which we have outlined above and builds on two formal models: the opinion formation model (Weidlich 1994), that is capable of modelling the dynamics of interacting populations with discrete attitudes; and the adaptive play framework (Young 1993a,b, 1998), that is capable of modelling peer selection.

We assume an international negotiation system consisting of 15 governments $i \in \{1,\ldots, 15\}$ negotiating over 46 issues $k \in \{ 1,\ldots, 46\}$. Let $O_k=\{1, \ldots, m_k\}$, where m_k is the number of

[2] Many thanks to Paul W. Thurner for allowing us to use some of the data of this data set.

negotiation options, be the set of possible outcomes for each issue k. Each issue's negotiation options are discrete, ordinally scaled and located in a Euclidian negotiation space. The options are known from empirical data (see section 3). Define the legally defined status quo in the k-th issue $SQ_k \in O_k$ and the Amsterdam negotiation result in the j-th issue $AO_k \in O_k$. Call the announced ideal point of a government *i* in issue *k* $w_{ik*} \in O_k$. Governmental preferences over the outcomes can be characterized by the following von Neumann-Morgenstein utility function $U_i(o_k, w_{ik*}) = 1-|w_{ik*} - o_k|$. We assume issue-by-issue negotiations, i.e. each issue is negotiated separately. Negotiations take place during a time span of 16 months.

For a particular issue, each individual government *i*, starts with a negotiation position, $w_{ik}(0)= w_{ik*}$, at negotiation step 0. This position is known from empirical data (see section 3). Initially, each government selects a random time $\tau(i)$, according to an exponential distribution with parameter λ_i, at which to 'poll the opinion' of other governments and consider a concession. λ_i is the average time between opinion polling. We set λ_i to be proportional to the national interest with respect to that issue. Thus governments to which an issue is important will poll opinion, and thus change opinion, less often than those to which an issue is less important. Governments with no position, i.e. governments that have not declared a preference for a position at the beginning of the negotiations, never poll or affect opinion.

The simulation is then run in discrete time steps as follows. Start with $t=0$.

(1) Selecting the focal government: The government with lowest value of $\tau(i)$ is selected to be the focal government for this time step.

(2) Peer selection: Focal government *i* picks a set *S,* of size *s*,[3] of other governments randomly according to connectedness weightings in the intergovernmental network (empirical data, see section 3). This set of governments are those that the focal government polls the opinions of. The focal government receives information on each peer's actual bargaining position.

(3) Concession behavior: We assume that governments make incremental concessions. From their present bargaining position they move either one position to the left or to the right. The probability that the focal government moves its position to the left increases with the number of polled governments with a position to the left, and likewise the probability it moves right increases with the number of polled governments with a position to the right. Specifically, if $R=|\{j \in S, : w_{jk}(t) > w_{ik}(t)\}|$ is the number of polled governments with a position to the right of the focal government, then the probability that the focal government moves right is

$$\frac{\exp(\alpha R)}{\exp(\alpha R)+\exp(\alpha q)} \quad \text{(eqn 1)}$$

where q is the threshold at which the probability that the government moves right equal ½ and α determines the steepness of this threshold. Figure 2 plots this threshold function for various values of α. As can be seen from figure 2, α dramatically changes the probability that a focal government moves. Whereas there is a smooth increase in the probability to move when α is small (e.g. $\alpha=1$), there is an abrupt increase when α is high (e.g. $\alpha=10$).

We thus select a uniformly distributed number between 0 and 1, and if it is less than eqn 1, the focal government moves one step to the right, i.e. $w_{ik}(t+\tau(i))=w_{ik}(t)+1$. Similarly, if L is the number of governments with a position to the left, then

$$\frac{\exp(\alpha L)}{\exp(\alpha L)+\exp(\alpha q)} \quad \text{(eqn 2)}$$

is the probability that the focal government moves one position left.

Here Figure 2: Examples of eqn 1, plotted for various values of α, with q=3.

(4) We update $w_{ik}(t+\tau(i))=w_{ik}(t)$ for all goverments, j, not equal to i; $t=t+\tau(i)$and $\tau(i) = \tau(i)+\lambda_i$ and return to stage 1.

For an overview on all variables and parameters of the model see table 1.

The simulation ends when all governments have adopted the same position or if no unanimous decision is reached, alternatively when 16 months, have passed the status quo option is adopted (i.e. the negotiations have failed). The mean value of λ_i over all issues was 0.1616 polls per month.

Here Table 1: Variables and parameters of the formal model

5. Model results

We have implemented this model, run experiments and finally checked for the robustness of the simulation results.

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[3] s is equivalent to Young's sampling ratio *r* (see section 2.3).

5.1 Experiments and results

Our experiments concentrated on sample size and quorum. The model was run repeatedly to give a probability distribution of possible outcomes. It turned out that five governments (sample size s=5) is the optimal number of governments that a focal government pools the opinion of. The optimal number of governments to the left (or to the right) of the focal government at which this focal government's probability to move to the left (or to the right) equal 50% turned out to be three or more (quorum $q \geq 3$). We have calculated correlation coefficients to measure the match between simulated negotiation outcome (we use the mode of predicted model outcomes over 20 simulation runs) and empirical negotiation outcome. At best, Pearson's correlation coefficient is 0.74 (model parameters are s=5, q=3.5, and α=5 or α=6, or s=5, q=4, and α=3, see table 2).

5.2 Sensitivity analysis

In order to test whether the model outcomes were simply an artifact of some particular parameterization, we performed a parameter scan of the model. We set s=5 and changed q between 1 and 4.5, and α between 1 and 10. Figure 3 and table 2 show how model performance changed with these parameter values.

In figure 3, model performance is measured by the number of issues where the most common outcome of simulation runs (the mode) was equal to the empirical Amsterdam outcome. Obviously, q and α interact. We find combinations of q and α in which the model performance is better (darker shading) all over the scaned parameter space. The same holds for combinations of q and α in which the performance is rather weak. With the exception of when α=1 or q=1, the model predicted at least 18 out of 46 issues correctly, independent of the parameter values. Rather than model performance improving smoothly with any one parameter, the landscape of model performance is relatively flat with peaks in random positions. This suggests that the model is rather robust to changes in the parameter values, with the variation being accounted for by the stochasticity of individual runs rather than by changes in the parameter values.

Here Figure 3: Results of sensitivity analysis.

In table 2, model performance is measured by Pearson's correlation coefficient. We set s=5 and changed q between 2.5 and 4.5, and α between 1 and 6. A comparison between the scaned parameter space in table 2 und figure 3 shows that the correlation coefficients are more robust

than the shading in figure 3. Measuring model performance by the number of issues that are forecasted correctly is obviously a stricter and more sensitive measure than relying to the correlation between simulated and empirical negotiation outcome.

Here Table 2: Results of sensitivity analysis.

In sum, the sensitivity analysis shows that both parameters are important. Until now, we do not have empirical data on these parameters, and more importantly, our theory does not even give a sociological interpretation to parameter α. Which are the social processes that determine the steepness of the threshold value? This question has to be answered in further studies in order to impove the understanding of the model and its results. Only then, the model performance can be further improved.

5.3 Comparison to an alternative theoretical model

How does our current model's performance compare to that of previous models? In this article, we want to compare the performance of our opinion formation model to that of the enhanced Zeuthen-Harsanyi model.[4] Both models were optimized on base of 17 randomly chosen issues. Forecasts were then calculated for all 46 issues. As stated above, the Zeuthen-Harsanyi model assumes coalition formation, whereas in the opinion formation model coalitions may emerge. We have calculated correlation coefficients to measure the match between simulated negotiation outcome (we use the mode of predicted model outcomes over 20 simulation runs) and empirical negotiation outcome for both models. For the best opinion formation model, Pearson's correlation coefficient is 0.73 or 0.74 (see table 2). For the best enhanced Zeuthen-Harsanyi model, Pearson's correlation coefficient is 0.61 (model parameters are a=1 and x=0.2). The opinion formation model has the best overall performance.

However, both models differ in predicting normal game issues and final game issues. An issue is called a final game issue if it has not been settled until the first 'single negotiation text' as

[4] The enhanced Zeuthen-Harsanyi model (Saam/Thurner/Arndt 2004) is a two-stage incomplete information model which assumes issue-by-issue bargaining. As a first step, all players play a coalition game in which they decide to join one of two coalitions that form at the extremes of the negotiation space of each issue. As a second step, the coalitions play a negotiation game, a dynamic Zeuthen-Harsanyi game (Harsanyi 1956, 1977) which is a battle of sexes until an agreement has been found. This model includes constraints that influence the subjective probability of conflict of each player, like the degree of domestic and international conflict, and the cumulated bargaining power of the players. The negotiation process is reconstructed as a process of successive concessions of boundedly rational coalitions of players.

proposed by the Irish presidency. Then, it had to be settled during the Netherland presidency, notably at the two-day final conference of the prime ministers and presidents in Amsterdam at the end of that presidency. The opinion formation (model parameters are q=3, α=2 and s=5) is tremendously better at forecasting the final game issues (r_{OF}=0.81; r_{ZHM}=0.16) but worse at forecasting the normal game issues (r_{OF}=0.70; r_{ZHM}=0.76; model parameters of the ZHM are a=1 and x=0.2).

In figure 4, we present the grouped predictions for both models in comparison to the empirical Amsterdam outcome. The negotiation space is subdivided into five quantiles with negotiation outcomes between [0.0, 0.2), [0.2, 0.4), [0.4, 0.6), [0.6, 0.8), and [0.8, 1.0]. Both formal models have the same problem in forecasting the fifth quantile correctly. The opinion formation model is better at forecasting the ascending order of the quantiles. However, it is too pessimistic in the forcast for issues that settle far from the status quo (which is located at 0.0 for almost all issues).

In sum, this result verifies our hypothesis. Peer coordination in intergovernmental policy networks in which coalitions may emerge, but need not do so, ultimately proves better at predicting for negotiation outcomes of multilateral, multi-issue negotiations than a model that assumes coalition formation. With respect to normal game issues, the opinion formation model turns out to be a good approximation of the performance of the enhanced Zeuthen-Harsanyi model that assumes coalition formation. With respect to the final game issues, the opinion formation model clearly outperforms the enhanced Zeuthen-Harsanyi model.

Here Figure 4: Grouped negotiation outcome for empirical negotiations.

6. Discussion

In research on multilateral, multi-issue negotiations descriptive case studies still prevail. In this paper, we have contributed to positive bargaining theory on negotiations involving multiple parties. In this setting, the social relations between policy domain actors are crucial for explaining policy outcomes. We have presented and tested a theoretical approach, peer coordination in intergovernmental policy networks, in which the formation of coalitions is no longer a strict consequence of the model assumptions. Coalition formation is conceived as one extreme type of coordinated action in bargaining processes. At the other extreme, there is uncoordinated action. However, in between, there is a type of coordinated action that does not automatically imply coalition formation: peer coordination in intergovernmental policy

networks. This approach gives a dynamical description of how a group of players change their negotiation positions through repeated interactions with neighbours in their social network. Players are assumed to have groups of peers whose negotiation positions are observed and evaluated. Players make concessions into the direction of their peers given that a quorum of selected peers have a different opinion in the same direction. In this model, pair interactions are assumed and coalitions may emerge or not, and their number may vary. Players economize on transaction costs because they only consider the negotiation positions of their peers. We have developed the peer coordination type of multilateral bargaining relying on two lines of theory: theories of interorganizational network formation and the policy network approach. The theoretical model was further elaborated by specification of a formal model which is based on the opinion formation model and the adaptive play framework.

Relying on a data set on the EU Intergovernmental Conference of 1996, we succeeded in verifying our hypothesis that this model ultimately proves better at predicting for negotiation outcomes of multilateral, multi-issue negotiations than alternative theory-based formal models. Peer coordination in intergovernmental policy networks in which coalitions may emerge, but need not do so, ultimately proved better at predicting for negotiation outcomes than the enhanced Zeuthen-Harsanyi model that assumes coalition formation. With respect to normal game issues, the opinion formation model turned out to be a good approximation of the performance of the enhanced Zeuthen-Harsanyi model. With respect to the final game issues, the opinion formation model clearly outperforms the enhanced Zeuthen-Harsanyi model.

We do not yet know exactly the causal explanation for those issues that our model makes bad predictions for. Some of these issues have been described as being strongly bipolar and often asymmetric, with only one or two nations initially having the position that became the final outcome. However, the reason might not be bipolarity or asymmetry. With respect to our model it could also be possible that the empirical intergovernmental networks prior to the negotiations reflect not only peer networks, or that they do not or not always reflect homophily (most important: same preference). The pre-negotiation networks instead could reflect quasi-institutionalized contacts between states of high centrality based e.g. on their generally perceived power. Then, these pre-negotiation networks would not induce the focal government to move to his/her peers but to behave in a different way. In the most simple case, a focal government could just stay where it is. Take, for example Great Britain, that has contacted Germany and France, but does not look upon them as peers and therefore will not move to Germany’s or France’s positions although it pools the opinion of both. So, it might be

that we make good predictions where the pre-negotiation networks reflect homophily, whereas we make bad predictions where they reflect quasi-institutionalized contacts. Here, further research is needed. We need to know more on the causal reasons for establishing network relations. These causal reasons may differ between different types of member states.

We conclude with a discussion of shortcomings of our approach and perspectives for further research:

Although our approach is based on theories of interorganizational network formation and the policy network approach, we are still in lack of a full action theoretical foundation of our approach. Peer coordination has been described as a behavioral strategy of rational governments which are involved in multilateral bargaining. We have hypothesized that governments optimize peer coordination in order to bring specific policy decisions closer to their prefered outcome. However, we have not even tested *this* hypothesis because our theoretical model is not yet precise enough to make predictions on peer selection that could be refuted. Our answers to the following questions have to be further elaborated: Which are the determinants of peer selection? Where does the number of peers of a focal government depend on? What is exchanged in the pair-interactions between peer and focal government? How can the influence that peers have on the focal government be explained? How can the concession behavior that is related to mutual adjustment be explained? When will coalitions eventually emerge? How do we know that coalitions have emerged?

In its present form, the formal peer coordination model which we derived from integrating the opinion formation model and the adaptive play framework includes one parameter which has not yet been given a sociological interpretation: It is α which we have introduced as parameter that indicates the steepness of the threshold q at which the probability that the government moves right (or left) equal ½. α determines whether the probability of the focal government to move increases smoothly or ubruptly near the quorum. But, what is α? Is it a behavior of a focal government? Is it a situational constraint? Does α depend on the peer network? Does it depend on the whole intergovernmental network? We do not yet know. The theoretical framework of our peer coordination model has to be further elaborated to give α a sociological interpretation.

Throughout this article we have looked upon the process of multilateral intergovernmental bargaining as a negotiation between governments. However, as already stated shortly in the section on the EU intergovernmental conference, these negotiations are in fact two-level games. This means that the negotiations are not just negotiations between governments. Rather, they are transgovernmental negotiations (Putnam 1988; for empirical evidence in our

case study see Thurner/Pappi/Stoiber 2002: 149ff.). Several ministries of each government are involved in the pre-negotiations for each issue. Disagreements may arise between ministries and / or governments. Competition within national governments may be bypassed by strategic network formation of equivalent or homologous ministries of internationally cooperating nations. Transnational coalitions may emerge between ministries of similar political preferences acting against their own governments' common objectives. A micro foundation of our peer coordination model would have to consider players on two levels, governments and ministries, who are involved in a transnational bargaining game. Peer coordination in intergovernmental policy networks then turns to peer coordination in transnational policy networks.

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Figure 1: Uncoordinated and coordinated action in multilateral bargaining

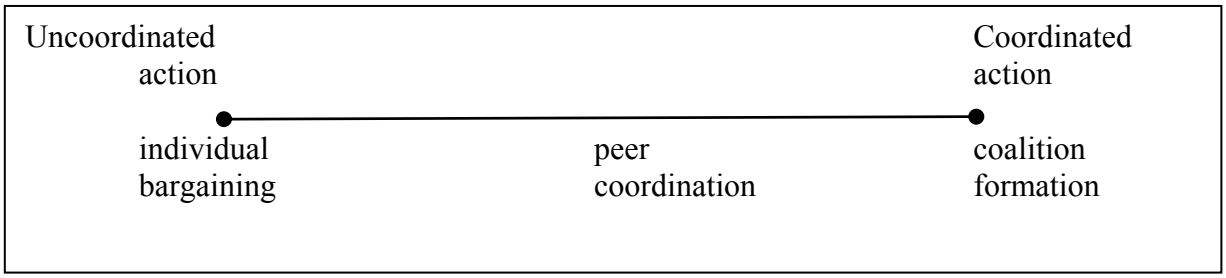

Figure 2: Examples of eqn 1, plotted for various values of α, with *q=3*.

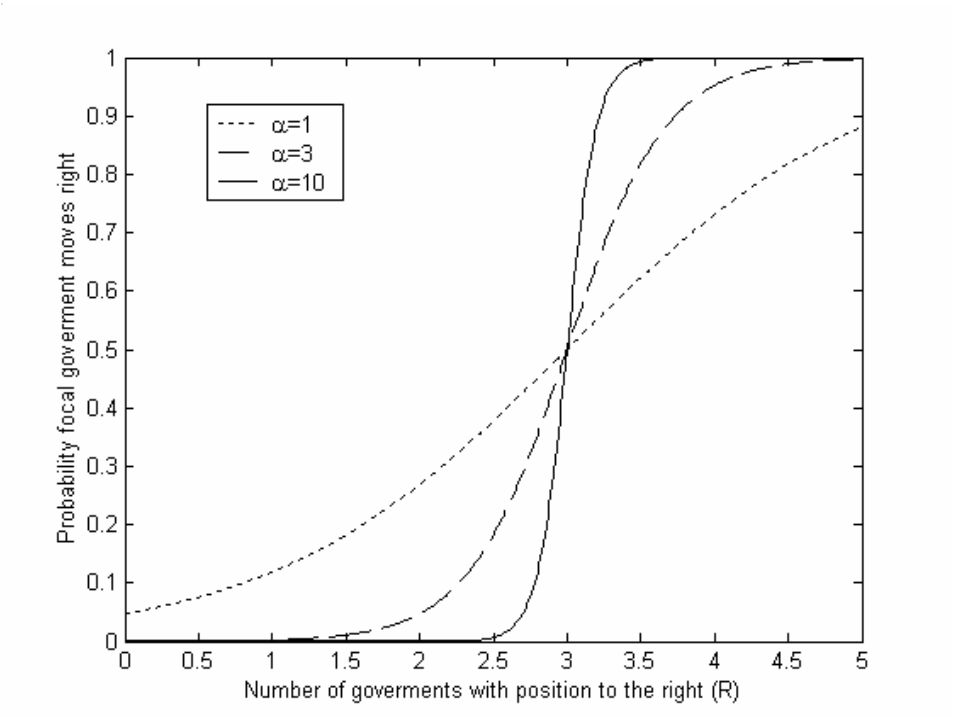

Figure 3: Results of sensitivity analysis. Model performance as a function of parameters, *q* and *α* (*s*=5). The figure shows how the number of issues where the most common outcome of simulation runs was equal to the empirical Amsterdam outcome changes with the parameter values. Darker shading indicates better model performance.

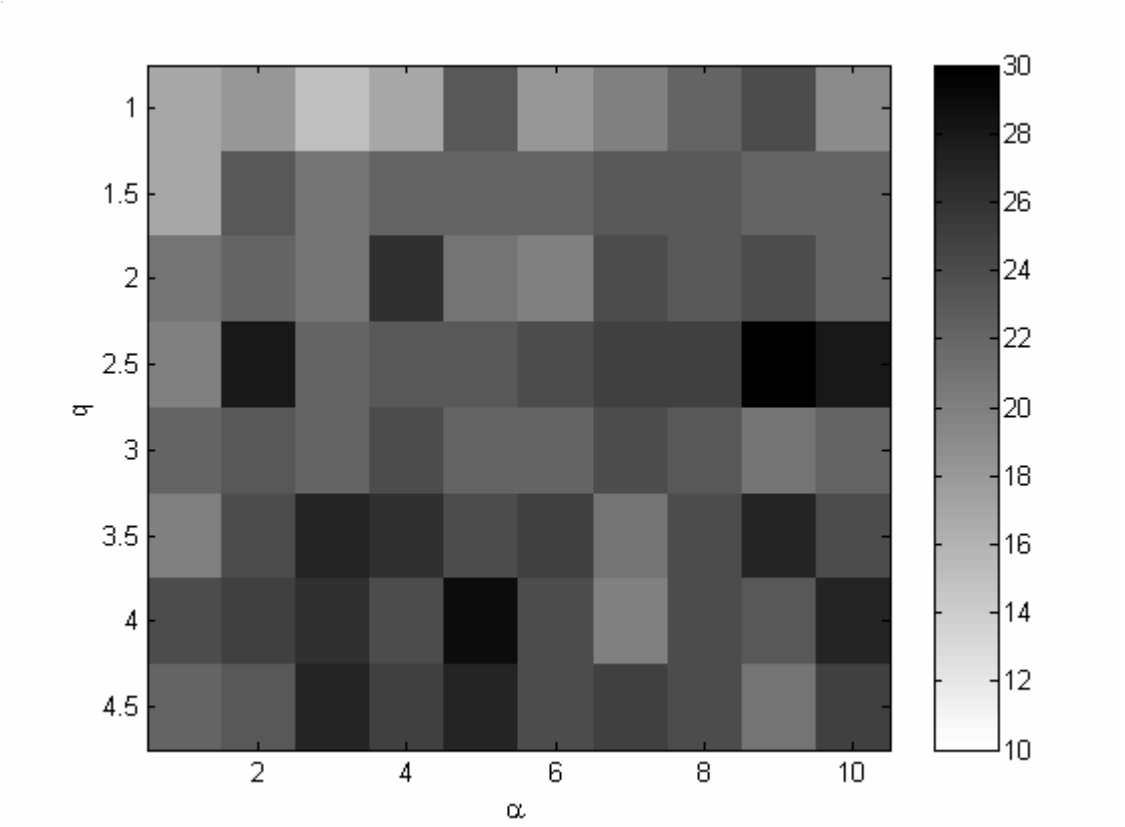

Figure 4: Grouped negotiation outcome for empirical negotiations (Amsterdam outcome AO), and alternative simulated negotiations (opinion formation model, OF; enhanced Zeuthen-Harsanyi model, ZHM), *n*=46 issues.

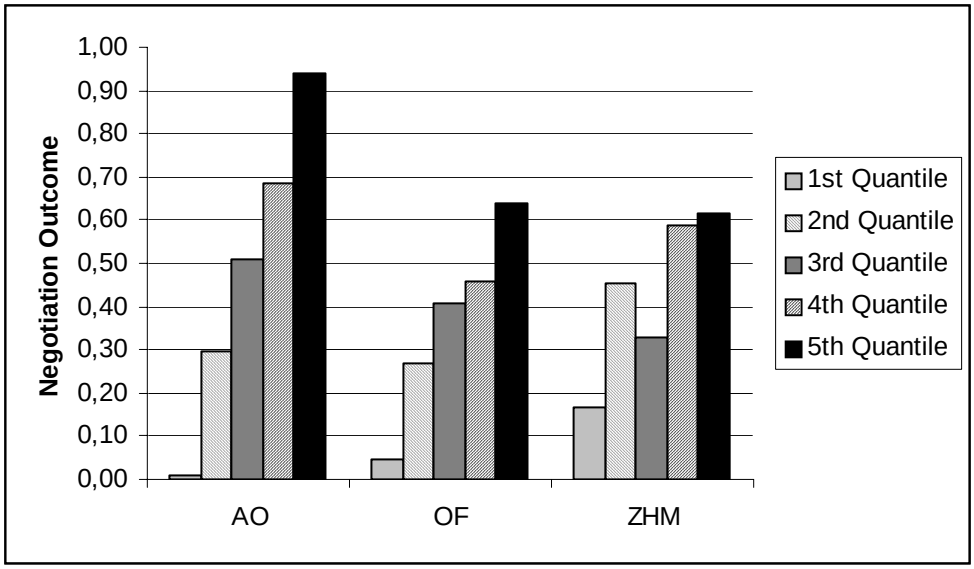

Table 1: Variables and parameters of the formal model

Variable	Interpretation	Initialization
w_{ikt}	**Bargaining position** of government *i* with respect to issue k at t (t > 1)	-
Parameter		
K_k	**Issues** (k = 1 to 46)	empirical data
m_k	**Number of different declared positions** with respect to issue k	empirical data
G_i	**National government** (i = 1 to 15)	empirical data
w_{ik*}	**Declared initial bargaining position of** government i with respect to issue k	empirical data
λ_{ik}	**Salience** of issue k for government i	empirical data
s	**Sample size:** number of governments that a government polls the opinion of	s = 5
q	**Quorum:** threshold value at which the probability that a government moves equal 50%	varied in experiments: $1.0 \leq q \leq 4.5$
α	**Steepness of threshold value**	varied in experiments: $1 \leq \alpha \leq 10$

Table 2: Results of sensitivity analysis. Model performance as a function of parameters, *q* and *α* (*s*=5). The table shows the correlation between simulated negotiation outcome (mode of predicted model outcomes over 20 simulation runs) and empirical Amsterdam negotiation outcome (Pearson's correlation coefficient).

				α		
q	1	2	3	4	5	6
2.5	0.46	0.72	0.71	0.67	0.72	0.71
3	0.71	0.73	0.72	0.73	0.71	0.72
3.5	0.69	0.71	0.71	0.72	0.74	0.74
4	0.71	0.71	0.74	0.73	0.73	0.69
4,5	0.70	0.68	0.71	0.73	0.73	0.69