Conflict measures in cooperative exchange models of collective decision-making

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CONFLICT MEASURES IN COOPERATIVE EXCHANGE MODELS OF COLLECTIVE DECISION-MAKING

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ABSTRACT

This study focuses on externalities of exchanges of voting positions in collective decision-making. Exchanges are represented by non-constant two-person cooperative games. It is assumed that the rate of exchange is specified by the Raiffa-Kalai-Smorodinsky solution, and a model is specified to identify the exchanges. Externality effects of these exchanges are assessed with two conflict measures we develop here. The measures assess within-group and between-group conflict, respectively, and are applied to collective decision-making in the European Union regarding support for fishery infrastructure. The application shows that the measures provide indispensable insights into the decision-making setting and that these can be used for strategic intervention in the setting. It also shows that both actors' power and the outcomes in exchange with externalities are very different from those in exchange without externalities as studied by theories of network exchange.

KEY WORDS • cooperative game theory • European Union • externalities • models of collective decision-making • network exchange theory • social exchange

1. Introduction

Actors, either individuals or organizations, frequently engage in decision situations where the outcomes are dependent on each other's behavior. Most of these situations are bargaining or *exchange situations* characterized by both common interests and opposed interests. Interests are *common* in the sense that the actors prefer cooperation leading to better outcomes than the status quo, and interests are *opposed* in the sense that interests conflict with respect

to which actor gets what in the bargain or exchange. Examples of these situations are numerous. A typical example from economics is a situation of *pure exchange*, where actors wish to exchange bundles of goods they hold at the outset for other more preferred bundles. However, exchange is broader than just the exchange of tangible goods and services. Homans (1958: 606) stated that 'social behavior is an exchange of goods, material goods but also non-material ones, such as the symbols of approval and prestige'.

An exchange can also have *externalities*, that is, consequences for the utilities of actors that are not directly involved in the exchange.[1] Such exchanges are frequently encountered in collective decision-making when deals are made between actors to support each other's positions. These deals are the basis of coalitions in parliament, but they are encountered in many other contexts as well. Well-known examples include the deals made between France and Germany before important European meetings, setting the broad lines of new European Union regulations and institutional arrangements. These deals set the outcomes of decisions or at least change the likelihood of certain outcomes fundamentally. The basic character of these deals is the agreement between two or more actors to exchange voting positions on two issues, i.e. to support each other's position on the issue that is of relatively more interest to the supported actor. Therefore, we represent such deals in the present study as exchanges of *voting positions*. If two actors agree, then such a shift in voting will have positive or negative consequences for the other actors involved as they have an effect on the outcomes of *collective* decisions to be made. *In the present study we derive conditions under which these externalities are positive or negative for other actors and we develop measures for these externality effects*. Because the sign and size of the externality effects are closely related to potential conflicts between the actors in the situation, the measures of externality effects are referred to as *conflict measures*. We illustrate the conflict measures in the context of EU decision-making and show how they can be used in strategic intervention in collective decision-making.

Some theories of *exchanges with externalities* have been developed. Coleman (1972, 1990) studied exchanges with externalities making use of general equilibrium analysis. Coleman's analysis is based on a system in which actors have control over events and are interested in events. Actors exchange control over events to get control over events in which they are interested. Stokman and van Oosten (1994) have shown that Coleman (and researchers such as Braun

(1994) and Marsden (1983), who extended his model to policy networks) had to make many unattractive and ad hoc assumptions to make the model suitable for the analysis of exchange processes in collective decision-making. This is primarily due to the fact that control over an event is a divisible good, whereas an outcome of a collective decision-making process is not. Stokman and van Oosten (1994) therefore developed a model in which actors exchange *voting positions* rather than control. Their representation of exchange is equivalent to the representation of exchange situations by actors who are distinguishable with respect to their *endowments* and *utilities* for commodity bundles, as in pure exchange in classical microeconomics, corresponding to a *natural and valid representation of an exchange situation*. In their model, voting positions take the role of endowments and saliences take the role of utility coefficients. The research in the present study is based on this representation of exchange situations. We show that this representation enables us to develop measures for the externality effects of exchanges for other actors, but also to derive conditions under which actors involved in the exchange face a *social dilemma*.

In Section 2 we briefly introduce the representation of the collective decision-making setting. In Section 3 we illustrate the representation with an example from the EU obtained from a systematic analysis of a proposal of the European Commission regarding EU support for fishery infrastructure made in 1998 (COM(98)728).[2] In Section 4 the exchange model of voting positions is introduced as a cooperative game. The model is an extension of the model of Stokman and van Oosten. Links with research on exchange without externalities in networks, which also assumes cooperative exchange, are explicated. Finally, the section concludes with an application of the model to the fishery example outlined in Section 3. Section 5 is devoted to two measures of conflict in collective decision-making. One measure, referred to as the *within-group conflict measure*, assesses the externalities or utility gain of an actor as a result of exchanges between members of the group to which the actor also belongs. The second measure, referred to as the *between-group conflict measure*, assesses the externalities or utility gain of an actor as a result of exchanges between members of the group to which the actor does not belong. The measures are illustrated with exchange situations from the fishery example. Finally, in Section 6 we present the conclusions of the present study and provide suggestions for future extensions of the model based on the conflict measures.

2. Representation of Collective Decision Situations

The exchange model and the conflict measures derived from it are based on two sets of objects, and a number of variables relating to these two sets. These elements are the foundations of a large number of models of collective decision-making developed by Bueno de Mesquita and co-workers (Bueno de Mesquita 1994; Bueno de Mesquita and Lalman 1986, 1992; Bueno de Mesquita et al. 1985) and by Stokman and co-workers (Stokman and van den Bos 1992; Stokman and van Oosten 1994; Stokman and Stokman 1995; Stokman and Zeggelink 1996; Stokman et al. 2000).

Two sets of objects are distinguished by all these collective decision-making models; *issues* (a, b) on which the decisions are to be made and *actors* (i, j, k) who make the decisions on the issues. The models assume that issues can be represented by unidimensional interval scales. Hence all possible decision outcomes on an issue can be represented by single numbers on a scale with an arbitrary unit of measurement and arbitrary zero point. Three *variables* in the models reflect actor-issue characteristics relevant for decision-making: position, salience, and influence. *Policy position* (x_{ia}) indicates actor i's most preferred decision outcome (O) on issue a. It represents the realistic outcome that i tries to realize in the given political context (Bueno de Mesquita 2000). In the present study, the issues are arbitrarily normalized on a scale from 0 to 100. *Salience* (s_{ia}) represents the interest of actor i in the decision on issue a, or, in other words, the importance of the outcome on issue a for actor i. Like position, salience is measured on an interval scale that in the present study is normalized to run from 0 to 100. *Capability* (c_{ia}) represents the potential of actor i to affect the final outcome of issue a by influencing other actors' positions in the stage before final decisions are made. In Section 3 an example is presented of EU decision-making with all the actors involved and their scores on these three actor-issue characteristics.

3. Example: EU Support for Fishery Infrastructure

Figure 1 is an illustration of two issues raised by the 1998 proposal (COM(98)728) regarding EU support for fishery infrastructure. The Commission wanted to reconcile the contradiction caused by two policies that were pursued by the EU. On the one hand, the EU

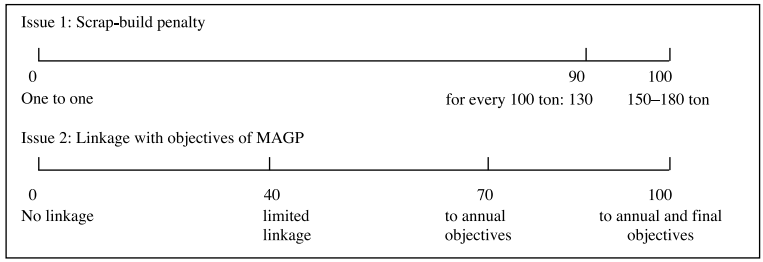

Figure 1. Controversial issues in COM(98)728

had an ongoing program to reduce the size of the fishing fleet (as part of the Multi-annual Guidance Programme, MAGP), but on the other hand the EU gives subsidies for fleet renewal. As new ships are more efficient than older ones, the latter induces larger fishing quantities. Experts specified two controversial elements in the proposal of the European Commission.

The first concerned the size of the scrap-build penalty. It is contested for both environmental and budgetary reasons. The actors in favor of a high scrap-build penalty thought this would restrict the demand for subsidies to renew the fleet. This would mean that newer, more efficient, boats with higher 'killing power' would be introduced at a slower pace. In the proposal, the European Commission called for a scrap-build penalty of 130 tonnes for each new ship of 100 tonnes. The UK favored the most extreme position, a scrap-build penalty of 150 to 180 tonnes of old ship for each new ship of 100 tonnes. On our scale, we scored that position 100. The other extreme, scored as 0, was the status quo position at that time, requiring a penalty of 100 tonnes for every new 100 tonnes. Most member states took the status quo as their initial position. According to the expert, the Commission's most favored outcome on this issue (a scrap build penalty of 130 tonnes) should be scored as 90 on our scale, much closer to the UK's position than to the status quo. Two member states, Denmark and Austria, were scored in between 90 and the most extreme score (see Table 1).

The second controversial element was the proposed linkage of the subsidy with the annual and final objectives of a member state within the context of the MAGP. These objectives are designed to restrict the size of the fishing fleet. The specific policy question addressed here was the extent to which member states should have to achieve

Table 1. Specification of capability, positions and saliences on both issues in COM(98)728. Capability of a member state was equal in both issues. The list of actors is rank-ordered by the ratio of salience linkage divided by salience scrap-building. The last column classifies actors into types on the bases of their positions. Positions and one salience of The Netherlands (bold-faced) are determined by a strategic move of that actor (see sections 5 and 6)

Capability	*Position Scrap-building*	*Position Linkage MAPG*	*Salience Scrap-building*	*Salience Linkage MAPG*	*Actor type*	
40	**0**	**40**	**40**	90	**A**	The Netherlands
85	90	100	60	90	D	European Commission
30	95	70	50	70	D	Denmark
20	95	70	40	50	D	Austria
30	0	70	40	40	B	Finland
85	100	70	65	60	D	UK
60	0	40	65	60	A	European Parliament
20	0	40	70	60	A	Ireland
85	0	40	60	50	A	Spain
30	0	70	65	50	B	Sweden
20	0	50	65	50	A	Greece
40	0	40	65	50	A	Italy
30	0	50	70	50	A	Belgium
25	0	50	70	50	A	Portugal
85	0	40	75	50	A	France
85	0	70	75	50	B	Germany

their objectives, as defined by the MAGP, to qualify for the subsidy. The issue was of concern primarily for budgetary reasons. Most member states have some difficulty meeting the MAGP objectives. Introducing strict adherence to these objectives as a necessary condition for obtaining subsidy for building new boats would have negative financial consequences for the sector. The European Commission took the position that strict adherence to all MAGP objectives should be a condition for receiving subsidy for fleet renewal. This position was scored as 100 on our scale. The Netherlands was said to have most difficulty meeting the MAGP objectives, which caused the Dutch to take the most extreme position on the other side. They would have preferred no linkage at all between the subsidy for building new boats and the extent to which MAGP objectives are met, which was the status quo position at that time. Most other member states took intermediate positions.

The capabilities, positions, and saliences of all member states are listed in Table 1. The actors are the European Commission, the European Parliament, and all EU members except Luxembourg, who took no position on the issue. The positions and saliences of the actors were obtained by interviewing one expert who had in-depth knowledge of EU decision-making and the issues at stake. The capabilities of the actors were obtained from one other expert. Special interview techniques were used that have been extensively tested to assure the validity of the data (Bueno de Mesquita 2000; Stokman et al. 2000).

The final decision on the two issues is 0 on the scrap-building issue (a penalty of 100 tonnes for every new 100 tonnes) and 70 on the linkage issue (linkage with annual objectives). The Netherlands and the UK abstained in the final vote, while all other actors voted in favor.

4. Theory of Exchange of Positions

The models of collective decision-making mentioned in Section 2, including the model developed in the present study, are based on two common assumptions; *maximization of expected utility* and *complete information*. It is assumed that actors have complete information about all actors' positions, saliences, and capabilities. However, it is not assumed that actors foresee all consequences of their behavior. With respect to the assumption of maximization of utility,

actor i's utility is assumed to be additive over (m) issues, where utility for one particular issue a is single peaked with the highest utility for the outcome (O_a) equal to his policy position.[3] In the present study it is assumed that actors are risk neutral, that is, utility is a linear function of the distance between the optimal outcome, equal to the actor's own policy position, and the outcome. More formally,

$$U_i = -\sum_{a=1}^{m} s_{ia}|x_{ia} - O_a| \tag{1}$$

All models mentioned assume that collective decision-making can be characterized by two stages. The first stage can be regarded as the *influence process*, while the second stage refers to the *final decision* or *voting* stage. During the influence process, each actor attempts to influence the other actors in order to optimize his outcomes or utility in the voting stage. The models differ with respect to their assumptions concerning the *influence strategies* actors use in the first stage, and with respect to actors' expectations and predictions of the final decision outcomes in the second stage. The exchange model employed in the present study assumes that actors influence each other, and hence the final outcomes and their utility, by exchanging (voting) positions. In addition, the model assumes that the actors' expectations of outcomes O_a are equal to the mean of the final positions of the n actors, weighted by their capability times salience (Stokman and van den Bos 1992):

$$O_a = \sum_{i=1}^{n} \frac{c_{ia}s_{ia}x_{ia}}{c_{ia}s_{ia}} \tag{2}$$

It is important to note that the theory and the conflict measures proposed in the present study are not dependent on the precise form of (1) and (2) in any way. That is, the conflict measures proposed in the present study can be adapted straightforwardly to other utility and definitions of the expected outcome.

In the present study, it is assumed that an exchange takes place between two actors who maximize their expected utility, attempting to affect the final decision outcome by exchanging their position with one or more other actors. In a bilateral exchange of positions, the two actors have a *common* interest in an exchange of positions when they have *opposed* interests with respect to the issues. Opposed

interests manifest themselves in a combination of fundamental differences in positions and salience over different issues. Exchanges of positions are most profitable between actors who have (1) opposing positions on the issues, and (2) very different patterns of salience. The latter means that one actor is mainly interested in one issue, whereas the other issue is strongly related to higher objectives of the other actor. The result of a position exchange between two actors is that they shift their position in the direction of the other on the issue that is relatively more salient to the other. In this way they create a win-win situation.

Table 2 describes all exchange possibilities of positions on a pair of issues in terms of positions held by the actors. Exchange possibilities only exist between actors who hold opposing positions on both issues, i.e. are located at different sides of the expected outcome on both issues.[4] From this perspective we distinguish four types of actors. An actor of type *A* is located on the left side of the expected outcome on both issues, an actor of type *D* on the right side. They have opposing interests on both issues and are therefore important potential exchange partners. The same holds for actors of type *B* and type *C*. As *A* and *B* have similar positions on the first issue, they cannot exchange. *A* and *C* cannot exchange as they have similar positions on the second issue. Similar arguments hold for *C* and *D* and *B* and *D*. Analyzing the example of Section 3 results in a classification of actors as summarized in the sixth column of Table 1. Calculating the expected outcomes with (2) results in values equal to 26.18 on the scrap-building issue and 57.76 on the linkage issue. On the basis of these values of the expected outcomes, eight actors are classified as type *A*, three as type *B*, and four as type *D*. No actor is classified as type *C*. Note that The Netherlands cannot be classified because it does not have a position on the scrap-building issue. However, because of its position on the second issue it must be either of type *A* or *C*.[5]

In the present study it is assumed, as in Stokman and van Oosten (1994), that exchanges are *jointly binding agreements*. That is, it is assumed that an actor cannot modify his voting position on the (supply) issue, after he shifted his position towards the other actor on this issue.[6] Actors in the example can therefore exchange at most only once. An actor of type *A* can exchange once with an actor of type *D*. Actors of type *B* are excluded from exchanges because there are no actors of type *C*.

Table 2. Possibilities of exchange of voting positions, dependent on the position of the actor in comparison to the expected outcomes on the two issues (left or right).

		Issue 2	
		Left	*Right*
Issue 1	*Left*	A	B
	Right	C	D

Figure 2 describes the exchange process as shifts in voting positions of the actors. Actors from two groups with opposing positions can profit from position exchange if the relative salience of the two issues for each of them is different (Stokman and van Oosten 1994). A position exchange is then profitable for both, but also has important side or externality effects on others' utility. This can clearly be seen in Figure 2. Assume an actor of type *D* attaches relatively more salience to issue 1 than to issue 2 if we compare his saliences with those of an actor of type *A*. Then issue 1 is *D*'s demand issue and *A*'s supply issue. Position exchange between *A* and *D* implies that

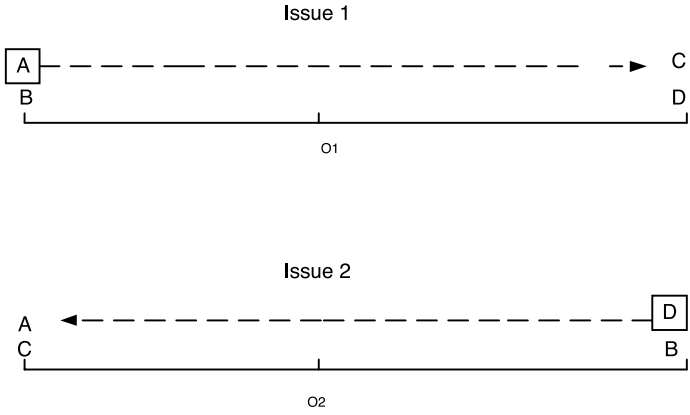

Figure 2. Effects of an exchange between actors of type A and type D on actors of type B and type C.

A is willing to shift his position on issue 1 in the direction of *D*, whereas *D* does the same on issue 2. If they do, they both shift away from *B* in the direction of *C* on both issues. In that case, *B* is punished twice and *C* rewarded twice, while neither of the two is engaged in the exchange. If issue 1 would have been *A*'s demand issue, *C* would have been punished twice and *B* rewarded twice.

Exchange is considered as a cooperative *two-person game* in the present study. That is, in the derivation and the calculation of the conflict measures it is assumed that actors not involved in the exchange do not affect the exchange rate of the exchange under consideration. We are aware that rational actors who experience externalities of an exchange will attempt to influence the exchange and its exchange rate, and therefore also the final decision outcomes. However, by analyzing the exchange possibilities in isolation, the size of the externality effects on other actors can be measured. These measures of externality effects can subsequently be used to predict how actors would react to certain exchanges. In the case of positive externalities they are predicted to encourage the exchange under consideration, in the case of negative externalities they are predicted to attempt to prevent it. The conflict measures in the present article must be regarded as a first step in the analysis of what strategies actors might use in complex exchange situations with externalities. The integral analyses leading to predictions of exactly who exchanges with whom at what exchange rate will be the focus of future research.[7]

It is assumed that two actors only exchange when both gain utility from the exchange. Using the terminology of game theory, it is assumed that the solution (exchange rate) is in the *core* of the two-person game (exchange). For example, consider the possibility of exchange between the UK and Italy. Italy is of type *A*, the UK is of type *D*. The UK is relatively more interested in the scrap-building issue (*a*), with a ratio of saliences equal to 0.92 (60/65). Italy is relatively more interested in the linkage issue (*b*), with a ratio equal to 0.77 (50/65). Hence a shift of the UK on issue *a* towards Italy's position and a shift of Italy on issue *b* towards the UK's position can yield gains to both member states. The exchange that is most profitable to the UK is a shift of Italy to the position of the UK on *b* (from 40 to 70), where the UK's shift on *a* only compensates the expected loss of Italy.[8] The expected gain of the UK because of Italy's shift can be calculated using (1) and (2). It is equal to the reduction in distance between the UK's position and the expected outcome on *b*

times the UK's salience on that issue, or $|\Delta O_b|s_{uk,b}$, with $|\Delta O_b|$ equal to Italy's shift times Italy's relative capability times its salience, or $|\Delta x_{it,b}|s_{it,b}c_{it,b}/\sum(s_{jb}c_{jb})$. Italy's shift on b from 40 to 70 results in a shift of O_b equal to 1.32, and in a loss to Italy equal to 66 and a gain to the UK equal to 79.21. The UK can compensate Italy's loss on b with a shift on a equal to 8.63. The UK's shift results in a utility gain to Italy equal to 66 and a loss to the UK also equal to 66. Hence the exchange most profitable to the UK has exchange rate equal to 0.2878 (8.63/30) and yields an expected gain of 13.21 (79.21–66), while Italy's expected utility gain equals 0. Similarly, it can be calculated that the exchange most profitable to Italy has exchange rate equal to 0.3454 (10.36/30) and yields an expected gain to Italy also equal to 13.21 (79.21–66). Hence the core of an exchange between Italy and the UK contains all exchange rates in the closed interval [0.2878, 0.3454].

It can be demonstrated that for each exchange rate in the interval of the example of an exchange between the UK and Italy, the sum of utility gains of both member states is equal to 13.21. Hence the exchange can be considered as a *constant-sum game*. If all exchanges in a situation are constant-sum games the situation can be represented by a set of divisions of common resource pools as studied in theories of network exchange, which are also constant-sum games. However, not all exchanges of positions can be considered as constant-sum games. Hence theories of network exchange cannot be applied to exchange with externalities.[9] It can be demonstrated that an exchange between i and j on a and b, with i shifting his position on a, is not a constant-sum game when

$$\frac{s_{ia}}{s_{ib}} < \frac{|x_{ib} - x_{jb}|(c_{jb}s_{jb}/\sum_{k=1}^{n} c_{kb}s_{kb})}{|x_{ia} - x_{ja}|(c_{ia}s_{ia}/\sum_{k=1}^{n} c_{ka}s_{ka})} < \frac{s_{ja}}{s_{jb}} \tag{3}$$

Or in words, when the inverted ratio of maximum shifts of the expected outcomes, as a consequence of a maximum shift of the actors on both issues, is in between the relative saliences of both actors. In our example, the inverted ratio of the maximum shifts of the expected outcomes is equal to 8.91 (11.76/1.32), which is not in between the relative saliences in (3), which are respectively 1.08 and 1.3.

Our model of exchange and the conflict measures based on it assume that exchanges are carried out at one particular exchange

rate contained in the core, called the equal proportional utility gain or Raiffa-Kalai-Smorodinsky solution (Raiffa 1953; Kalai and Smorodinsky 1975).[10] There is a strong link between our work in the present study and the exchange-resistance theory of network exchange, because this theory is also based on the RKS solution (Heckathorn 1980; Willer and Anderson 1981). A characteristic of the RKS solution is that in constant-sum games it provides equal utilities to both actors. In our example of an exchange between Italy and the UK, the solution is an exchange rate equal to 0.3166 ([0.3454 + 0.2878]/2), which yields a utility gain of 6.6 to both.

The example of EU support for fishery infrastructure contains more exchange possibilities than the exchange between Italy and the UK alone. Disregarding The Netherlands, because it cannot be classified, it in principle contains 4 (number of *D*'s) times 8 (number of *A*'s) = 32 possibilities. However, 31 exchange possibilities remain because the UK and the Parliament have identical relative saliences and therefore cannot exchange profitably. Only 4 of the 31 possible exchanges can be carried out. A first problem is that four exchanges have to be selected to be able to calculate the conflict measures. The procedure to select the exchanges in the example is as follows. First, for each actor a list of his exchange possibilities is generated and ordered with respect to the utility gain it yields to the actor according to the RKS solution. Then the exchange(s) is (are) carried out that is (are) on top of the list for both actors involved in the exchange(s). Subsequently, in all lists the exchange possibilities with one of the actors involved in the previous exchange are deleted. These three steps are repeated until four exchanges have been selected. A problem could occur in the second step of this procedure. That is, it is theoretically possible that there is no exchange possibility on top of both actors' lists. However, in the example this problem did not occur. The four exchanges that are selected are exchanges European Commission–France, Denmark–Spain, Italy–Austria and UK–Belgium. In Section 5 the consequences of these exchanges for all actors' utilities and conflicts are analyzed.

The exchange possibilities in the example can in principle also be analyzed with theories of network exchange that do not deal with exchanges with externalities. Well-known theories of network exchange are core theory (e.g. Bienenstock and Bonacich 1992), power-dependence theory (e.g. Cook and Emerson 1978; Cook and Yamagishi 1992), exchange-resistance theory (e.g. Willer et al.

1989; Willer 1999), or expected-value theory (e.g. Friedkin 1992). Under the condition of maximally one exchange per actor, all these theories would predict high profits for the actors of type D and low profits for actors of type A. This is due to the fact that the eight actors of type A attempt to outbid each other in order to be able to exchange with one of the four actors of type D. Consequently, profits of the actors of type D are high, the profits of four actors of type A are low, and four other actors of type A become excluded. However, it is shown in Section 5 that the presence of externalities changes the situation dramatically, in the sense that possible or even certain exclusion is no longer sufficient to generate extreme power and outcome distributions. Therefore, the four theories of network exchange are presently not suited to study exchanges with externalities.

5. Measures of Conflict

The consequences of all exchanges on the utility or total utility of an actor i can be decomposed into three components (see also Table 3). The utility gain as a consequence of his *own exchanges*, plus the consequences or (changes in) utility resulting from *exchanges in the own group*, plus the (changes in) utility resulting from *exchanges in the other group*. The 'own group' of an actor is defined as the set of actors that contains his possible exchange partners and the actors that can exchange with his possible exchange partners. That is, the own group of an A actor includes all other A and all D actors. The 'other group' of an actor contains all other actors, e.g. for an A actor all actors of type B and C.

Utility as a result of exchanges between other actors represents externalities. Negative externalities (negative utilities) signal conflict. Therefore the sum of utilities resulting from exchanges in the other group and from exchanges in the own group are denoted by measures of *between-group conflict* and *within-group conflict*, respectively. The two measures are explained in the following. The measures are applied to the fishery example described in Section 3. By considering a possible strategic move of The Netherlands, it is shown that the conflict measures are of great value in gaining insight into exchange situations with externalities in general and collective decision-making in particular.

5.1. Strategic Move of The Netherlands

The positioning of The Netherlands on the two issues is puzzling. On the linkage issue, The Netherlands took an isolated extreme position with a very high salience of 90. If we consider the distribution of the capabilities over the linkage issue continuum, it is clear that the positions 40 and 70 are about equally strong and that only these two alternatives are realistic outcomes. In the EU there is a strong pressure towards unanimity. Taking a lost position with such a high salience is certainly costly. As we explained above, The Netherlands took no position at all on the scrap-building issue, probably due to a conflict between the Ministry of Agriculture and Fisheries and the Ministry of the Environment. It is therefore safe to assume that the main objective of The Netherlands was to safeguard a low outcome on the linkage issue. One may wonder whether that objective could be better served by joining the rather large group of member states with position 0 on scrap-building and 40 on linkage. It would bring The Netherlands out of its isolated position. It would strengthen the coalition behind 40, and would give that alternative extra weight against 70. We can imagine that quite a few political advisers would support such a strategic move. As The Netherlands is primarily concerned with the linkage issue, we assume that the salience on the linkage issue remains high, at 90, but that the salience of The Netherlands for the 0 position on scrap-building could be estimated as rather low, say 40. Table 1 shows that the consequences of this strategic move are that The Netherlands joins the *A* group, but with a relative salience of 2.25 for the linkage issue. With its high relative salience for the linkage issue, the interests of The Netherlands in the direction of the exchange are the opposite of those of the other *A* members. It is shown in the next two sections that this strategic move of The Netherlands dramatically alters the decision situation, improving the situation for two of the four *D* actors, but worsening the situation for all other actors, in particular The Netherlands.

Remember that exchanges are assumed to be jointly binding agreements. Hence, an actor can use a supply issue only once in one exchange. However, after adding The Netherlands the *D* actors have two different exchange possibilities. In one, a *D* can exchange with an actor with the scrap-building issue as supply issue. In the other, he can exchange with The Netherlands with the linkage issue as his supply issue. Therefore, one of the *D* actors can exchange

Table 3. Within and between conflict measures in the original data (first four columns) and after The Netherlands is added to the data (last four columns). Total utility is divided into utility as a result of own exchange(s) (*Own*), of exchanges between members of the own group (C_{iW}), and of exchanges between members of the other group (C_{iB})

	Original data				*Addition of The Netherlands*			
	C_{iB}	C_{iW}	*Own*	*Total*	C_{iB}	C_{iW}	*Own*	*Total*
Netherlands	Missing	Missing	Missing	Missing	0	−494	92	−401
Commission	0	137	140	277	0	110	140	250
Denmark	0	134	45	179	0	125	44	169
Austria	0	68	13	81	0	75	13	88
Finland	855	0	0	855	617	0	0	617
UK	0	−94	4	−90	0	−92	69	−23
Parliament	0	90	90	180	0	23	0	23
Ireland	0	145	0	145	0	61	0	61
Spain	0	97	42	139	0	24	40	63
Sweden	1233	0	0	1233	885	0	0	885
Greece	0	194	0	194	0	101	0	101
Italy	0	173	20	193	0	81	20	101
Belgium	0	244	5	249	0	134	5	139
Portugal	0	249	0	249	0	139	0	139
France	0	128	175	303	0	2	175	177
Germany	1343	0	0	1343	960	0	0	960

twice. Applying the procedure to select the realized exchanges as discussed in Section 4 results in five exchanges, the four in the original example and an exchange between the UK and The Netherlands.

5.2 Measures of Between-Group Conflict

All four exchanges in the original data are exchanges in the AD group. Because there are no exchanges in the BC group, values of between-group conflict for all actors i (C_{iB}) in the AD group are equal to zero (see second column of Table 3). The three other actors are of type B and are rewarded twice by all four exchanges in the AD group, resulting in very large C_{iB} values for the B actors. The non-negative values of the between-group conflict measures indicate that there is no conflict between (members of) the AD and BC group in the original data.

The addition of The Netherlands has no effect on the between-group conflict measures of members of the AD group, because members of the BC group still cannot exchange (see column 6 of Table 3). However, it decreases the positive externalities for the BC group substantially (compare columns 2 and 6 of Table 3). This is because in the exchange UK–The Netherlands, both actors shift their position *away* from the B actors, thereby punishing the B actors twice.

Theories of network exchange without externalities would predict that actors attempt to avoid becoming excluded in order to maximize their own payoff. This changes dramatically in the case of exchanges with externalities. Note that in the example here, actors of type B are necessarily excluded, do not prevent exclusion, and profit more than all other actors in the situation. This illustrates that in the case of externalities there is no longer a close correspondence between being included or excluded in exchanges and profiting from these exchanges.

5.3 Measures of Within-Group Conflict

Within-group conflict is caused by negative externalities of exchanges among actors of the own group. Externalities in own group exchanges can originate in two fundamentally different types of exchange situations, in which the character of the within-group conflict is also fundamentally different. In situation (I) externality

effects can be negative but are usually positive; in situation (II) externality effects are always negative and always lead to within-group conflict. Both situations are discussed separately below and applied to the fisheries example.

Exchange Situation (I)

Exchange situation (I) occurs when in the pairs of exchange possibilities between two actors of one type, say A, with one actor of the other type, in this case D, the type D actor is either relatively more or relatively less interested in issue a than *both* type A actors. More formally, if the actor of type D is symbolized by i, and both type A actors by $j = 1$ and $j = 2$, then situation (I) occurs among all triples of actors D_i, A_1, A_2 with

$$\frac{S_{ia}}{S_{ib}} < \frac{S_{ja}}{S_{jb}} \quad \text{for} \quad j = 1, 2 \quad \text{or} \quad \frac{S_{ia}}{S_{ib}} > \frac{S_{ja}}{S_{jb}} \quad \text{for} \quad j = 1, 2 \qquad (7)$$

Note that in the original data all Ds are relatively more interested in the scrap-building issue than the A actors. Hence, all pairs of exchanges conform to exchange situation (I). Hence, both A_1 and A_2 (and all other A actors) propose to shift their position on the scrap-building issue. However, only one of the A actors can exchange with the D actor. It can be shown that D prefers to exchange with the A actor that is relatively most interested in A's demand issue, while both As prefer an exchange between D and the A that is least interested in their demand issue. In the literature this phenomenon is called the *principle of least interest* (e.g. Homans 1974). The principle states that if A_1 is less interested in what both As want, then A_1 can make a better deal or exchange rate with D than A_2.

Of course, the D and the A involved in the exchange profit from the exchange. The externality effects of the exchange on the remaining A actor, say A_2, are usually positive but can be negative. A_2 profits from the exchange A_1–D when the rate of this exchange is also in the core of exchange possibility A_2–D. A_2 loses utility when the rate is not in the core of A_2–D. Because the least interested A can make a better deal than the most interested A, negative externalities can only occur if the most interested A exchanges at a rate that is not profitable to the least interested A.

In the original data, all A and D actors experience positive externalities as a consequence of exchanges in the own group, except the

UK, the D actor that is least interested in D's demand issue (scrap-building). Although the UK gains utility in the exchanges Denmark–Spain and Italy–Austria, it loses much more utility in the exchange European Commission–France. The sum of the consequences of these exchanges or the value of within-group conflict C_{iW} is equal to -94 (see third column of Table 3). These losses of the UK are not compensated by a gain equal to 4 as a result of the UK's own exchange with Belgium (column 4), yielding a total utility change equal to -90 (column 5). It is interesting to note here that the UK (together with The Netherlands) was also the only actor that abstained from voting. Finally, note that $C_{iW} = 0$ for all B actors because they do not exchange, and that their total utility gains are relatively much larger than those of the other actors because they profit from all position shifts in all exchanges without any concession from their own side.

The addition of The Netherlands to the example does not add new exchange possibilities of situation (I) because The Netherlands is more interested in the other A's supply issue than all D actors.

Exchange Situation (II)

Exchange situation (II) refers to all pairs of exchange possibilities between two actors of one type, say A, with one actor of the other type (D), where the relative interests of the D actor are in between the relative interests of the A actor. More formally, if the D actor is symbolized by i and A_1 and A_2 by respectively 1 and 2, then the externality effect is negative if

$$\frac{s_{2a}}{s_{2b}} < \frac{s_{ia}}{s_{ib}} < \frac{s_{1a}}{s_{1b}} \tag{8}$$

In situation (II) A_1 and A_2 have conflicting interests with respect to their demand and supply issue in an exchange with D. A_1 is prepared to shift his position in the direction of D on issue b. In contrast, A_2 wants to maintain his position on issue b and is prepared to shift his position on issue a in the direction of D. If D exchanges with A_1 then actor A_2 loses utility. If the other exchange is carried out, A_1 loses. Hence, as opposed to situation (I), externality effects of exchanges are *always negative*. Therefore situation (II) always results in within-group conflict and can be very threatening for internal group cohesion.

Exchange situation (II) does not occur in the original data, but is created by the addition of The Netherlands. The addition of The Netherlands, an *A* actor, worsens the utility of all other *A* actors because of the exchange UK – The Netherlands, as can be seen in Table 3 by comparing the values of C_{iW} in columns 3 and columns 7. Hence The Netherlands induces some intragroup conflict, although the values of C_{iW} are still positive for the other *A*s. However, The Netherlands experiences the largest negative externalities and within-group conflict. Its value of C_{iW} is negative, because The Netherlands is punished by all other exchanges. The exhange rate of the exchange UK – The Netherlands is of course profitable for the UK. However, for the remaining other *D* actors, the European Commission, Denmark, and Austria it is only profitable for Austria and not for the other two countries because the exchange rate of UK – The Netherlands is not in the core of the possible exchanges EC – The Netherlands and Denmark – The Netherlands. Finally, note that even after a very profitable exchange with The Netherlands (65), the total utility gain of the UK is still negative ($-23 = 4 + 65 - 92$).[11]

5.4 Conclusions with Respect to Strategic Move of The Netherlands

The analysis of the new situation with the conflict measures suggests that the strategic move of The Netherlands is a bad one, one that should be avoided. *Only* the UK profits from the move (although the UK's utility is still negative), but it harms *all other A* actors including The Netherlands itself. It creates within-group conflict with other members of the *A* group *and* it reduces the utility of the members of the opposite group. Moreover, the move results in a situation where, after the exchange, The Netherlands takes an isolated position on *both* issues, instead of only on the linkage one as in the original example.

In a similar way it is possible to evaluate the positioning of The Netherlands if it would join the 40 group on linkage but the 90 group on scrap-building. The Netherlands then would be the only member in the *C* group. We will not do that here, as our main objective is to show how bilateral exchanges with externalities can create important conflicts and how such conflicts can be evaluated by several conflict measures.

6. Conclusions and Discussion

We demonstrated that two-person cooperative games can create serious conflicts if the outcomes of such games have externality effects for others. We elaborated this for bilateral exchanges of voting positions in collective decision-making processes. Exchanges of *voting positions* solve a number of problems with the extensions of Coleman's model for collective events. Moreover, it connects Coleman's model both with other important models of collective decision-making in political science and with research on network exchange. We argued that the fixed price representation or common resource pool split used in research on network exchange, which implies that exchange is a constant-sum game, is not an appropriate representation of exchange, and not suited to studying the externality effects of exchange. We adopted the more appropriate pure exchange representation of classical microeconomics, with voting positions on issues taking the role of endowments, and saliences on issues taking the role of utility coefficients. Our analyses showed that some (5 out of 35 potential) exchanges in the example were not constant-sum games, indicating the invalidity of the fixed prize representation.

The conflict measures developed in the present study are based on the externalities of bilateral exchanges of voting positions. It was assumed that negative externalities of exchanges were associated with conflict. Exchanges were categorized into exchanges between members of the AD group and between members of the BC group. Each of these groups consists of two subgroups with opposite positions on both issues but with a common interest in an exchange. One measure was concerned with between-group conflict, that is externalities of exchanges between members of the other group, the other with within-group conflict, caused by exchanges between members of the same group. The externalities of an exchange were calculated on the basis of the assumption that the rate of an exchange is equal to the RKS or equal proportional utility gain solution. Two types of exchange situations could be distinguished that generate fundamentally different within-group conflict. In type (I), externalities are usually positive, but in type (II) externalities were necessarily negative.

The conflict measures were applied twice to an example of EU decision-making with two issues regarding support for fishery infrastructure. In a first application, the member state The Netherlands

was excluded. Values of the measures showed that all three *B* actors profited from the exchanges in the AD group. Because all exchange situations were of type (I), externalities of exchanges in the AD group were mainly positive, indicating that most members did not experience within-group conflict. Only the UK, the *D* actor least interested in *D*'s demand issue, experienced in total negative effects from exchanges between members of the AD group.

On the basis of an intuitively good strategic move, The Netherlands was added as an *A* actor, relatively more interested than all other actors in the linkage issue. This move had major consequences for both within-group and between-group conflict. The move resulted in *D* splitting the *A* group, creating exchange situations of type (II), creating more within-group and between-group conflict than before. In comparison to the situation without The Netherlands, (i) the *B* actors profited less, (ii) two of the *D* actors profited more, and (iii) the *A* actors profited less. On the basis of these analyses it was first concluded that the intuitively attractive strategic move was not a good one for The Netherlands and its *A* group. The conflict measures can also be used for other strategic moves of other actors; we therefore argue that the measures are of great value in gaining insight in strategic considerations in collective decision-making situations and for strategic intervention in these situations.

The example was simple in that it consisted of only two issues. The analyses can be generalized straightforwardly to collective decision-making situations consisting of more issues. We have already applied the conflict measures in intervention studies to provide strategic advice to clients on how to bargain with other actors in multi-issue collective decision-making situations. In these situations each pair of issues is analyzed separately. The only difficulty is that the theory to select the realized exchanges from all potential exchanges becomes increasingly complex.

The conflict measures are only a first step in the strategic analyses of collective decision-making situations. The analyses are static and do not acknowledge *how* actors deal with the externalities or conflicts. At least four potential, not mutually exclusive mechanisms to solve the conflicts can be identified. One of the mechanisms is to allow actors to impose external restrictions on exchanges in the form of contracts between two or more actors in order to prevent large negative externalities occurring. In our research we are more interested in the other three mechanisms, which do not result from externally imposed structures like contracts, but from structures

already present in the collective decision-making situation. These three mechanisms extend bilateral exchanges on a pair of issues at a certain time point to agreements including *future* exchanges, to exchanges between *groups of actors*, and to exchanges of voting positions on *more than two issues*.

Situation (II) contains exchanges that always have negative externalities and hence within-group conflict. Future interactions can have an effect on conflict situations that do not seem to be solvable. For example, assume that A_1 and D_1 can only exchange by making A_2 lose utility, and that at a later time these actors enter an exchange situation where A_2 can make an exchange where A_1 or D loses, or both lose. Then, after taking into account the effect of the exchanges at the two time points, the possible conflicts can be solved by making no exchange at all. Other effects of future interactions can be thought of.

Another mechanism is to allow for cooperation or exchange between groups of actors, that is, *group exchange*. For example, in the example without The Netherlands, cooperation or exchange between all A and D actors seems reasonable. In particular, the UK is interested in cooperation between the A actors to prevent it experiencing negative externalities because of exchanges of individual A countries with members of the D group.

A final mechanism to deal with conflicts is to link exchanges on a pair of issues with other potential exchanges on other issues. It is reasonable to assume that if a pair or a group of actors negotiate about a set of issues, they involve all the issues in the negotiation, and not only one pair of issues. A simple extension of the analyses here is a bilateral exchange consisting of shifts of two actors on all issues such that both actors have an equal proportional utility gain, not on two, but on the whole set of issues.

We plan two future studies on externality effects in exchange. First, as in the present study, we will focus on externalities of exchanges of voting positions in collective decision-making. In this study we will work out and formalize the three mechanisms outlined above. In a second study we plan to apply the analyses and conflict measures in the present study to exchanges of goods with externalities. We plan experiments in which actors in a network, distinguishable with respect to their *endowments* and *utilities* for commodity bundles, can exchange with each other. The experiments are similar to experiments in network exchange research, with two differences. First, the pure exchange representation instead of the fixed prize

representation will be employed. Second, externality effects will be introduced by making an actor's utility dependent on other actors' endowments. The analyses and conflict measures in the present study can then also be applied to *and* experimentally tested with the exchanges of goods.

NOTES

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1. *Exchange without externalities* as a typical example of bargaining is intensively studied in economics (e.g. Young 1975) and in the fields of social psychology and sociology (see special issues of *Social Networks 14* (1992) and *Rationality and Society 9* (1997)). Research on exchange in sociology and social psychology focused on the effects of *network structure* on outcomes in exchange in small groups (e.g. Cook et al. 1983; Molm 1997; Willer 1999). Small-group exchange research in economics mainly focused on explaining outcomes in bilateral exchanges (e.g. Roth 1995) and exchange markets (e.g. Holt 1995; Sunder 1995). In most social and economic small-group exchange research, exchange is represented as a game in which formally identical actors bargain how to divide a fixed prize. Similarly, experimental tests of the social exchange theories represented an exchange situation by a *constant-sum game* or a *common resource pool split* as in bilateral bargaining research. Most researchers in the field justify the representation by stating that it is equivalent to an exchange situation (Cook and Emerson 1978: 725–6; Markovsky 1987: 104; Willer et al. 1989: 350; Willer 1992: 198; Skvoretz and Willer 1993: 803; Molm 1994: 169). However, it can be proved that exchange is *not* equivalent to a constant-sum game in some common exchange situations (van Assen 2001). The fixed prize representation of exchange and the equivalent common resource pool split are not appropriate to studying the effect of *externalities* in exchange. The inappropriateness of the representation at least partly explains the absence of small-group exchange research on this issue.
2. The example is part of the study of the research group working on the project *Decision Making in the European Union*. This project was initiated by social scientists from universities across Europe and the United States: Christopher Achen (University of Michigan, USA), Madeleine Hosli (Free University of Amsterdam, The Netherlands), Thomas König (University of Konstanz, Germany), Gerald Schneider (University of Konstanz, Germany), Bernard Steunenberg (Leiden University, The Netherlands), Frans Stokman (University of Groningen, The Netherlands), Adrian Van Deemen (University of Nijmegen, The Netherlands), and Mika Widgren (University of Helsinki, Finland). An additional seven researchers are currently working on the implementation of this project. This group is officially recognized by the European Consortium for Political Research, and is funded by the Dutch and German National Science Foundations (*Nederlandse Organisatie voor Wetenschappelijke Onderzoek* and the *Deutsche Forschungsgemeinschaft*). Robert Thomson conducted the interviews

from which the data of the example were generated. We thank him for providing us with the data for this illustration.

3. Wherever we use the male form we also imply the female one.
4. If both actors are on the same side of the expected outcome, a shift on one issue of one actor to the other actor with the more extreme position is also profitable. In this case exchange is not necessary and is therefore redundant.
5. Spokesmen in the Dutch administration indicated that the scrap-building issue was highly controversial. The Ministry of Agriculture and Fishery strongly supported the status quo position of 0, whereas the Ministry of the Environment favored the position of the European Commission (90).
6. If an actor shifts his voting position on the supply issue in the direction of the other actor, but not completely, the other actor will not object if the actor uses the supply issue for a further shift in his direction in another exchange. We exclude this option in the present study because it unnecessarily complicates our analysis and does not yield fundamentally new insights.
7. Directions for future research with respect to the integral analysis of exchange of voting positions in collective decision-making are outlined in the Conclusions section (Section 6).
8. It is assumed, as in the exchange model of Stokman and van Oosten (1994), that a larger shift of Italy towards 0, which is much more extreme than the UK's position, is not credible, even though it makes a more profitable exchange possible.
9. It can also be demonstrated that theories of network exchange do not deal with exchanges of goods without externalities. Analogous to (3), in case of *pure exchange* as studied in classical microeconomics (Kreps 1990: ch. 6) exchange is not a constant-sum game if $u_{ia}/u_{ib} < E_{jb}/E_{ia} < u_{ja}/u_{jb}$. Symbol u_{ia} denotes the linear utility coefficient of i for one unit of endowment a. E_{ia} denotes the number of i's units of endowment a. This result implies that the representation of exchange by a common resource pool division is invalid for the exchange of endowments. It also suggests that theories of network exchange would be more general when applied to exchange situations that are represented by actors having utilities for endowments. A part of van Assen's (2001) dissertation offers a review and a critique of representations of (negotiated) exchange in economic and sociological research.
10. The conflict measures proposed in the present study can be adapted straightforwardly to other solutions in the core, e.g. the equal utility gain solution or the Nash solution (Nash 1953).
11. Adding The Netherlands results in slightly other rates in exchanges that do not involve The Netherlands, because its capabilities on the scrap-building issue enter the analyses. Therefore, the measure of realized within-group conflict of the UK is slightly different in the two examples (−94.33 versus −92.36).

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