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MODELING CONFLICT AND EXCHANGE IN COLLECTIVE DECISION MAKING

by

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Résumé. Modélisation de conflits et d'échanges dans la prise de décisions collectives. Deux modèles dynamiques de prise de décisions collectives sont présentés et illustrés par un exemple simple. Une présentation et une application plus élaborées concernant la Communauté européenne peuvent être trouvées dans Bueno de Mesquita et Stokman (1994). Les deux modèles reflètent deux approches alternatives de la prise collective de décision et de la politique. La première, représentée par le modèle de l'utilité anticipée, conceptualise la prise de décision collective comme résolution de conflit, comme un jeu non-coopératif, fondamentalement différent des relations d'échange en économie. La seconde, représentée par le modèle d'échange de Stokman et Van Oosten (1994), ne voit pas de différence fondamentale entre échanges économiques et prise de décisions politiques. **Modèles dynamiques, Prises de décisions collectives, Résolution de conflits, Relations d'échange économiques.**

Abstract. Two dynamic models of collective decision making are introduced and illustrated with a simple example. A more extensive presentation and application concerning the European Community can be found in Bueno de Mesquita and Stokman (1994). The two dynamic models reflect two alternative views of collective decision making and politics. The first, represented in the expected utility model, conceives of collective decision making as conflict resolution, a non-cooperative game, fundamentally different from exchange relations in economics. The second, represented in the exchange model of Stokman and Van Oosten (1994), does not see fundamental differences between economic exchanges and political decision making. **Dynamic Models, Collective Decision Making, Conflict Resolution, Economic Exchange Relations.**

INTRODUCTION

In this paper, two dynamic models of collective decision making are introduced and illustrated with a simple example. A more extensive presentation and application concerning the European Community can be found in Bueno de Mesquita and Stokman (1994).

The two dynamic models reflect two alternative views of collective decision making and politics. The first view, represented in the expected utility model, conceives of collective decision making as conflict resolution, a non-cooperative game, fundamentally different

from exchange relations in economics. Bueno de Mesquita developed a very powerful dynamic model that is based on this view (Bueno de Mesquita et al., 1985; Bueno de Mesquita and Lalman, 1986; Bueno de Mesquita, 1994). The second view, represented in the exchange model of Stokman and Van Oosten (1994), does not see fundamental differences between economic exchanges and political decision making. It conceives of collective decision making as a cooperative game in which all actors can gain under certain conditions and in which promises to shift positions are taken as binding commitments. Exchange models of social systems go back to Coleman (Coleman, 1972; 1990). The important difference between Coleman's model and the model presented here lies in the commodity that is being exchanged. Whereas Coleman assumes that actors exchange control over issues, Stokman and Van Oosten conceive of collective decision making as a process in which voting positions are exchanged. The latter makes it possible to predict the content of decision outcomes whereas the Coleman model was able to predict only outcomes for pro/con decisions. Moreover, the model is based on the same set of variables and basic assumptions as the Bueno de Mesquita conflict model. This enables us to compare directly consequences of different fundamental processes in politics. In reality both processes may be assumed to take place simultaneously. The two models provide us with the tools to study the conditions under which the one is more likely than the other.

The two models share the most basic assumptions, namely unidimensionality of decisions and single-peaked preference functions for the actors. Unidimensionality means that the possible outcomes of a decision can be represented as points on a line; as values on an underlying continuum. Some issues, like the size of a budget, seem to fulfill this criterion easily, but for others special interviewing techniques are required to transform the different alternatives into such a scale.

Collective outcomes can not be explained without reference to the choices made by the actors in the relevant social system. At the highest level of abstraction, actors are assumed to have monotonically increasing utility functions related to universal goals, like physical well-being and social approval, but they have different instrumental preferences for the means that lead to these ultimate goals (Lindenberg, 1990, 741). In this perspective, outcomes of collective decision making can be perceived as instrumental goals: whereas one outcome can produce physical well-being or social approval for one set of people, another outcome can be better for others. Within a collective decision making setting, differences of instrumental goals among actors result in two types of relations between actors and issues.

First, what is an important issue for one actor might well be irrelevant for the realization of the ultimate goals of another actor. Second, differences in instrumental goals result in diverging political stances of actors on issues. Consequently, people can be expected to behave quite differently despite the assumption that they are all rational in the sense that they are interested in maximizing their welfare. Even people in possession of the same information and, of course, holding the same universal goals, may nevertheless have radically different instrumental objectives.

The importance of an issue a for an actor i is denoted by the *salience* actor i attaches to issue d (s_{id}). The outcome on issue a that actor i desires is denoted by the actor's *policy position* on the issue (x_{id}). The policy position expresses the policy preference of the actor, while the salience expresses the relevance of the issue compared to other (perhaps unspecified) issues. These two elements--position and salience--are combined into a utility function for each actor that specifies the value the actor attaches to each feasible alternative outcome on the issue in question. The policy position, then, denotes the point on the continuum that has the highest utility for the actor. For any actor, the utilities of the other alternatives are assumed to be a function of their distance from the actor's most preferred position, taking the salience of the issue into account.

The next basic assumption has to do with the transformation of the preferences of the actors into a collective outcome, a final decision. This step requires a third element in which actors differ fundamentally, namely their *capability* to influence the collective outcome (c_{id}). In both models this is the third empirical element that needs to be specified within a field of application. The models differ slightly in their assumptions about how this transformation occurs. The Bueno de Mesquita expected utility model (EU model) take the median voter position as the predicted outcome, whereas the Stokman and Van Oosten exchange model takes the mean of the votes as the predicted outcome.

The similarity of variables and basic assumptions in the models makes it possible to compare them in terms of their fundamental difference, namely the assumed dynamics in the decision making process. Both models do not take the initial median vote or mean vote as the predicted outcome, but as the starting point from which actors try to improve their utility through the decision making processes. The Bueno de Mesquita expected utility model gives actors the opportunity to challenge the positions of other actors if they expect a positive outcome from such a possible confrontation. In this process actors may be forced to take less attractive stances if they have no better alternatives. These challenges may, therefore,

result in forced or negotiated shifts of policy positions for some actors and consequently may imply shifts in the predicted collective outcome. This process is repeated until no further important effects on the outcome of a decision can be observed.

The Stokman and Van Oosten exchange model assumes that the dynamics in decision making result from the possibility of actors exchanging voting positions over a set of decisions. For instance, consider two actors with opposing policy positions on two issues. Let us furthermore assume that the first actor has less interest in the first issue than in the second and that the reverse is the case for the second actor. Then both actors can expect to gain utility if the first actor supports the policy position of the second actor on the first issue in exchange for support from the second actor for his own policy position on the second issue. In this model, actors do not challenge one another; they cooperate by logrolling to get a better expected solution for all. Whereas the actors behave strategically in the expected utility model, they are sincere and cooperative in the exchange model.

AN EXAMPLE

We will illustrate the two models with a small empirical example, namely the future of the Dutch water provision. The 1994/1995 NIAS Research Group on Social Dilemma's investigated the policy alternatives for the Dutch water provision (Ruys *et al.*, 1995). On the basis of an economic and institutional analysis, three major issues were singled out for a prospective analysis. The data for this prospective analysis were obtained by interviewing two experts.

The first issue (Table 1) deals with the *concentration* of the water provision to be expected in year 2000. If we take into account ongoing mergers, the status quo can be characterized as production and distribution by twenty water companies who coordinate their policies in a loosely organized union, the VEWIN (position 100). Table 1 shows that several groups support the status quo. However, a number of groups want more concentration and a stronger coordination. As owners of important water companies, Provincial Authorities fear to loose control by further concentration but are open for stronger coordination through a holding-like organization (position 75). Many CEO's of water companies (VEWIN vertical integration proponents) aim at further concentration of water production and distribution. In their view, water production and distribution should be concentrated in about six large companies with a loose coordination structure (position 25). The Ministry of Environment (VROM) wants in addition a strong coordination of the

six companies in one holding (position 0). In this way the Ministry is assured of a strong control on the environmental effects of water production.

The second issue deals with the question of whether the water production and distribution should be organized by separate water companies or integrated with production and distribution of electricity. Table 2 shows again strong support for the status quo (position 0) with some support for a free choice of mergers with the energy sector (position 50). Only one group is in favor of enforced merger of the water and energy production and distribution (position 100). This is the minority in VEWIN, consisting of CEO's of water companies who have already been merged with electricity companies (VEWIN horizontal integration proponents).

The third issue deals with the question of whether or not water production, distribution, and delivery should be vertically integrated. Again strong support exists for the status quo of vertical integration (position 0 in Table 3). Some support exists for production in publicly controlled companies and commercial distribution and delivery (position 40). Only the European Commission is assumed to support the English model in which all activities are privately organized under control of a water regulation committee (position 100).

THE EXPECTED UTILITY MODEL OF BUENO DE MESQUITA (CONFLICT MODEL)

In the EU model, the issues are not linked with each other. For each issue a separate analysis is done. The dynamic element in the decision making process lies in the ability of actors to challenge the policy position of other actors. Figure 1 gives the choices an actor (say actor *i*) can make *vis a vis* every other actor *j*. (S)he can challenge actor *j* or can decide not to do so. If (s)he challenges actor *j*, his opponent can give in or not. If actor *j* gives in, the opponent (actor *j*) will have to support the policy position of the challenger (actor *i*). If actor *j* resists, there are again two possibilities: the challenger (actor *i*) wins or the opponent wins. The other possible outcomes result from situations where actor *i* does not challenge actor *j* (given in the left part of Figure 1). In that case actor *j* will not move due to challenges by actor *i*. However, due to other challenges actor *j* may move, resulting in a better or worse policy outcome from the perspective of actor *i*. Every actor computes the utility of each alternative and the likelihood of occurrence. This requires an estimate of the utility and the likelihood of occurrence from the perspective of the opponent. In the latter, the model

simulates misperceptions because actors do not take into account that some actors are risk accepting and others risk averse. These computations take into account the support actor i and j get from the other actors.

The expected utility for i to challenge actor j can now be computed as follows. The likelihood that actor j will accept a challenge of actor i can be estimated by the salience of issue d for actor j, s_{jd}. The likelihood that actor j will give in is equal to $(1 - s_{jd})$. In the latter case actor j will support the policy position of actor i. The utility of the move of actor j in the direction of actor i is denoted by $u^i\#x^+_{jd}$. If actor j accepts the challenge, actor i can win or lose. In the first case again the shift of the position of actor j to that of actor i has a utility of $u^i\#x^+_{jd}$. If actor i loses, (s)he is forced to support the position of actor j. The negative utility for actor i of that move is denoted by $u^i\#x^-_{jd}$. The likelihood of success or failure for actor i in such a dispute depends on the relative powers of actor i and j, denoted by p_{ij}. It depends on the leverage (capability times salience) each of the actors is willing to invest and the support each of them gets from third actors. The expected utility for actor i to challenge actor j is now equal to:

$$E^i u^i\#x_{jd} \mid \textit{Challence} = s_{dj} \{ p_{ij}[u^i\#x^+_{jd}] + (1-p_{ij})[u^i\#x^-_{jd}] \} + (1-s_{dj})[u^i\#x^+_{jd}] \quad (1)$$

In a similar way, we can compute the expected utility for actor i not to challenge the policy position of actor j. If we assume no anticipation of autonomous changes, none of the actors will shift their support. The utility for actor i of such a status quo is denoted by $u^i\#x^o_{jd}$. The expected utility, given no challenge is simply:

$$E^i u^i\#x_{jd} \mid \text{No Challence} = u^i\#x^o_{jd} \quad (2)$$

The total expected utility for actor i relative to actor j is now equal to:

$$E^i u^i\#x_{jd} = E^i u^i\#x_{jd} \mid \textit{Challence} - E^i u^i\#x_{jd} \mid \textit{No Challence} \quad (3)$$

The dynamic element in the Bueno de Mesquita model can now be summarized by Figure 2. On the horizontal axis the expected utility of the challenger (actor i) is given relative to the opponent (actor j). On the vertical axis actor i's estimate of the expected utility of a

challenge by actor j towards actor i is given. Actor i will challenge the policy position of actor j solely if he estimates his expected utility as positive and larger as that of actor j (the sectors 1, 8, and 7). The opponent (actor j) reacts on his or her own perception of the situation which is not necessarily equal to that of actor i because of misperceptions of the other actor's expected utility. On the basis of this combination the model predicts which actors will challenge other actors, of whether the other actors will accept such a challenge or not, and what will be the outcome of the challenge.

This model has given very promising results. This model has been evaluated in independent research over 1000 predictions. In about 50 percent of the cases, the experts and the model arrived at the same predictions. In the other 50 percent of the cases, 80 percent of the predictions of the model were better than those of the experts. Another indication of the success of the model was delivered in the investigation of 133 European conflicts between 1816 and 1970 in which at least one of the larger powers was involved (Bueno de Mesquita and Lalman, 1986; 1993). Of the conflicts that were classified in the first quadrant of Figure 2 (sections 1 and 2), 90 percent resulted in war. Of the conflicts classified in the negotiating parts of the figure (sections 3 and 8), 38 percent ended in a war. In the sections 4 and 7 (one of the actors yield to the other), only 12 percent resulted in a war. In the status quo quadrant (sections 5 and 6), none of the conflicts resulted in war. The model therefore does not solely predicts outcomes very well, but also the amount of conflict involved and the stability of the outcome.

THE EXCHANGE MODEL OF STOKMAN AND VAN OOSTEN

The exchange model of Stokman and Van Oosten is based on the same three elements that were used in the Bueno de Mesquita model: capabilities, saliences, and policy positions. In contrast to the Bueno de Mesquita model the issues are linked. Actors are prepared to vote for another position than their policy position on one issue if another actor is willing to make a similar shift in his direction. Stokman and Van Oosten restrict such exchanges to actors who are at opposing sides of the expected outcome on both issues. These actors have no other possibilities than exchange to improve their utility simultaneously. Actors located at the same side might improve the expected outcome also in other ways (*e.g.* by both taking a more extreme position).

To investigate the conditions for exchange, let us consider two actors i and j and two decisions d and e. We assume that decision d is *relatively* more important for i than for j. In other words, d is the

demand issue for actor i and consequently the *supply issue* for actor j. For decision e the reverse holds: decision e is the demand issue for actor j and the supply issue for actor i. This implies that actor i asks actor j to take a for actor i more favorable position. In exchange actor i is willing to do the same on issue j. We denote such a new position the *voting position* of an actor. An exchange that is favorable for both actors can be realized under the following conditions:

1. A change of voting position on the supply issue should result in a positive change in the expected outcome.
2. Both actors should attach positive salience to their demand issue.
3. The salience of actor i on his or her demand issue d should (relative to the salience of actor j on d) be larger that the salience of actor i on his or her supply issue e (relative to the salience of j on e). Notice that the condition is also fulfilled if both issues d and e are less salient for actor i than for actor j as long as actor i attaches *relatively* more importance to issue d. Of course, exchange is also possible if the salience of actor j on his supply issue (decision d) is zero:

$$sja = 0 \quad \text{or} \quad \frac{s_{id}}{s_{jd}} < \frac{s_{ie}}{s_{je}} \quad (\text{if } s_{jd} > 0) \tag{4}$$

These conditions are also the conditions under which the political process can take the form of an exchange. If these three conditions are not fulfilled, an outcome can only be obtained through confrontation of power and interests.

Stokman and Van Oosten elaborate the exchange rate from the assumption that both actors aim at an equal utility gain. This exchange rate is:

$$\#O_{jd} = \frac{s_{ie} + s_{je}}{s_{id} + s_{jd}} \#O_{ie} \tag{5}$$

If we know the decision rule and the weights of the actors therein, we can compute the shifts in voting positions of the two actors to realize such shifts in expected outcomes. In addition, the assumption is made that none of the actors is willing to support a more extreme voting position than the other actor.

In the model of Stokman and Van Oosten all potential exchanges are computed. They assume that exchanges with the highest utility gain take place first. As an actor can't give away his or her voting position twice, each realized exchange usually results in the deletion of many potential exchanges. As each realized exchange affects all actors and not only the two exchange partners, the finally realized utility gain for actors can well be quite different from what actors expect on the basis of their own exchanges. This might well result in suboptimal solutions for all actors.

APPLICATION OF THE MODELS ON THE FUTURE OF THE DUTCH WATER PROVISION

In our example, we concentrate on the first issue, the number of water companies in the year 2000. The effective power for the different policy alternatives can be computed from Table 1. The effective power of an actor is given by his or her capability times salience. The salience can be interpreted as the proportion of his or her capability an actor is willing to mobilize. The status quo (position 100) attracts the most effective power. Table 4 gives the results of the conflict model. At t_0 the original policy positions of the actors are given. In the first iteration the Ministry of Economic Affairs has to give in to the majority group in VEWIN, whereas the Provincial Authorities move a bit in the direction of the status quo. In the second iteration the status quo seems to win, as both the Ministry of Economic Affairs and the Provincial Authorities shift to 100. However, the powerful VEWIN majority group and the Ministry of Environment are able to maintain their original position. This has dramatic effects in the next iterations. They remain able to challenge other actors and, after some wavering movements, to shift the expected outcome to position 25 (six companies with a loose coordinating organization). The two groups that maintain their position of 100 are not strong enough to shift the expected outcome back in their own direction.

The results of the exchange model supports those of the conflict model. The exchange model results in three exchanges in which the issue on the number of water companies is involved. These three exchanges are given in Figures 3 to 5. Two exchanges bring the Ministry of Economic Affairs and the Energy Sector to voting position 25. In Table 4, these two actors just gave sufficient momentum towards position 25 to let the expected outcome shift to that position. The other exchange brings VROM closer to 25. Although it is in the other direction, it helps to create the vast majority around position 25 that we saw in Table 4.

For the other two issues, both the conflict and exchange model show a tendency towards a free choice for the water companies to merge with electricity companies and some commercial activities. The latter are confined to the margin, however.

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TABLE 1. ISSUE: NUMBER OF WATER COMPANIES AFTER FIVE YEARS (MAY 2000).

Code	Name Group	Capability	Position*	Saliences
vrom	Ministry of Environment (VROM)	0.5	0	0.5
vewv	VEWIN vertical integration proponents	0.9	25	1
prov	Provincial owners (politicians)	1	75	0.5
trun	Trade unions	0.4	100	0.5
ener	Energy sector (hawks)	0.5	100	0.5
city	Municipal owners	0.75	100	1
ez	Ministry Economic Affairs	0.2	100	0.2
vewh	VEWIN horizontal integration proponents	0.2	100	1

* 0: Six with holding
25: Six with VEWIN
75: Twenty with holding
100: Twenty with VEWIN (Status Quo)

TABLE 2. ISSUE: SEPARATE WATER COMPANIES OR MERGER WITH ELECTRICITY COMPANIES.

Code	Name group	Capability	Position*	Salience
vrom	Ministry of Environment (VROM)	0.50	0	0.50
city	Municipal owners	0.75	0	0.90
pold	Polder Boards	0.10	0	0.20
vewv	VEWIN vertical integration proponents	0.60	0	1.00
green	Green Movement	0.10	0	0.60
trun	Trade unions	0.25	10	0.25
prov	Provincial owners (politicians)	1.00	20	0.50
ez	Ministry Economic Affairs	0.20	50	1.00
prno	Provincial Authorities, non owners	0.10	50	0.10
cino	Municipal non-owners	0.20	50	0.50
ener	Energy sector (hawks)	0.75	50	1.00
cons	Consumers organization	0.10	50	0.40
vno	Employers Association VNO	0.10	50	0.20
vewh	VEWIN horizontal integration proponents	0.20	100	1.00

* 0: separate (Status Quo)
50: free choice
100: obligatory merger

TABLE 3. ISSUE: VERTICALLY INTEGRATED WATER PRODUCTION VERSUS DISTRIBUTION OR PUBLIC PRODUCTION AND COMMERCIAL DISTRIBUTION

Code	Name Group	Capability	Position*	Saliences
vrom	Ministry of Environment (VROM)	0.40	0	0.65
vewv	VEWIN vertical integration proponents	0.40	0	1.00
prov	Provincial owners (politicians)	0.70	0	0.70
cons	Consumers organization	0.10	0	0.50
ener	Energy sector (hawks)	0.25	40	0.70
city	Municipal owners	0.30	40	0.60
ez	Ministry Economic Affairs	0.45	40	0.60
vewh	VEWIN horizontal integration proponents	0.20	40	1.00
pold	Polder Boards	0.15	40	0.50
euro	European Commission	0.30	100	0.50

* 0: vertically integrated (Status Quo)
40: Public production/commerical distribution
100: English model (commercial production and distribution)

TABLE 4: DYNAMICS IN CONFLICT MODEL (NUMBER OF COMPANIES)

Code	pos* t_0	pos t_1	pos t_2	pos t_3	pos t_4	pos t_5	pos t_6
vrom	0	0	0	0	0	0	25
vewv	25	25	25	25	25	25	25
prov	75	85.8	100	75	85.8	25	25
trun	100	100	100	100	100	25	25
ener	100	100	100	25	100	25	25
city	100	100	100	100	100	100	100
ez	100	25	100	100	25	100	25
vewh	100	100	100	100	100	100	100
Outcome	*75.3*	*85.9*	*100*	*93.3*	*85.9*	*25.2*	*25*

* 0 Six with holding
25 Six with VEWIN
75 Twenty with holding
100 Twenty with VEWIN (Status quo)

FIGURE 1: THE DECISION PROBLEM

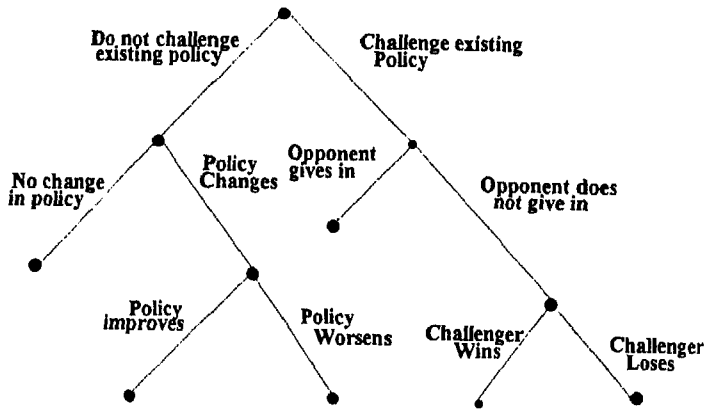


FIGURE 2: POLITICAL DYNAMICS OF POLICY PROCESS

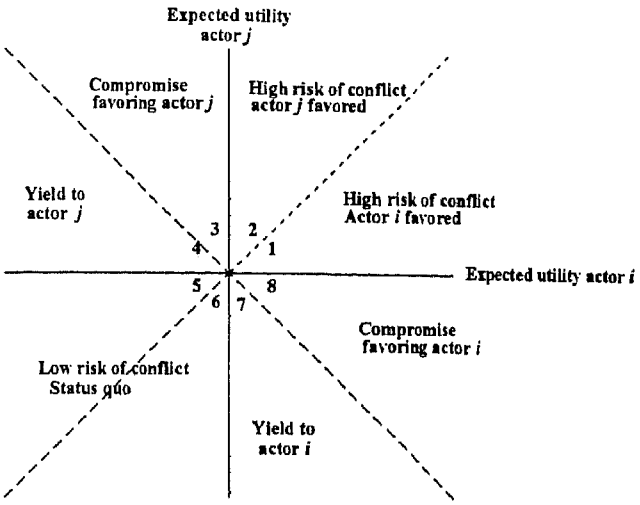
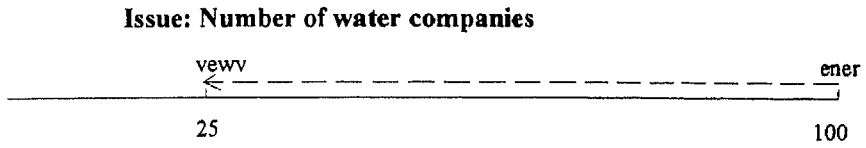


FIGURE 3: FIRST EXCHANGE OF VOTING POSITIONS



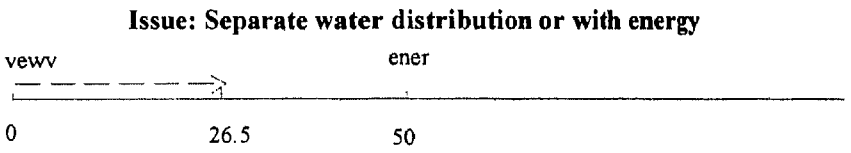


FIGURE 4: SECOND EXCHANGE OF VOTING POSITIONS

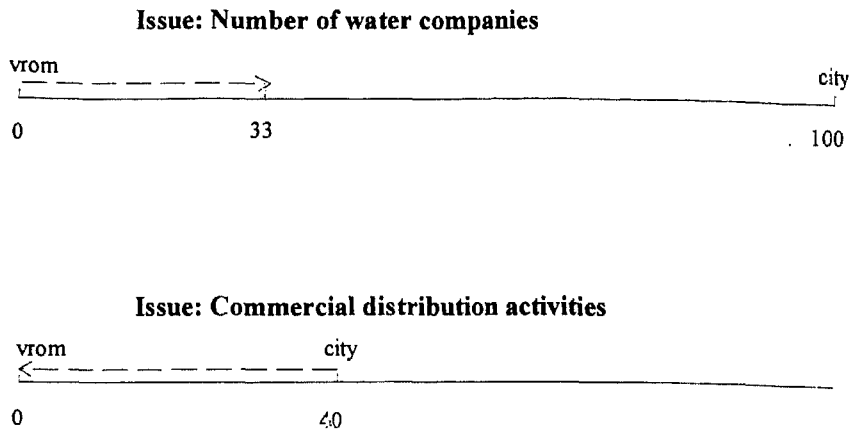


FIGURE 5: THIRD EXCHANGE OF VOTING POSITIONS