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Mathematical Models of Issue Voting

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1. Introduction

Traditionally, students of electoral studies in Japan use quantitative approaches to analyze whether voters trust their elected representatives to accurately represent their will. However, this paper aims to analyze voting behavior with a mathematical model instead. Although quantitative analysis works well for explaining circumstances specific to individual elections, it only allows for speculation when it comes to identifying general tendencies beyond a particular election. By contrast, a mathematical model first provides a general hypothesis to which individual cases can then be applied. In other words, the inductive method of quantitative analysis and the deductive of a mathematical model will be able to complement each other in explaining voting behavior.

There are several problems with the conventional theories of rational voting behavior. First, because studies of the conventional rational choice theories were mainly conducted in the United States, the models generally reflect the assumptions of a two-party system. Consequently, such rational choice models cannot be easily applied to a multi-party system like Japan. As such, rational choice models have not

yet been generalized. Consider, for example, the problem of measuring the policy distance relationship between a voter and a political party, that is, the expected utility. Whereas there is only one distance relationship in a two-party system, in a multi-party system with N parties there will be $(N-1)^2$relationships. Thus, there is a fundamental difference between a rational choice theory based on a two-party system and one based on a multi-party system.

The second problem with the existing rational choice models is that they often have too few examinations based on empirical data, which at times has resulted in unnecessarily complicated formulae. In other words, it is hard to find common ground between traditional rational choice theories and quantitative demonstrations. Obviously, there are exceptions as we see from Shaffer's simulation model, which uses the ANES data from the ICPSR. But despite such exceptions, we need more analyses based on empirical data.

Therefore, in order to resolve these problems, this paper will construct a Japanese voting behavior model based on opinion and attitude surveys conducted during national elections. Due to limited space, this paper will focus on the analysis results of the 2001 upper house election since similar results were obtained in all four elections between the 2001 upper house and the 2005 lower house elections.

2. An Examination of the Expected Utility Model

To begin with, let us see how well voter turnout can be explained by a traditional rational choice model. The rational choice model of voting behavior assumes that parties and politicians act in ways that enable them to win elections and that voters act in ways that enable them to maximize expected utility. More specifically, supposing that there are two issues in question, if a candidate's policy coincides with a voter's optimal point, this will be the maximum utility for the voter, and as the policy moves further away from his optimal point, so his utility will also decrease. Downs believed that when parties and politicians engage in

vote maximizing behavior, each party's policy would converge at the center of the voters' distribution. Later on, however, this hypothesis was disproved by Ordeshook and others, and it is now believed that parties and politicians actually engage in vote difference maximizing behavior.

However, this paper does not focus on rational choice models that make parties and politicians the actors, but on those which make voters the actors. First, Downs lists the following four factors as those which determine whether voters will turn out to vote: a) the weight of one's vote, b) the expected utility gap amongst parties, c) the cost of voting, and d) the long-term benefit of voting. Riker and Ordeshook, and Good and Mayer, building upon Downs's theory, argue that the benefits voters gain from voting, that is, the likelihood of their turning out (R), can be determined by the subjectively perceived possibility of a close election (P) multiplied by the expected utility gap among parties (B) minus the cost of voting (C) plus the long-term benefits (D). This is the famous formula $R=PB-C+D$. Moreover, Riker and Ordeshook have shown that the formula is applicable in reality by using the SRC's survey data collected from U.S. presidential elections.

To see whether this expected utility model can be applied to Japan, let us examine the $R=PB-C+D$ model. The problem here is that Japan has a multi-party system. Thus, this model will face various difficulties since it is built upon the assumptions of a two-party system. There are two problems that we need to overcome before we can move from this particular model, which assumes a two-party system and can therefore reduce policies to a one dimensional plane, to a more general model. The first problem is the number of parties. We need to expand from a Republican-Democrat two-party system to an N-party system. Specifically, in our analysis of the 2001 upper house election, we included six parties, the Liberal Democratic Party (LDP), Democratic Party of Japan (DPJ), New Komeito, Social Democratic Party (SDP), Japan Communist Party (JCP), and the Liberal Party (LP). The Conservative Party (CP) was excluded as a dependent variable because there were only a tiny number

of samples voting for the party. Independent candidates who were endorsed by a specific party have been included with that party. Furthermore, independent candidates who have been endorsed by several parties have been included in the party with which he or she is most closely associated.

The second problem is the number of dimensions of policies. In Downs's studies, debates were carried out on one dimension, such as "liberal-conservative." However, it seems impossible, in the context of Japanese elections, to reduce the election issues to a one dimensional liberal-conservative axis. In our analysis of the 2001 upper house, we will take up the following five issues [3]: public service, national-local relations, amending the constitution, collective defense, and visits to Yasukuni Shrine.

When analyzing the voters' voting behavior with respect to each party, we used the difference between (the distance between [one's preferred party's policy position] [4] and [one's issue attitude]) and (the distance between [the policy of a party other than one's preferred party with the supposed closest optimal point] and [one's issue attitude]) as the expected utility gap. We also considered the "saliency," [5] or the relative importance one attaches to each issue, and used this as each sample's expected utility gap. In this way, we moved from a one-dimensional, two-party model to an N-party, M-dimensional model. In our analysis, we used the samples that responded to all of the questions in the panel survey (1253 samples) conducted before and after the 2001 upper house election [6]. We omitted proportional representation constituencies from our analysis because in an expected utility model, we use the weight of one's vote, or the degree of competition, as an independent variable. In the case of proportional representation constituencies, degrees of competition do not develop. Put differently, setting aside parties that cannot secure even one seat in proportional representation constituencies, voters can imagine that their vote would make a difference in some way.

When we applied the expected utility model to constituency

elections [7], the model was not satisfactory in analyzing electoral participation. To apply the expected utility model to voting direction, we examined how well the model could explain votes cast for each party (LDP vote＝whether one votes for the LDP, New Komeito vote＝whether one votes for New Komeito, and so on for DPJ vote, SDP vote, JCP vote, and LP vote). Again, however, the results of the expected utility model analysis did not achieve a satisfactory degree of validity.

We therefore developed a revised expected utility model, which replaced the expected utility in the expected utility model with the absolute value of the difference between (the absolute value of the difference between [one's issue attitude] and [one's preferred party's policy position]) and (the absolute value of the difference between [one's issue attitude] and [the policy position of the party other than one's favorite with the closest policy]). We then examined whether this model could be applied to the voting behavior of the 2001 upper house election (so only those who support a particular party were considered). However, we could not see a great difference between the quality of the revised expected utility model and the original expected utility model for either electoral participation or voting direction. We therefore tried including people who don't support a particular party but do lean toward one and then tried applying the revised expected utility model once again (so these samples included people with favorite parties and people without but who do lean toward some party). Even though we expanded the target of samples, there was no great difference in the analysis results.

3. An Examination of the Minimax Regret Model

Next, let us examine the minimax regret model. It is well known that Ferejohn and Fiorina analyze electoral participation from a different approach than Riker and Ordeshook. Two salient features of their study are: 1) that they apply game theory and 2) that they analyze multi-party systems as well as two-party systems.

Let us begin by analyzing the behavior of Voter Y, who tries to maximize his gain in a two-party system. We will suppose that the utility Voter Y gains from Candidate 1's policy is 1 util and the gain from Candidate 2's policy is 0 utils. Then, let us consider five possible scenarios from Voter Y's subjective perception as to how other voters might vote.

S1: Even if Voter Y votes for Candidate 2, Candidate 1 will win
S2: If Voter Y votes for Candidate 2, Candidate 2 will have the same number of votes as Candidate 1
S3: There are the same number of votes for both Candidate 1 and 2, excluding Voter Y's vote
S4: If Voter Y votes for Candidate 1, Candidate 1 will have the same number of votes as Candidate 2
S5: Even if Voter Y votes for Candidate 1, Candidate 2 will win

Considering the utility Voter Y will gain in these five scenarios, we see that Voter Y will vote for Candidate 1 if the cost of voting is less than half the expected utility gap, and will abstain if it is more than half the expected utility gap.

Ferejohn and Fiorina believed that Voter Y's behavior could not be applied to all voters. They believed that there were voters who operated on the principle of "minimizing one's maximum regret," a minimax regret strategy (Voter Z). Taking into account Voter Z's regret (the possibility of wasting time voting in a lopsided election, for example), we see that he will vote if the cost of voting is less than one fourth of his expected utility. Thus, they concluded that Voter Z, who fears the worst, has a higher probability of abstaining from voting [8].

Ferejohn and Fiorina believed that the expected utility model (EU) and the minimax regret model (MR) could be summed up as follows:

Hypothesis EU: As the product of the subjective perception of a close election and the expected utility gap increases, more voters will turnout.

Hypothesis MR: As the expected utility gap increases, more voters will turnout.

For Ferejohn and Fiornia, the difference between these two hypotheses could be boiled down to whether one's subjective perception of a close election had an effect on electoral participation, and thus, the two models could be reduced to one model.

Now when we apply the minimax regret model to voting behavior in Japan, although we would expect voters to abstain should there be any voting costs, the empirical data suggests otherwise. That is, because the minimax regret model overestimates the probability of voters abstaining, whether considering proportional representative constituency elections or constituency elections, the differences between this model and the expected utility model become a little blurry.

Thus Ferejohn and Fiorina constructed a revised minimax regret model which considers the voting cost and long-term benefits and sets the expected utility gap as (the absolute value of the difference between [issue attitude] and [the policy position of one's preferred party]) minus (the absolute value of the difference between [issue attitude] and [the policy position of one's second choice party]). The revised model was more applicable, yet the accuracy of its predictions was not satisfactory concerning electoral participation and voting direction, both in proportional representation and constituency elections. As with the revised expected utility model we expanded the sample target zone, but this did not have a significant impact on the results.

4. An Examination of the Diametros Model

As we have seen, neither the expected utility model nor the minimax regret model is very accurate. In this section, we will consider the reasons for this. Regarding the expected utility model, we can agree that voting behavior is influenced by variables such as the cost of voting and long-term benefits. But what about the expected utility gap or the degree of competition? In order to see an expected utility gap, voters

must be aware of and understand the issues in a given election and have a clear idea of their optimal point, that is, an idea of which policy will be most personally beneficial. They must also correctly understand the policies that each party is proposing, and be able to identify and calculate the merits and demerits of these policies. In reality, however, there are many voters who vote on the basis of party loyalty rather than on an understanding of the issues and policies. Thus we constructed a revised model, but as has been noted, it is not satisfactorily accurate.

Regarding the degree of competition, we need to ask to what extent voters are aware of candidates' odds of winning in their own constituencies. Supposing that voters do obtain information about the closeness of the election through electoral projections in the media, to what extent do they put their trust in this information? Supposing that they do trust this information, how does this affect their voting behavior? Even if voters know that their preferred candidate is very likely to win, it is hard to imagine that they will abstain from voting. We can reasonably expect that rational voters might not bother paying a high information cost to determine their votes. This is why the expected utility model does not seem relevant in explaining party voting behavior.

Like the expected utility model, the minimax regret model has its problems. We need to first consider how far the idea of minimax regret can be applied to elections. If we think about car accidents and their potential costs, no matter how low the chances are of getting into one, we can easily imagine people purchasing an insurance policy simply to avoid the worst. But in the case of an election, what is the worst case scenario? The worst that could happen is that you realize that your vote had little weight and therefore that going to the polling station was a complete waste of time. If this is the case, then, it is hard to imagine rational voters basing their vote choice on regret.

As an alternative to these models, this paper introduces a new model, the diametros model. In building this model, we start from the assumption that the fear of the worst case scenario has little, if any, influence on voting behavior. Is voting behavior then solely determined

by expected utility gaps, the cost of voting, and the long-term benefits of voting? Certainly not. As a matter of fact, we know from survey data on U.S. presidential elections that there are voters who vote for candidates whose policies are different from their optimal point. Similarly in Japan, we see that many people will vote for a candidate from a party they support even if there is a candidate from a different party whose policy is closer to their optimal point. However, at the same time, it is also true that people will vote for one candidate over a candidate from the party they support if the latter's policies are too far from their optimal point. Party loyalty is important, but it is not the only consideration.

Given this, we postulate that voting behavior is determined not by expected utility gaps alone but by the combination of expected utility gaps and voters' psychological distance from each party. The diametros model is composed of diagonal lines, which are the sum of 1) the square of the difference between one's optimal point on the electoral issue axis and the campaign policy of a given party and 2) the square of the psychological distance from that party. Thus, we developed variables in (Formula 1) to search for the difference between the diagonal lines.

Formula 1: Diametros

$$\sqrt{(b\_ij)^2+(t\_ij)^2}$$

However, $i \neq j$,
b__ij: expected utility gap between party i and party j
t__ij: emotional temperature gap between party i and party j

The first variable in the square root of this formula represents the expected utility gap. The second variable represents the thermometer rating gap [9].

To see whether this model is applicable to voting behavior, we examine how the voting decision is affected by differences in diametros for each party together with the cost of voting and the long-term bene-

Table 1: Examination of Diametros Model (Proportional Representation-Stepwise procedure)

	Electoral participation		Voting direction: LDP vote		DPJ vote		NK vote		SDP vote		JCP vote		LP vote	
Determination coefficient (adjusted)		0.964		0.396		0.210		0.129		0.051		0.131		0.079
Voting cost		0.338•••		0.473•••				−0.164••						
Sense of duty to vote		0.056••		−0.114•		−0.170••						−0.222•••		−0.184••
Diametros	JCP-SDP	0.142•••	LDP-NK	0.255•••	DPJ-LDP	0.222••	NK-LDP	0.238•••	SDP-DPJ	0.226•••	JCP-DPJ	−0.292••	CP-LP	0.232••
	SDP-JCP	0.071•••	LDP-LP	0.316•••	DPJ-NK	0.165•	NK-JCP	0.441•••			JCP-NK	0.733•••		0.197•
	CP-LP	0.142•••	LDP-CP	−0.269•••	DPJ-LP	0.224••	NK-SDP	−0.558•••			JCP-LP	0.419•••		
	SDP-LDP	−0.058•••					NK-DPJ	0.357•••			JCP-CP	−0.387••		
	DPJ-LP	0.098•••												
	LP-DPJ	0.144•••												
	SDP-DPJ	0.060•••												
	CP-DPJ	−0.190•••												
	CP-NK	0.122•••												
	LDP-CP	0.027•••												
	NK-DPJ	0.067•••												

Linear regression passing the origin ···$\rho<0.005$ ··$\rho<0.01$ ·$\rho<0.05$

fits of voting. To exclude constant terms, we use a regression that passes through the origin. First, we were able to obtain a high determination coefficient (0.96) concerning electoral participation in proportional representation constituencies. The factor that contributed most greatly to electoral participation was the cost of voting, and as we expected, those who thought the costs were higher tended to abstain from voting. Also, the diametros showed that the difference between the JCP and the SDP, or the difference between the LDP and the DPJ, or the difference between the New Komeito and the Conservative Party had an impact on voting behavior.

Furthermore, when we apply the diametros model to voting direction, regarding the LDP votes, we see that people with lower voting costs and people with a stronger sense of duty to vote tend to vote for the LDP. Within the differences of diametros, the difference between the LDP and the Liberal Party, and betwen the LDP and New Komeito, work to the advantage of the LDP (Table 1). In other words, when the difference of expected utility and the psychological likability between the LDP and the Liberal Party or the LDP and New Komeito is larger, there is a greater tendency for voters to vote for the LDP. It should be noted that rather than the difference between parties with significantly different policies, such as the JCP and the primary opposition party, the

DPJ, the difference between a party in the ruling coalition, the New Komeito, and former allies, the Liberal Party, tend to have a greater impact on the LDP vote.

Next, as expected, one's sense of duty to vote had a negative impact on the DPJ vote, and according to the diametros, the difference between the DPJ and the LDP, the Liberal Party and the New Komeito had a huge influence on this. Therefore, whereas the difference between the opposition parties did not have a significant impact on the LDP vote, the difference between the ruling parties (the LDP and New Komeito) had a large influence on the DPJ vote. It also became clear that for New Komeito votes, the diametros difference between the New Komeito and the JCP or the LDP had a positive effect. For JCP votes, the diametros difference from the New Komeito had a positive effect, and thus, we can see that there is a certain kind of rivalry between the New Komeito and the JCP.

Although the diametros model demonstrates a higher accuracy of voting direction than the expected utility model or the minimax regret model, apart from its analysis of the LDP, it does not demonstrate an adequate level of accuracy. This is likely because the number of non-LDP samples taken was too small, and therefore we could not distinguish the difference between the samples. For example, the dependent variable for the SDP vote model was "whether you voted for the SDP," and the large majority of the samples replied that they did not. However, these samples included voters who simply abstained from voting, those who voted for the LDP, and those who voted for a party other than the LDP. So although there was a difference in diametros, the dependent variable was simply reduced to whether one voted for the SDP or not. The relation between the independent and dependent variable was weakened, thus rendering the model inadequate.

Next, let us examine to what degree the diametros model is applicable to voting behavior in constituency elections. We have omitted from our analysis parties without candidates in the relevant constituency. Thus, we constructed the diametros model by distinguishing the

Table 2: Examination of Diametros Model (Constituency election-Stepwise procedure)

		Electoral participation	Voting direction: LDP vote	DPJ vote	NK vote	SDP vote	JCP vote	LP vote
Determination coefficient (adjusted)		0.900	0.377	0.184	0.045	0.022	0.080	0.041
Voting cost		0.969•••	0.479•••	0.133••				
Sense of duty to vote		−0.113•••						
Diametros	JCP-SDP		LDP-DPJ 0.353•••	DPJ-CP 0.323•••	NK-CP 0.214•••	SDP-DPJ 0.151•••	JCP-NK 0.177••	LP-SDP 0.205•••
	SDP-JCP		LDP-CP −0.172••				JCP-LP 0.120•	
	CP-LP							
	SDP-LDP							
	DPJ-LP	0.064•••						
	LP-DPJ							
	SDP-DPJ							
	CP-DPJ							
	CP-NK							
	LDP-CP							
	NK-DPJ							

Linear regression passing the origin ••• $\rho<0.005$ ** $\rho<0.01$ * $\rho<0.05$

choices given to each sample. Here, we were able to see that in its analysis of electoral participation, although the model demonstrates high accuracy, the role of the difference in diametros seems to be limited to the difference between the DPJ and the LDP or New Komeito. On the other hand, the role of the cost of voting seems to be evident and this is followed by the sense of duty to vote (Table 2). The factors affecting voting direction were, for LDP votes, the voting cost and the diametros difference between the LDP and the DPJ, and for the DPJ votes, the voting cost and the diametros difference between the DPJ and the Conservative Party. We thus see that the difference in diametros is an important factor in explaining voting direction. However, as a whole, compared to the analysis of proportional representation constituencies, the accuracy of the model demonstrated was lower. This is likely due to the fact that the choices offered to the samples were different amongst different samples.

5. An Examination of the Revised Diametros Model

As we have seen, the diametros model can explain voting behavior better than existing rational choice models can. However, the problem with this model is that it is too complicated. In order to simplify the di-

ametros model, the variable in (Formula 2) was formulated. A revised diametros model was thus constructed, which calculates the average of the difference of the expected utility gap between one's favorite party and multiple parties other than one's favorite party, and the average of the difference of the thermometer rating between one's favorite party and multiple parties other than one's favorite party.

Formula 2: Revised Diametros

$$\sqrt{\left[(b\_i)-\left(\frac{\sum_{m=1}^{n-1} b-j_m}{n-1}\right)\right]^2+\left[(t\_i)-\left(\frac{\sum_{m=1}^{n-1} b-j_m}{n-1}\right)\right]^2}$$

However, i ≠ j, n-1: number of parties other than one's favorite party
b__i: expected utility of party i b__j: expected utility of party j
t__i: emotional temperature of party i t__j: emotional temperature of party j

When this model is applied to the voting behavior of proportional representation constituencies, we see, first of all, a smaller the cost of voting, and a greater diametros difference between the LDP and the other parties, the New Komeito and the other parties, and among other parties. This will result in more people turning out to vote (Table 3). We also found out that for all parties, voting cost and the difference in diametros between one's favorite party and other parties had an impact on voting direction. However, excluding the analysis of the LDP, the model did not achieve a satisfactory level of accuracy. This is likely because, as in the case of the diametros model, the number of samples voting for parties other than the LDP was too small.

Next, we applied the revised diametros model to constituency elections, and, as in the case of Proportional Repsesentation elections, voters with smaller voting costs and a stronger sense of duty and who feel a greater diametros difference between the JCP and other parties, tended to turnout more often (Table 4). For the voting direction concerning any

Table 3: Examination of Revised Diametros Model (Proportional Representation-Stepwise procedure)

	Electoral participation		Voting direction LDP vote	DPJ vote	NK vote	SDP vote	JCP vote	LP vote
Determination coefficient (adjusted)		0.971	0.421	0.184	0.168	0.086	0.062	0.071
Voting cost		0.100**	1.133***	1.061***	1.036***	0.813***	0.556***	0.816***
Sense of duty to vote					0.312***			
Diametros	LDP-Others	0.080***	−0.577***					
	DPJ-Others	0.134***		−0.723***				
	NK-Others	0.162***			−1.090***			
	SDP-Others	0.127***				−0.620***		
	JCP-Others	0.106***					−0.388***	
	CP-Others	0.136***						
	LP-Others	0.173***						−0.633***

Linear regression passing the origin ***$\rho<0.005$ **$\rho<0.01$ *$\rho<0.05$

Table 4: Examination of Revised Diametros Model (Constituency election-Stepwise procedure)

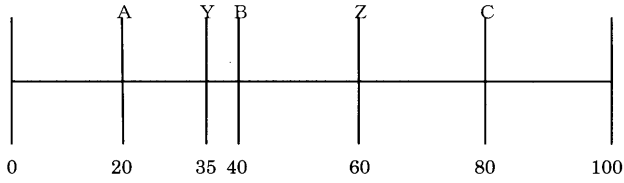
	Electoral participation		Voting direction LDP vote	DPJ vote	NK vote	SDP vote	JCP vote	LP vote
Determination coefficient (adjusted)		0.900	0.373	0.144	0.090	0.039	0.058	0.057
Voting cost		0.962***	0.730***	0.480***	0.304***	0.320***	0.357***	0.241***
Sense of duty to vote		−0.129**						
Diametros	LDP-Others		−0.169***					
	DPJ-Others			−0.122*				
	NK-Others							
	SDP-Others					−0.153*	−0.159**	
	JCP-Others	0.114**						
	CP-Others							
	LP-Others							

Linear regression passing the origin ***$\rho<0.005$ **$\rho<0.01$ *$\rho<0.05$

party, we observed that voting cost was a greater determining factor than the sense of duty to vote. We learnt that the difference in diametros between one's favorite party and another party particularly affected LDP votes, JCP votes, and SDP votes.

For electoral participation and voting direction in proportional representation constituency and constituency elections, the revised diametros model greatly reduced the number of independent variables while, on the whole, its accuracy maintained the same level as the diametros

Figure 1: Voting rationality under a coalition government



A. Downs (1957) p.149

model. Thus, because it is simpler, the revised model is superior to the diametros model [10].

6. An Examination of the Coalition Model

In a multi-party system, there are cases in which no one party can win a clear majority. Under such a circumstance, several parties join together to form a coalition government. In such a case, how have the existing models perceived voter rationality? Looking back at Downs's account, suppose that on a one dimensional axis, parties A, B, and C are located on points 20, 40, and 80 respectively (Figure 1). In this case, possible coalitions are between A and B or B and C (If A and C form a coalition, B must also join, which will create a grand coalition, and an election will be unnecessary).

A Voter X with an optimal point at 35 will vote for B if there is no coalition. The problem arises when B and C form a coalition. Voter X must choose between the policy of the average between B and C (Point Z), or A. For Voter X, it is rational to cast for A even though A is not his favorite party. When A has absolutely no chance of winning, Voter X will vote for the BC coalition so that his favorite party B will have a greater say in parliament. Thus, for Voter X, when B and C form a coalition, the voting intentions of the other voters become a matter of concern. That is, on a rational choice model, when the intentions of the

Table 5: Examination of Coalition Diametros Model (Proportional Representation-Forced entry method)

		Voting direction	
		Ruling party vote	Opposition party vote
Determination coefficient (adjusted)		0.493	0.323
Voting cost		0.352***	0.358***
Sense of duty to vote		−0.132**	−0.136*
Diametros	Ruling party	0.485***	
	Opposition party		0.354***

Linear regression passing the origin ***$\rho<0.005$ **$\rho<0.01$ *$\rho<0.05$

Table 6: Examination of Diametoros Model for Coalition (Constituency election-Forced entry method)

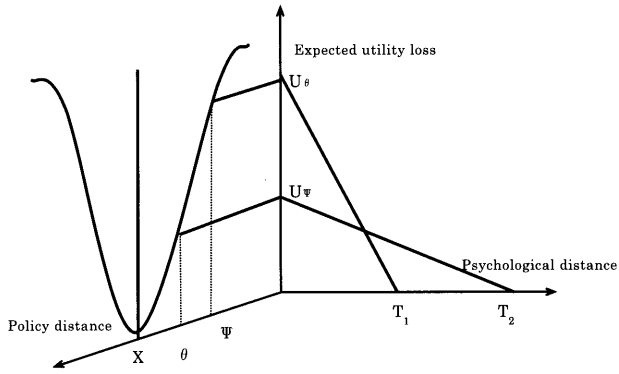
		Voting direction	
		Ruling party vote	Opposition party vote
Determination coefficient (adjusted)		0.426	0.296
Voting cost		0.327***	0.338***
Sense of duty to vote		−0.110*	−0.089*
Diametros	Ruling party	0.440***	
	Opposition party		0.309***

Linear regression passing the origin ***$\rho<0.005$ **$\rho<0.01$ *$\rho<0.05$

other voters are not known, Voter X may abstain or vote for B.

To verify whether such rational voting behavior in a coalition government is applicable to Japan, we constructed a further revision of the revised diametros model based on [the average point of the coalition government's policy position] minus [the average point of the coalition opposition's policy position]. This was applied to the voting behavior of the 2001 upper house election. We saw that for the proportional representation portion of the election, both the voting cost and the difference in diametros had a strong influence on voting behavior (Table 5). We also saw the same tendency for the constituency portion of the election (Table 6).

Figure 2: Structure of Diametros Model



7. The Construction and Examination of the Diametros II Model

In this section, we start from the assumption that voting decisions are made not simply by the expected utility gaps but also by the voters' psychological distance from each party. More specifically, the diametros II model is composed of diagonal lines (Figure 2) comparing voters' optimal point on the electoral issue axis, the campaign policies of a given party, and their psychological distance from that party (Formula 3). The next stage is to examine how voting decision is affected by differences in diametros for each party together with the cost of voting and the long-term benefits of voting. In measuring diametros, the question is how to set the appropriate units for policy distance and psychological distance. For example, a party with loyal supporters can afford to have candidates with campaign policies that are slightly off the supporters' optimal point. On the other hand, in the case of parties that do not have many loyal supporters, a small policy gap may affect the voters' decision. Here, the unit ratio of policy distance and psychological distance was set as the D coefficient, and we sought the D coefficient that best explains the voting behavior in relation to each party.

Formula 3: Diametros Model II

$$R = \sqrt{(T_i - \frac{\sum_{j=1}^{n-1} T_j}{n-1})^2} + D_i \sqrt{\left(|X - \theta_i| - \left| \frac{\sum_{j=1}^{n-1} (X - \theta_j)}{n-1} \right| \right)^2} - C + D$$

R : Voting probability
T : Thermometer rating
X : Voter's Optimal point
C : Voting cost
Di : D coefficient
D : Long-term benefits of voting
θi : Policy of party i
θj : Policy of party j(parties excluding party i)
n-1 : Number of parties excluding party i

Let us calculate the D coefficient by applying the diametros II model to opinion and attitude survey results. Given the limited space in this paper, and given also that similar results were obtained in all the elections from the 2000 lower house election to the 2005 lower house election, we will only discuss the analysis results of the 2005 lower house election. Moreover, the 2005 lower house election was known as the "postal service election" because privatizing the postal service was the main issue at stake, and since the year 2000, it has been the one national election in which issue attitude voting was most likely to have occurred.

In order to make clear what kind of policy dimensions the voters were aware of, we conducted a base analysis of eight issues: economy boosting policy or financial reconstruction, collective defense, big or small government, participation in a multinational force, national/local relations, amending the constitution, unification of public pension plans, and the Iraq War. We separated out the first principal component,

Table 7: Principal components of each issue (Score)

	First component	Second component	Third component
Economy boosting measure/ Fiscal reform	0.006	0.542	0.149
Collective defense	0.757	0.059	0.024
Social welfare	0.238	0.216	−0.722
Participation in a multinational force	0.803	0.069	0.076
National/Local relations	−0.049	0.724	−0.239
Constitutional amendment	0.595	0.103	−0.001
Unification of public pension plans	−0.070	0.353	0.648
Iraq War	0.691	0.104	0.174
Privatization of postal service agency	0.562	−0.405	0.011

Table 8: D coefficient of all voters

	All voters
LDP vote	0.31
DPJ vote	0.62
New Komeito vote	0.73
SDP vote	0.86
JCP vote	1.93

Table 9: D coefficient according to supporting party(Diametros Model II)

	LDP vote	DPJ vote	NK vote	SDP vote	JCP vote
LDP supporters	0.50				
DPJ supporters		0.64			
NK supporters			1.23		
SDP supporters				0.26	
JCP supporters					0.82

"security positive or negative," and the second component, "financial liberal or conservative." (Table 7) Thus, voters perceive international liberal-conservative and domestic liberal-conservative policy dimensions.

To construct a diametros II model on the 2005 lower house election voting behavior, we calculated the D coefficient of all the voters, and we saw that the coefficients of the DPJ, New Komeito, SDP, and LDP were respectively 0.62, 0.73, 0.86, and 0.31. From this, we observed that the impact that the psychological distance from a party had on the voters' decision concerning these four parties was greater than the distance between one's optimal point and one's subjective perception of a party's policy (Table 8). Furthermore, when we calculated the D coefficient of each party, (excluding the SDP supporters, which were only a small

Table 10: D coefficient of all voters (Revised Diametros Model II)

	All voters
LDP vote	0.96
DPJ vote	1.06
New Komeito vote	0.86
SDP vote	2.67
JCP vote	0.85

number), the D coefficient of the supporters of the LDP, DPJ, New Komeito, and JCP, were smaller than the D coefficient of all the voters (Table 9). In other words, the impact of the psychological distance from a party is greater for the supporters of a certain party voting for that party than for other people voting for that party. For all voters, the D coefficient was 1.93, indicating that the impact of the distance between one's optimal point and one's subjective perception of a party's policy was large. If we limit this observation to JCP supporters, we see that the coefficient drops to 0.82, indicating that the psychological distance from a party has a stronger influence. In other words there are people who vote for the JCP other than those who vote for the party because they feel psychologically close to it or because of policy proximity. Other than the JCP, regardless of whether one is a supporter of a particular party or not, psychological proximity is the determining factor for voting behavior. Put differently, excluding JCP supporters, the main factor that determines the voting behavior of the Japanese is the psychological distance from a party, not the supposed distance between one's optimal point and party policy.

To simplify the diametros II model even further, we constructed a revised model in which the voters compare their favorite party and other parties with policies that are closest to their optimal points (Formula 4). Looking at the D coefficient calculated by the revised new diametros II model, we observed that for voting behavior (constituency portion of the election), the D coefficient for the JCP was the lowest at 0.85, followed by the New Komeito at 0.86, the LDP at 0.96, the DPJ at 1.02, and

the SDP with the exceptional highest score what is the SDP score? (Table 10). Excluding the SDP with only a small number of samples, it became clear that for those voting for the DPJ, JCP, and New Komeito, the psychological distance was important. In the 2005 lower house election, because of postal privatization, the policy distance was important for LDP voters, but as we see from the 2004 upper house election, the LDP D coefficient was 0.47. Thus the influence of psychological proximity on voting behavior is greater in national elections other than the 2005 lower house election.

Formula 4: Revised Diametros Model II

$$R = \sqrt{(T_i - T_j)^2} + D_i \sqrt{(|X - \theta_i| - |X - \theta_j|)^2} - C + D$$

R : Voting probability
T : Thermometer rating
X : Voter's Optimal point
C : Voting cost
Di : D coefficient
D : Long-term benefits of voting
θi : Policy of party i
θj : Policy of party j(parties excluding party i)

8. Conclusion

To summarize: First of all, we succeeded in upgrading the traditional rational choice model concerning voting behavior from a one-dimensional, two-party system model to a multi-dimensional, multi-party system model. Next, we also showed that when the multi-dimensional, multi-party system expected utility model and the multi-dimensional, multi-party system minimax regret model were applied to the 2001 upper house election, their explanatory power was poor. We then examined a revised model which took into account party

loyalty. Although the explanatory power of this was somewhat better than the previous model, it was still not satisfactory. We then formulated a new multi-dimensional multi-party system diametros model, and a revised version of it, and the results showed that these were superior to the former two models. Finally, we constructed a coalition model, and found out that it too demonstrated valid results.

When we apply rational voting models developed in the U.S. to voting behavior in Japan, we may at first be inclined to think that Japanese voters are not voting rationally. But the reason for this is not simply because of differences between Japanese and American voters, but because the rational voting model was constructed with U.S. elections in mind. Thus, once we construct and apply a more general rational voting model, we can "rationally" explain Japanese voting behavior. Of course, it can be said that the model developed in this paper is in certain respects restricted to elections in Japan. However, by repeating this process in different countries, we can see that in the same way that Japanese voting behavior is unique, American voting behavior is also unique. Thus, we should consider the possibility of constructing an all-encompassing meta-model. In this way, Japanese electoral studies can contribute to studies in the U.S. and elsewhere.

Furthermore, the following point became clear in our analysis. The introduction of manifestos in the 2003 lower house election was hailed as the beginning of the new era of the "manifesto elections." Many believed that this would promote issue voting, in which voters would be expected to vote for a party or candidate whose policy pledges were the closest to their own issue attitude. Such a situation would signify the achievement of "party-centered, policy-oriented politics," promoted by those who supported reforming the electoral system and the public subsidy systems in the 1990s. However, as we have seen through our analysis, although party headquarters now have more control over electoral campaigns and candidate selections, the influence of parties' and candidates' policy pledges is still weak. The reasons for this are, as was noted at the outset, that despite having two major parties, there is not much

difference between the pledges of the LDP and DPJ candidates, and their policy positions are quite different from the voters' issue attitudes. In other words, although Japanese citizens technically have the right to choose whom to vote for, this is a rather paltry right if the available options converge at a point distant from their optimal points.

A properly functioning democracy in Japan requires not parties that present the outcomes of their top-down decisions to supporters and voters and ask for their votes, but parties that absorb the policies formulated by the public will from the bottom up. Theoretically, the role of a political party is to absorb the public will and pass it on to the legislature where policies are decided upon. However, we must question how many Japanese parties actually do this. Even if there are such parties, it is likely that the interests they represent are closely associated with a certain politician or particular organizations such as labor unions. However, it seems true that voters, whether LDP or DPJ supporters, are beginning to move beyond these practices and are seeking to meet directly with electoral candidates to participate in the policymaking process without intermediary organizations. This may be one reason as to why non-aligned voters tend to jump between different parties depending on their policy distance in a given election. For example, in the 2000 lower house election, 60% of the non-aligned voters voted for the DPJ when Hatoyama, the party leader, pledged fiscal reform by lowering standard taxable income levels. Only 20% voted for the LDP. But in the 2001 upper house election, Koizumi attracted the non-aligned votes due to the fact that of the four candidates in the LDP presidential race, he was the only one who openly promised fiscal reform. But because Koizumi's reforms did not meet the rising expectations in 2001, non-aligned voters began to lean back towards the DPJ in the two subsequent elections in 2003 and 2004. In the 2005 lower house election, however, Koizumi again secured the non-aligned votes by pushing for reform built around the idea of a fiscally sound, small government.

Democracy is essentially a political structure in which voters make their own decisions. Thus, should a political party depart from this

principle, it will eventually lose support from voters. Ideally, democracy should function in such a way that parties represent the interest of their supporters, and indeed, the voters at large, and formulate policies accordingly. Voters then should be able to make a choice according to the proposal that comes closest to their optimal point and thereafter accept the consequences of their decisions.

There are still many problems that have not been considered in this paper. For one, it is possible that the expected utility gap of rational choice models is measured by projection and persuasion. In the future, we hope to pursue this question and others that have not been covered.

* This paper is an English translation for chapter 5 of *Is Democracy Working in Japan after the Political Reform* published by Bokutakusya, 2008. The chapter was translated by Yoshiaki Kobayashi and Kei Numao.

Endnotes

(1) The public opinion and attitude data used in this paper are the outcome of *Specially Promoted Research: A national and chronological survey of voting behavior in the early 21st century* funded by the Ministry of Education, Culture, Sports, Science and Technology. I would like to thank my co-investigators, Kenichi Ikeda, Yutaka Nishizawa, and Hiroshi Hirano.

(2) Using the results from opinion and attitude surveys carried out in the 1993 and 1996 lower house elections, I have been trying to construct a Japanese rational voting model (Yoshiaki Kobayashi, "The practice and theory of coalition politics from a voter/party relation perspective," paper presented at the Japanese Association of Electoral Studies, Musashi Institute of Technology, 2000).

(3) Specifically, we provided the respondents with two views on each of the five issues, and asked them which of the two was closer to their opinion. Respondents were asked to choose from the follow-

ing four options: 1) Close to A 2) Somewhat closer to A 3) Somewhat closer to B 4) Close to B.

"Public Service"

A: We should enhance our social welfare programs even if this means higher taxes.

B: We should cut taxes even it this means cutbacks in social welfare programs.

"National/Local Relations"

A: The National government should distribute subsidies to help weak local regions and governments.

B: The National government should reduce the distribution of subsidies to encourage free competition in the local regions.

"Amending the Constitution"

A: The Constitution is outdated. We should make amendments.

B: The Constitution is by and large good. We should not make any amendments right now.

"Collective Defense"

A: We should sanction collective defense in order to strengthen the Japan-US security partnership.

B: We should not sanction collective defense lest we become involved in international conflicts.

"Visits to Yasukuni Shrine"

A: The prime minister should visit the Yasukuni Shrine to pray for the souls of those who died in WWII.

B: The prime minister should not visit the Yasukuni Shrine. The principle of the separation of Church and State should be observed.

(4) We asked the respondents what they believed the views of the LDP, DPJ, New Komeito, SDP, JCP, Conservative Party, and Liberal Party were concerning the five issues in note 3.

(5) We asked the respondents concerning the five issues in note 3, how important they thought each issue was for them. We asked them to choose from the following four options. 1) Very important 2) important 3) not very important 4) not important at all

(6) For the preliminary survey of the 2001 upper house election, we collected 2,064 valid responses from the 3,000 samples we interviewed, which were selected at random in two stages. Furthermore, we conducted a telephone survey of 1,588 samples, and we received 1,253 valid responses.

(7) We asked the respondents about the "degree of competition" in their constituencies, and asked them to answer which of the scenarios on the minimax regret model, S1-5, best described the situation. The degree of competition was separated into "high," "medium," and "low." For voting cost and the sense of duty, we asked the respondents to choose from "high," "medium," and "low" or "strong," "medium," and "weak." More specifically, we anticipate a positive relation between voting cost and electoral participation. That is, with lower voting costs, more people will vote. We also expect a positive relation between voting cost and voting direction because, all things being equal, those who will not vote for a favorite party tend to abstain.

On the other hand, we anticipate a negative relation between the sense of duty and electoral participation (people with a weaker sense of duty are more likely to abstain). The same relation is thought to exist between voting duty and voting direction.

(8) We may apply the minimax regret scenario to three-party systems as well. In this case, there will be nineteen scenarios and it will be possible to explain the voting participation of Voter Y, who is a utility maximizer, and Voter Z, who is a risk minimizer. For further details, see Yoshiaki Kobayashi, Koukyo Sentaku [Public Choice], Tokyo University Press, 1988, pp.129-39.

(9) I have constructed various different diametros models in the past (Yoshiaki Kobayashi, ed. *Nihonjin no touhyoukoudou to seiji ishiki* [Voting Behavior and Political Attitudes in Japan], Bokutansha, 1997, pp.158-60). Yet although their accuracy has been high, they are very complicated. So far, the key issue in calculating diametros was how to set the appropriate units for policy distance and psy-

chological distance. For example, a party with loyal supporters may afford to have candidates with campaign policies that are slightly off the supporters' optimal point. On the other hand, in the case of parties that do not have many loyal supporters, a slight policy gap may affect the voters' decision. Here, the unit ratio of policy distance and psychological distance was set as the D coefficient, and we sought the D coefficient that best explains the voting behavior in relation to each party. More specifically, when a voter compares the D coefficient between his favorite party and the party other than this whose policy is closest to his optimal point, we observed that the Japan Renewal Party (JRP) scored the highest, which was followed by the LDP, SDP and the JCP. By contrast, the Japan New Party (JNP) scored the lowest. Using these D coefficients, I constructed the Japanese diametros model. In addition to this, I made an applied model which considers a party individually. However, although the diametros models based on the D coefficient demonstrated high accuracy, I questioned whether it was overly complex. Thus in this paper, I decided to prioritize simplicity over accuracy. We can achieve a higher level of accuracy if we keep introducing independent variables. Yet, I want to avoid losing sight of the realties of voters' behavior and political attitudes by making the model too complicated.

(10) When constructing and examining a model, whether one should prioritize its accuracy or simplicity is a difficult question. In fact, reasonable scholars disagree about this.