

Knowledge of the Electoral System and Voter Turnout*

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Abstract

Taiwan's new MMM legislative electoral system first implemented in 2008 was a sharp departure from the half-century long SNTV system. This paper examines effects of knowledge of the new electoral system on citizens' decisions to vote or not to vote.

Existing literature on voting either assumes that voters are fully aware of the electoral system and thus ignores the effect of knowledge or at best assumes it is an exogenous factor. This study distinguishes itself from other related works in three respects. First, we do not assume that voters are fully

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aware of the new two-ballot electoral system and make their voting choices accordingly. Instead, we design a set of four survey questions to measure the degree to which citizens understand the new electoral rule. Secondly, instead of summing up the number of correct answers to these survey questions (i.e. the traditional “raw score” approach), we use a two-parameter item response model to estimate item loadings and then construct a continuous measure of latent knowledge. Thirdly, instead of assuming knowledge is exogenous, we build a two-equation simultaneous probit model to account for the effect of electoral system knowledge on voter turnout. This model is meticulously specified so that it allows for knowledge to be endogenous. We find that knowledge of electoral system is indeed endogenous and, in both SMD and PR ballot voting, higher knowledge of the new MMM system stimulates higher probability of voting after taking into account the endogeneity of knowledge.

Keywords: political knowledge, electoral system, voting behavior, item response theory, endogenous explanatory variable

I. Introduction

Taiwan transformed its legislative electoral system from a half-century long single non-transferable vote (SNTV) system to a mixed-member majoritarian (MMM) system in 2005. The new MMM system is a sharp departure from the original SNTV system in terms of total number of legislative seats, district magnitude, electoral formula and ballot structure. There have been several research works by scholars examining the impacts of adopting the mixed-member majoritarian system. However, almost all of them assume that voters are fully aware of the new two-ballot electoral system and make their vote choices accordingly (Cox and Schoppa 2002; Huang, Wang and Kuo 2005, 2008; Kohno 1997; Hsiao and Huang 2010; Wellhofer 2001).

Yet on the election day of 12 January 2008, only 58.5 percent of eligible voters cast valid ballots for district seats and 58.3 percent for a party list. These record-low turnout rates since the island's first nationwide legislative election in 1992 raise an interesting question. Was the low voter turnout rate caused by a sharp change in the electoral system, or it simply reflected a secular declining trend, or perhaps the former worsened the latter? In other words, does the level of information on the new electoral system affect the probability of voting? In their pioneering study, Huang and Yu (2011) find that a proportion of citizens is not fully aware of institutional components of the new MMM system. Furthermore, they find that citizens' knowledge of the new MMM system is a function of elec-

toral momentum, i.e. citizens' knowledge rises as the election date approaches and declines after the election date. This paper examines effects of knowledge of the new electoral system on citizens' decisions to vote or not to vote.

However, information is neither free nor exogenous. We expect the decision to be informed may be endogenous and a function of education level, media exposure and party affiliation. Furthermore, some latent factors may affect both knowledge and voting. For example, people cynical about politics may pay attention to and receive the information about electoral system on the one hand and yet fail to turn out to vote on the other hand. To overcome the potential endogeneity problem that plagued earlier literature, we specify a structural equation model (SEM) to first take into account how the knowledge of electoral systems is accumulated and then estimate if and how such knowledge affects voting. By utilizing a pre-election rolling cross-sectional survey to measure respondents' knowledge of the new MMM system and a post-election panel survey to trace their voting behaviors, this paper further establishes the causal linkage to enhance understanding of the way knowledge affects voting.

This study is organized as follows. We first review the literature on political knowledge in general as well as the relationship between knowledge of electoral system and voting. Then the data source and items used to measure the key concept - knowledge of electoral rules - are explained. The fourth section specifies the item response model of measuring knowledge as well as the structural

equation model of voting. The fifth section presents empirical findings. The last section concludes.

II. The Nature and Origins of Political Knowledge

A politically informed citizenry is a pre-requisite of democracy. Classical democracy theory suggests that whether democratic politics functions well depends on whether ordinary citizens are knowledgeable or not. The more political knowledge a citizen acquires, the more likely he (she) understands political institutions, politicians and political events, leading to more prudent decisions (Huang, Yu, and Hsiao 2011, 20). However, empirical results demonstrate the average citizen's limited political knowledge. Most citizens are ignorant about public affairs and are not interested in politics either (Campbell et al., 1960; Delli Carpini and Keeter 1991).

Political knowledge is defined as “the range of factual information about politics that is stored in long-term memory” (Delli Carpini and Keeter 1996, 10). It is closely related to other concepts such as political awareness, political sophistication, cognitive sophistication and political expertise. Although these concepts are not completely equivalent to political knowledge, they are often interchangeable to measure citizen competency.¹

¹ For example, Zaller (1992), in his influential book about the formation of public opinion, *The Nature of and Origins of Mass Opinion*, utilizes political knowledge as the major indicator to measure ordinary citizens' political awareness. In addition, Delli Carpini and Keeter (1996, 294) noted that “factual political knowledge is the most important component of a broader notion of

In fact, there are different types of political knowledge. It can be divided into the domains of “taught facts” and “surveillance facts”. Taught facts include knowledge of facts such as the president’s veto power and amendments to the U.S. constitution. Surveillance facts include knowledge of who is the vice president and which party is the majority party in the U.S. House and Senate (Delli Carpini and Keeter 1991, 598). A further classification suggests that there are three types of political knowledge (Jennings 1996, 229). The first type is called “textbook facts”, consisting of questions about the mechanics of government and politics, which is quite similar to “taught facts”. This type of knowledge is relatively stable and is often learned via the educational system. The second type of political knowledge is “current events” which is also labeled “surveillance facts” by Delli Carpini and Keeter (1991). Compared with the former type of knowledge, it changes more frequently and is usually acquired through mass media and personal interaction. The third type of knowledge has elements of both tuition and surveillance, labeled “historical facts”.

According to previous studies (Delli Carpini and Keeter 1996, 106-16; Luskin 1990, 334), three major determinants of political knowledge are civil ability, opportunity and motivation. Ability includes various types of skills, talents and attributes which help individuals process and retain information. Compared with other poten-

political sophistication”, showing that these concepts are often interchanged when they are employed to analyze citizen’s political behavior.

tial information sources such as work place and mass media, public education is considered the main source offering the opportunity to teach individuals skills for obtaining information and providing substantive information. As for motivation, it is a sense of obligation which results from interest, a sense of efficacy and civic duty. The motivation drives citizens to pay more attention to public affairs, obtaining more political knowledge.

What factors make an impact to the level of political knowledge? Previous studies suggest that factors such as education, age, gender, media contact, party identification, political interest and political efficacy significantly influence citizens' political knowledge (Karp 2006; Delli Carpini and Keeter 1996; Lambert et al. 1988; Luskin 1990; Jennings 1996; Lin 2005; Lin and Wang 2007). Among these factors, education is believed to be the most crucial. Citizens with higher education tend to be more politically informed. Education matters because it provides individuals the opportunity to learn civic ability and foster motivation to acquire political knowledge. Empirical research findings also confirm a positive relationship between education and political knowledge (Karp 2006; Delli Carpini and Keeter 1996; Jennings 1996).

However, influence of education on political knowledge is conditioned by the country's degree of economic redistribution. Education exerts a larger influence on the degree of political knowledge in countries where income is more unequally distributed. Furthermore, education plays a more important role in contributing political

knowledge in countries adopting majoritarian electoral system than in those with proportional representation system (Gronlund and Milner 2006).

When it comes to the determinants affecting political knowledge in Taiwan, according to previous studies, education, gender, age, region, occupation, ethnicity, education, gender, party identification, media exposure and political discussions are the determinants of the Taiwanese public's political knowledge (Hawang 1996; Weng and Sun 1993; Sun 1994; Chuang 2001; Lin and Wang 2007). In fact, Hawang (1996) even indicated that the origins of political knowledge in Taiwan are very similar to those in the United States. Nevertheless, gender plays a more critical role in Taiwanese public's political knowledge than that of the U.S. citizens. In addition, though participation is a significant factor affecting the degree of the U.S. citizens' political knowledge, it does not make a huge impact on that of the Taiwanese public.

As for the impact of political knowledge on democracy, Delli Carpini and Keeter (1996, 224) noted that "political knowledge boosts participation because it promotes an understanding of why politics is relevant." It has also been argued that "political knowledge can be thought of as an important precursor of political action, such as voting" (Lambert et al. 1988, 360). Compared with less informed citizens, the more knowledgeable are more likely to pay attention to political affairs, participate in various types of political activities, commit to democratic principles and have higher degree

of political efficacy (Delli Carpini and Keeter 1996, 6).

Furthermore, political knowledge matters and serves as an instrumental good which contributes to good citizenship (Delli Carpini and Keeter 1996). Political knowledge promotes civic virtues like political tolerance, active political participation and stable and consistent public opinion. In addition, it also helps people find their true interests and connect their opinion with participation to serve their interests (Delli Carpini and Keeter 1996, 219). Moreover, Lambert et al. (1988) even suggested that political knowledge itself is a form of political participation since people need to acquire political knowledge to participate in political activities and this promotes their political sophistication. In a nutshell, political knowledge is closely related to political participation, particularly to electoral participation.

III. Electoral Knowledge and Voting Behavior

As noted, Taiwan began electoral reforms in 2004, adopting a new electoral system to replace the SNTV system which was believed to have caused great damage to Taiwan's democracy.² Since the SNTV system was blamed for its negative impacts on Taiwan's political development, the Legislative Yuan passed the constitutional

² SNTV system in Taiwan was criticized for it encouraged intra-party competition instead of inter-party competition, candidate's parochial or radical appeals in election, and gangster politics and money politics (Huang, Yu, and Hsiao 2011, 9).

amendment to replace the SNTV system by the MMM system in 2004 and the National Assembly then approved the amendment in 2005. Elections for the 7th Legislative Yuan on 12 January of 2008 were the first implementation of this new MMM electoral system in Taiwan.

The MMM system is a compromise between a plural system and a proportional representation system, suggested to contribute to a stable two party-system and higher political equality (Huang, Yu, and Hsiao 2011, 10). Unlike the SNTV system, each eligible voter, under the MMM system, has two ballots. The first ballot chooses a district representative under a single member district system and the second ballot is cast for determining the number of seats a political party can have if its vote share exceeds 5% of total votes.

The MMM system is quite different from the SNTV system and is more complicated in some key elements, including assembly size, district magnitude, ballot structure and electoral formula (Huang, Yu, and Hsiao 2011).³ Since the institutional design of the MMM system is more complicated than the SNTV system, it appears to require some degree of awareness of electoral rules when an individual casts his (her) vote. Therefore, it is appropriate to make an inference that the level of knowledge about the new electoral system may affect people's voting behavior.

³ More information about the differences between the MMM system and the SNTV system in Taiwan can be found in Hung, Yu, and Hsiao (2011, 13-18).

However, does the Taiwanese public understand the institutional design of the MMM system? Empirical results suggest that most citizens are not fully aware of the institutional components of the MMM system (Huang, Yu, and Hsiao 2011; Tsai and Yu 2008; Shiao 2009). Huang, Yu, and Hsiao (2011) used four survey questions to examine the extent to which the respondents understood the new electoral system adopted for the Legislative Yuan election. The four questions relate to district magnitude, ballot structure, threshold of votes parties require to qualify for proportional representation and the new length of term of the legislators under the MMM system. Their research findings demonstrate that the four-year term question was answered correctly by most respondents whereas most respondents did not know the correct answer of the threshold of party list. Tsai and Yu (2008) and Shiao (2009), analyzing different survey data, also drew a similar conclusion.

It is also worth mentioning that an important contribution of Huang, Yu, and Hsiao is the finding that there is an electoral cycle of political knowledge. Studies of political learning have already confirmed that campaigns matter because they create an environment that educates voters about the candidates and policies and reduces the level of information inequality among the electorate (Freedman, Franz, and Goldstein 2004; Holbrook 1999; 2002; Ondercin, Garand, and Crapanzano 2011).⁴ They found that the closer the election

⁴ Holbrook (1999, 68) defined political learning as “the acquisition of political information as a consequence of exposure to the campaign process.” However,

date, the more electoral knowledge voters possess (Huang, Yu, and Hsiao 2011). Karp, focusing on the Mixed Member Proportional (MMP) system in Germany and New Zealand, also confirmed that most of the learning of electoral rules takes place before the election rather than afterwards (Karp 2006, 718).

When it comes to the impact of electoral knowledge, Larcinese (2007) argued that political knowledge indeed contributes to higher political participation, suggesting a huge impact of political knowledge on the probability of voting. Wattenberg, McAllister, and Salvanto (2000) also argued that voters who possess more knowledge about the US House are more likely to vote in the House election.

On the other hand, a research confirms that citizens' confusion about electoral rules discourages participation and leads to results not consistent with voters' preferences (Cox and Schoppa 2002). Meanwhile, Fukui and Fukai (1997) take Japan as the subject, which also adopted the MMM system in 1994, finding that the complexity of the new electoral system indeed makes Japan's voters more confused and frustrated and thus results in lower voter turnout. Their assertion is also confirmed by Kohno (1997).

Karp (2006) proposed a different point of view. By analyzing the causal relationship between citizens' knowledge of the MMP

previous studies of political learning emphasize the effect of campaign process and some events, such as debates, on the level of citizens' knowledge of candidates and issues. Only a few studies focus on the extent to which campaigns affect people's understanding of electoral system.

system and voting behavior in Germany and New Zealand, Karp claimed that a lack of electoral knowledge does not make a significant impact on voting behavior. Nevertheless, it is noteworthy that Karp's research focuses on how voters cast their votes rather than whether they vote at all. Karp's proposition that political knowledge has little or no effect on voting behavior is to suggest that a lack of electoral knowledge does not make a great impact on split-ticket voting. He did not examine whether confusion about electoral system affects voter turnout.

As for the case of Taiwan, only a few studies deal with this issue since the new electoral system has been introduced only recently, in 2008. Nevertheless, these studies also demonstrate that electoral knowledge makes a great impact on voter turnout. Tsai and Yu (2008) noted that an individual's knowledge about Taiwan's new electoral system markedly influences his (her) electoral participation. The more electoral knowledge an individual possesses, the more likely he (she) would turnout to vote. Furthermore, the lack of correct information about the new electoral system keeps people away from voting, even those who are used to vote (Shiao 2009).

However, even though previous studies confirm a significant relationship between knowledge about the electoral system and voting participation, they fail to solve a methodological problem before they start the analyses. In general, scholars are used to establish an index, which is made up of survey questions about the electoral system, to measure the level of respondents' electoral knowledge.

They then use this summation index to examine whether electoral knowledge affects voting intention. Nevertheless, this may not be an appropriate approach to establish an index of electoral knowledge, which is simply a sum of the survey questions the respondent answers correctly.

The reason why we claim so is that the probabilities of electoral knowledge questions being answered correctly are different. As noted earlier, only a few respondents know the threshold of the party list elections. However, more than 50% of respondents correctly answered the question of length of term of the new legislators (Tsai and Yu 2008; Shiao 2009; Huang, Yu, and Hsiao 2011). A simple index without taking this into account may not effectively distinguish citizens' level of knowledge. As a result, before examining how electoral knowledge affects voting behavior, we believe it is necessary to reconsider how to create a more appropriate measure of citizens' electoral knowledge. A further discussion of this issue is presented in later sections.

IV. Data

This study uses several waves of telephone interviews conducted before and after the 2008 legislative election. The data set⁵

⁵ The data set analyzed in this paper was from "Taiwan's Election and Democratization Study, 2008: Legislative Election: Telephone Interview (TEDS 2008L-T) (NSC 96-2420-H004-002-025)." The coordinator of the multi-year project TEDS is Professor Chi Huang (National Chengchi University). TEDS 2008L is an annual project on the Legislative Yuan

consists of a five-wave pre-election rolling cross-sections (RCS, see Huang 2009; Johnson and Brady 2002) between late 2007 and early 2008, as well as a post-election panel study of valid cases in the pre-election surveys. The first wave began on 13 December 2007, 30 days before the election. Then the second, third, fourth and fifth waves of the survey followed, until 11 January 2008, one day before the election day. Each wave successfully collected around 700 cases. The five wave pre-election rolling surveys were designed not only to collect data of overall understanding of voters' knowledge before election, but also to provide a dynamic picture of changes in voters' knowledge during the campaign period. The post-election telephone survey was conducted from 15 to 19 January 2008. This panel interview successfully traced 1,530 pre-election respondents and collected information about their voting behavior.

As Rae (1967) pointed out, there are three key elements of electoral systems: district magnitude, ballot structure and electoral formula. The above mentioned pre-election telephone interviews involved designing of a set of survey questions covering these three elements, plus a question related to extension of legislators' terms from three years to four, to gauge respondents' knowledge of the new MMM electoral rules. This set of four questions is listed below.

election in 2008, and TEDS 2008L-T is its telephone interview component. The principal investigator is Professor Yun-han Chu for TEDS 2008L. More information is available on TEDS website (<http://www.tedsnet.org>). The telephone interviews were conducted by the Election Study Center of National Chengchi University.

1. [Single Member District] Do you know how many legislators will be elected in your district in this Legislative Election?
2. [Two-Ballot Structure] Do you know how many ballots you can cast in this Legislative Election?
3. [Five Percent PR Threshold Formula] Do you know the threshold of the PR vote that a party must poll in order to get some seats under the PR system?
4. [Four-year Term] Do you know how long the term of the office is for the new legislators? (Assuming there is no premature dissolution of the legislature).

These four survey questions were coded as binary indicators with each correct answer to an item coded as 1 and incorrect answer/don't know coded as 0.

V. Model and Methodology

The primary focus of this study is of course the effect of voters' knowledge of the MMM electoral system on turnout. Our model is illustrated by a path diagram in Figure 1. We hypothesize that voters' knowledge of the MMM electoral system y_2 has a positive effect on turnout y_1 . Knowledge and turnout, in turn, are affected by vectors of exogenous variables \mathbf{x}_2 and \mathbf{x}_1 , respectively.

At first glance, this seems to be a fairly standard two-equation recursive model. However, we face two methodological complications here. First of all, we do not have a direct measure of voters'

knowledge. Instead, we only have four binary indicators or ‘items’ (a 4×1 vector of \mathbf{x}_3) discussed in the last section for probing voters’ awareness of the MMM electoral system. Secondly, knowledge involves cost and thus may be an endogenous explanatory variable even after controlling for other exogenous variables such as sex, age and education and political attitudes in \mathbf{x}_1 . That is, there is always the possibility that some unobserved or even unobservable variables may affect both knowledge and voting. For example, people disinterested in politics may disregard information about electoral system and also fail to turnout to vote. Ideally, political interest should be included in the vector of \mathbf{x}_1 as a control variable. Unfortunately, the TEDS 2008L-T telephone survey did not include this variable in its questionnaire.

This study adopts two strategies to overcome these methodological challenges. We tackle the first problem with a sophisticated measurement model of latent trait, i.e. the logistic item response model based on the item response theory (IRT) for categorical responses (Embretson and Reise 2000; de Ayala 2009), to construct a continuous measure of knowledge y_2 . We then evaluate the effect of this latent knowledge on voting by specifying a ‘probit model with a continuous endogenous regressor’ in order to confront the endogeneity problem.

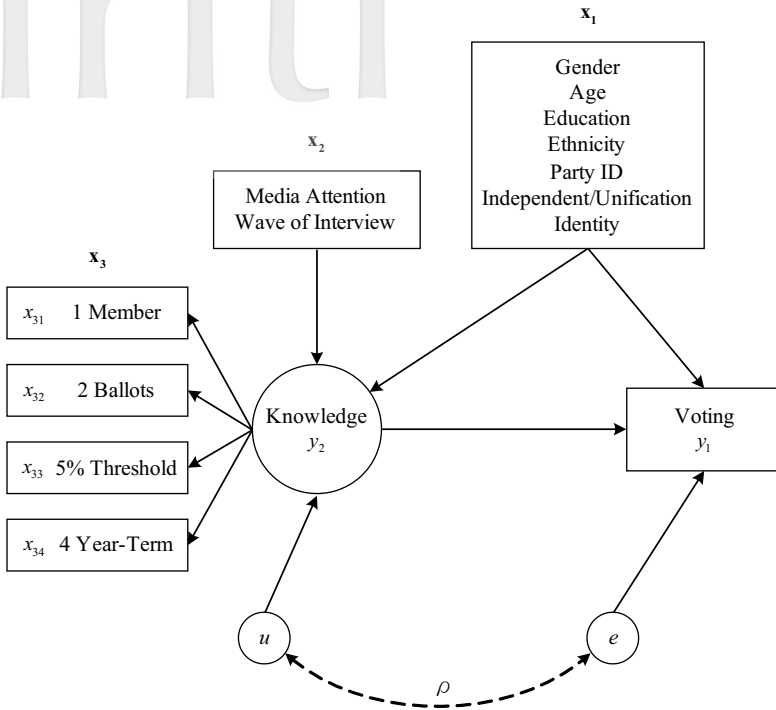


Figure 1 Knowledge of Electoral System as an Endogenous Explanatory Variable of Voting

Note: Circles \circ denote latent variables, while rectangles \square represent observed variables (see Kline 2011, 95).

Logistic Item Response Models

The Rasch model developed in the 1960s is undoubtedly the most well-known IRT model for dichotomous items (see Molenaar 1995). In this model, the probability of a correct response for item i ($i = 1, \dots, I$) by person p ($p = 1, \dots, P$) is a function of an item difficulty parameter δ_i , and a person's latent trait ("knowledge level" in this study) y_{2p} :

$$\Pr(x_{3ip} = 1 | y_{2p}) = \frac{\exp(y_{2p} - \delta_i)}{1 + \exp(y_{2p} - \delta_i)} = \frac{1}{1 + \exp[-(y_{2p} - \delta_i)]} \quad (1)$$

Equation (1) indicates that the Rasch model is based on the idea that the distance between a person's knowledge and the item difficulty, i.e. $(y_{2p} - \delta_i)$, is a determinant of probability of responding to item x_{3i} correctly. Since the Rasch model uses one parameter δ_i to characterize each item, it is often referred to as a one-parameter logistic (1PL) model in IRT literature. However, if we consider I items responses nested within each subject and assume that the continuous latent knowledge y_{2p} has a standard Normal distribution, then the Rasch model is simply a random-intercept multilevel logistic model (Hedeker 2008, 257-58; Kamata and Vaughn 2011, 45-46).

Birnbaum (1968) extended the 1PL to a two-parameter logistic (2PL) model by including a slope parameter λ_i which determines how well an item discriminates between different trait levels. This λ_i is sometimes referred to as "item discrimination parameter" (Jackman 2008, 135). The 2PL item response model is specified as:

$$\Pr(x_{3ip} = 1 | y_{2p}) = \frac{1}{1 + \exp[-\lambda_i(y_{2p} - \delta_i)]} = \frac{1}{1 + \exp[-(\lambda_i y_{2p} - \alpha_i)]} \quad (2)$$

where $\alpha_i = \lambda_i \delta_i$, and the item difficulty is represented by $\delta_i = \alpha_i / \lambda_i$ (de Ayala 2009, 17-19). λ_i 's can also be interpreted as factor loadings of items on the unidimensional latent knowledge score y_{2p} (Skrondal and Rabe-Hesketh 2004, 293). If we constrain these factor loadings to be equal to 1 by assuming weights of all items are the same, 2PL

model collapses into 1PL model. Since 2PL model is nested within 1PL, we can test 2PL against 1PL for goodness-of-fit by conducting a likelihood ratio test.

We first estimate a 1PL item response model; parameter estimates are given in the first column of Table 1. The estimated item difficulties⁶ $\hat{\delta}_i$ indicate that item 4 (4-year term) is the easiest, item 1 (SMD) is the second easiest, item 3 (two-ballot structure) is harder and item 3 (5% PR threshold) is the most difficult. The level 2 variance, i.e. variance of respondent knowledge, is estimated as 0.963 with a standard error of 0.116. As mentioned earlier, however, 1PL model assumes that the effect of increased knowledge of the electoral system is the same for all the four items. This assumption can be relaxed using the 2PL model.

Table 1 Estimates for 1PL and 2PL Item Response Models

| Parameters | 1PL Model | | 2PL Model | |
|--------------------------------------|-----------|---------|-----------|---------|
| | estimates | (s.e.) | estimates | (s.e.) |
| Intercepts* | | | | |
| α_1 [Item1: SMD] | -0.024 | (0.062) | -0.024 | (0.067) |
| α_2 [Item2: 2 Ballots] | 0.251*** | (0.062) | 0.263*** | (0.065) |
| α_3 [Item3: 5% PR Threshold] | 2.445*** | (0.097) | 4.125*** | (0.741) |
| α_4 [Item4: 4 Year Term] | -0.521*** | (0.063) | -0.444*** | (0.054) |
| Item Loadings | | | | |
| λ_1 [Item1: SMD] | 1 | — | 1 | — |
| λ_2 [Item2: 2 Ballots] | 1 | — | 0.881*** | (0.185) |
| λ_3 [Item3: 5% PR Threshold] | 1 | — | 2.233*** | (0.727) |

⁶ For 1PL, $\delta_i = \alpha_i$ in Table 1.

| | 1PL Model | | 2PL Model | |
|------------------------------------------|---------------|---------|---------------|---------|
| Parameters | estimates | (s.e.) | estimates | (s.e.) |
| λ_4 [Item4: 4 Year Term] | 1 | – | 0.256*** | (0.069) |
| Level 2 Variance | | | | |
| ψ | 0.963*** | (0.116) | 1.619*** | (0.454) |
| Model information | | | | |
| Number of persons×number of items | 1530×4 = 6120 | | 1530×4 = 6120 | |
| Log-likelihood | –3586.315 | | –3547.865 | |

Data Source: TEDS 2008L-T

Note: ***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$

[†]As explained in text, $\alpha_i = \lambda_i \delta_i$. Thus, for 1PL, item difficulties $\delta_i = \alpha_i$. For 2PL, item difficulties $\delta_i = \alpha_i / \lambda_i$.

In the 2PL item response model there are four item loadings and we set the first item loading $\lambda_1 = 1$ for identification. Parameters estimates of 2PL model are given in the second column of Table 1. Although the estimated item difficulties⁷ confirm that item 4 is the easiest while item 3 is the hardest, the 2PL model's estimated discrimination parameters (or item loadings) $\hat{\lambda}_3$ and $\hat{\lambda}_4$ are quite different from 1, as assumed by the 1PL. The likelihood-ratio test of $G^2 = 76.9$ with $df = 3$ is highly significant ($p < .0001$), confirming that the 2PL model fits much better than the 1PL model. Perhaps the best way to report parameters estimates of the 2PL model is to draw item characteristic curves (ICC). Figure 2 shows ICCs describing the relationship between latent knowledge levels, discriminating power of the four items and probabilities of answering each item correctly.

⁷ For 2PL, $\delta_i = \alpha_i / \lambda_i$ in Table 1.

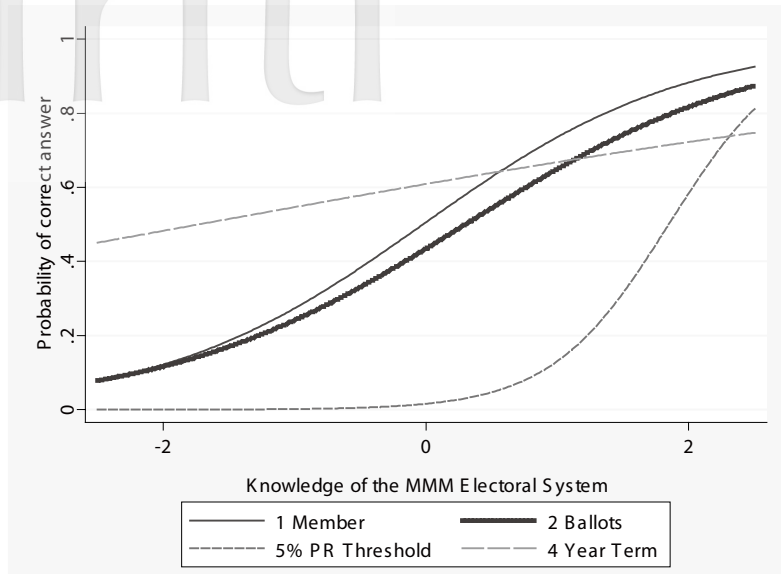


Figure 2 Item Characteristic Curves of the four Items of the Electoral System Knowledge under the 2PL Model

In the following analysis, we adopt the better fitting 2PL model and obtain its empirical Bayes predicted mean values (see Zheng and Rabe-Hesketh 2007, 331; de Ayala 2009, 77-78) as our measure of the latent knowledge score y_{2p} for each individual p in the sample.

Simultaneous Probit Model with Endogenous Knowledge Variable

Once we solve the problem of measuring knowledge of the electoral system, we turn to our structural equation model with a continuous endogenous variable, as illustrated in Figure 1. We start by specifying the following linear latent-variable model where y_1^* is the dependent variable, propensity to vote, of the structural equation and y_2 is a continuous endogenous regressor, i.e. knowledge of the

new MMM electoral system.

$$\left\{ \begin{array}{l} \text{Structural Equation: } y_{1p}^* = \mathbf{x}'_{1p}\gamma + \beta y_{2p} + \varepsilon_p \end{array} \right. \quad (3)$$

$$\left\{ \begin{array}{l} \text{Reduced-form Equation: } y_{2p} = \mathbf{x}'_{1p}\pi_1 + \mathbf{x}'_{2p}\pi_2 + u_p \end{array} \right. \quad (4)$$

where \mathbf{x}_1 is an 8×1 vector of a constant plus seven exogenous variables, including four demographic variables (sex, age, education and ethnicity) and three variables of political attitudes (party identification, stand on independence/unification issue and national identity). \mathbf{x}_2 is a 3×1 vector of a constant term plus two additional instrumental variables (IV), including media attention and the specific wave (timing) of the interview which affects y_2 but does not directly affect y_1^* .

Structural equation (3) is of primary interest in this study and we would like to estimate coefficients γ and β consistently. If y_1^* is continuously observed, then we can overcome the endogeneity of y_2 by applying the two-stage least squares (2SLS) method, i.e. do the least squares regression of Equation (3) with the endogenous y_2 replaced by its fitted values from Equation (4). However, the dependent variable y_1^* is not directly observed. Instead the binary outcome y_1 is observed with $y_1^* = 1[y_1^* > 0]$ and thus a nonlinear probit/logit model is more appropriate than a linear probability model. Unfortunately, the 2SLS interpretation of linear IV does not extend to nonlinear models, so we cannot simply do probit regression with the endogenous regressor replaced by fitted values from a reduced-form Equation (4) (Wooldridge 2010, 596-97).

In order to handle potential endogeneity of y_2 as well as non-linearity of Equation (3) in our model, we adopt an instrumental variable probit approach (Wooldridge 2010, 590-91). This approach specifies joint distributions of y_1^* and y_2 in Equations (3) and (4) as bivariate Normal (BVN)

$$\begin{bmatrix} \varepsilon_p \\ u_p \end{bmatrix} \sim \text{BVN} \left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \sigma_{\varepsilon u} = \rho \cdot 1 \cdot \sigma_u \\ \sigma_{u\varepsilon} = \rho \cdot \sigma_u \cdot 1 & \sigma_u^2 \end{bmatrix} \right)$$

From this setting, endogeneity of y_2 arises if and only if ε_p and u_p are correlated. A test of the null hypothesis of exogeneity of y_2 is equivalent to the test of $H_0: \rho = 0$. If $\rho = 0$, ε_p and u_p are independent and there is no endogeneity problem. Maximum likelihood (ML) estimation of this IV probit model is more efficient and allows estimation of structural coefficients γ and β consistently.

VI. Findings

Results of ML estimates of both SMD and PR voter turnout are reported in Table 2. Wald tests of exogeneity of y_2 $H_0: \rho = 0$ in both SMD and PR equations are rejected at $p < .001$. This finding confirms our conjecture that voters' knowledge of the MMM electoral system is indeed endogenous, i.e. both knowledge and turnout are affected by some unobserved factors. Our specification of the instrumental variable probit model takes into account such endogeneity and renders consistent estimates of structural coefficients γ and β .

Table 2 IV Probit Model of Voter Turnout (with Endogenous Regressor)

| | SMD ballot | | PR ballot | |
|--------------------------------------------------------|---------------------|---------------|---------------------|---------------|
| | estimates | (Robust s.e.) | estimates | (Robust s.e.) |
| First-stage reduced form Equation (4): | | | | |
| <u>Knowledge</u> | | | | |
| Gender (Male = 0) | | | | |
| Female | -0.564*** | (0.044) | -0.565*** | (0.042) |
| Age | 0.011*** | (0.002) | 0.012*** | (0.002) |
| Education (elementary school or illiterate = 0) | | | | |
| Junior high school | 0.380*** | (0.101) | 0.386*** | (0.097) |
| Senior high school | 0.522*** | (0.087) | 0.543*** | (0.083) |
| College | 0.577*** | (0.108) | 0.611*** | (0.099) |
| University(or above) | 0.597*** | (0.117) | 0.620*** | (0.110) |
| Ethnicity (Hakka = 0) | | | | |
| Minnan | 0.021 | (0.062) | 0.012 | (0.060) |
| Mainlander | -0.066 | (0.088) | -0.083 | (0.086) |
| Party Identification (KMT = 0) | | | | |
| DPP | 0.037 | (0.072) | 0.006 | (0.067) |
| NP | 0.217 [†] | (0.119) | 0.166 | (0.117) |
| PFPP | 0.394* | (0.157) | 0.364* | (0.151) |
| TSU | 0.264* | (0.132) | 0.370** | (0.138) |
| Independents | -0.137 [†] | (0.071) | -0.138* | (0.067) |
| Independence/Unification | | | | |
| (prefer unification = 0) | | | | |
| prefer status quo | 0.043 | (0.075) | 0.057 | (0.076) |
| prefer independence | 0.062 | (0.095) | 0.095 | (0.094) |
| Identification as Taiwanese / Chinese | | | | |
| (Taiwanese = 0) | | | | |
| Both | -0.070 | (0.067) | -0.075 | (0.067) |
| Chinese | -0.201 [†] | (0.108) | -0.184 [†] | (0.110) |

| | SMD ballot | | PR ballot | |
|--------------------------------------------------------|---------------------|---------------|---------------------|---------------|
| | estimates | (Robust s.e.) | estimates | (Robust s.e.) |
| Media Exposure (Very close attention = 0) | | | | |
| Moderately close attention | 0.162* | (0.072) | 0.136 [†] | (0.075) |
| Not very close attention | 0.413*** | (0.062) | 0.399*** | (0.062) |
| No attention at all | 0.591*** | (0.095) | 0.548*** | (0.090) |
| Wave of Interview (First wave = 0) | | | | |
| Second wave | 0.098 | (0.067) | 0.088 | (0.064) |
| Third wave | 0.222*** | (0.057) | 0.208*** | (0.055) |
| Fourth wave | 0.364*** | (0.051) | 0.351*** | (0.047) |
| Fifth wave | 0.521*** | (0.065) | 0.509*** | (0.065) |
| Constant | -0.161*** | (0.228) | -0.071*** | (0.224) |
| <u>Structural Equation (3): Voting</u> | | | | |
| Knowledge of the MMM Electoral System | 0.961*** | (0.089) | 0.956*** | (0.098) |
| Gender (Male = 0) | | | | |
| Female | 0.499*** | (0.104) | 0.491*** | (0.104) |
| Age | 0.010* | (0.005) | 0.008 | (0.005) |
| Education (elementary school or illiterate = 0) | | | | |
| Junior high school | -0.305 | (0.229) | -0.290 | (0.222) |
| Senior high school | -0.399 [†] | (0.211) | -0.396 [†] | (0.209) |
| College | -0.498* | (0.217) | -0.533* | (0.214) |
| University(or above) | -0.570* | (0.226) | -0.562* | (0.218) |
| Ethnicity (Hakka = 0) | | | | |
| Minnan | 0.299** | (0.100) | 0.307** | (0.097) |
| Mainlander | 0.254 [†] | (0.143) | 0.245 [†] | (0.137) |
| Party Identification (KMT = 0) | | | | |
| DPP | -0.189 | (0.130) | -0.171 | (0.123) |
| NP | -0.240 | (0.249) | -0.182 | (0.246) |
| PFP | -0.648* | (0.323) | -0.598 [†] | (0.326) |
| TSU | -0.516* | (0.262) | -0.693** | (0.240) |

| | SMD ballot | | PR ballot | |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| | estimates | (Robust s.e.) | estimates | (Robust s.e.) |
| Independents | -0.800*** | (0.139) | -0.807*** | (0.140) |
| Independence/Unification (prefer unification = 0) | | | | |
| prefer status quo | 0.016 | (0.136) | 0.024 | (0.138) |
| prefer independence | 0.050 | (0.212) | 0.018 | (0.204) |
| Identification as Taiwanese / Chinese (Taiwanese = 0) | | | | |
| Both | 0.157 | (0.116) | 0.152 | (0.117) |
| Chinese | 0.299 | (0.215) | 0.276 | (0.219) |
| Constant | -0.167 | (0.344) | 0.420 | (0.352) |
| Model information | SMD ballot: $n = 1139$; Log Likelihood = -1744.1099 Wald test $X^2 = 604.28$; $df = 18$; $p < 0.001$ $\hat{\rho} = -0.564$, Wald test of exogeneity $H_0: \rho = 0$, $X^2 = 27.17$; $df = 1$; $p < 0.001$ | | PR ballot: $n = 1175$; Log Likelihood = -1786.6024 Wald test $X^2 = 594.57$, $df = 18$, $p < 0.001$ $\hat{\rho} = -0.543$, Wald test of exogeneity $H_0: \rho = 0$, $X^2 = 23.29$; $df = 1$; $p < 0.001$ | |

Data Source: TEDS 2008L-T

Notes: 1. ***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$; †: $p < 0.1$. s.e. adjusted for clusters in districts

2. Dependent variable: y_1 , 1 = “Vote”; 0 = “Not vote”

A glance at the first-stage reduced-form Equation (4) results in Table 2 indicates that males, older citizens and those with higher education and those who pay more attention to news media are more aware of the new electoral system. Furthermore, as Huang, Yu and Hsiao (2011) find, the closer to the election day respondents were interviewed, the more knowledgeable about the electoral system they tended to be. In other words, campaign dynamics indeed create

the momentum for understanding of the electoral system. It is also interesting to note that in terms of party identification, those who identified themselves with smaller parties (including NP, PFP and TSU) were more aware of electoral rules. Those identifying with small parties are either more sensitive to constraints the new MMM system poses to their preferred parties or more likely to receive campaign messages from their party leaders.

Structural Equation (3) is of primary interest for this study. We first notice that in both SMD and PR, higher knowledge level of the new MMM electoral system indeed stimulates higher probability of voting after taking into account endogeneity of knowledge. As shown in Table 2, β coefficient estimates of knowledge level, 0.961 and 0.956 in SMD and PR, respectively, are highly significant at $p < .001$ level. Since probit regression is a nonlinear model, we interpret the estimates in terms of average marginal effects (or partial effects) on the probability of voting. A calculation of partial effects indicates that one standard deviation increase in electoral system knowledge leads to an average increase of 0.240 and 0.236 in the probability of the voter turning out to vote for SMD and party list, respectively. In other words, an increase in knowledge of electoral rules indeed contributes to higher probability of voting, as hypothesized.

After taking into account voters' knowledge level, effects of other variables on voting change in interesting ways. For example, female voters, although less knowledgeable about the electoral sys-

tem, are more likely to vote. The opposite is true for effects of education and party identification on voting. People with higher education (college and university or higher), albeit more knowledgeable, become less likely to vote. Even more interestingly, voters identified with smaller parties (especially with PFP and TSU), although more aware of the new MMM electoral rules, are less likely to turnout to vote. For example, voters identified with the Taiwan Solidarity Union are more aware of the new electoral rules and yet less likely to vote. This is perhaps due to the fact that their knowing the constraints of MMM on their preferred party discourages their participation. However, independent voters who do not identify with any party are probably the most negatively affected group. They tend to be less aware of the new MMM system and, after controlling for knowledge level, are also less likely to vote.

VII. Conclusion

Existing literature on voting either assumes there is no effect of knowledge or treats it as an exogenous factor. This study distinguishes itself from other related works in three aspects. First, we do not assume that voters are fully aware of the new two-ballot electoral system and make their vote choices accordingly. Instead, we design a set of four survey questions to measure the degree to which citizens understand the new electoral rules. Secondly, instead of summing the number of correct answers to survey questions (i.e. the traditional “raw score” approach) we adopt a two-parameter item

response model to estimate item loadings and then construct a continuous measure of latent knowledge. Thirdly, instead of assuming that knowledge is exogenous, we build a two-equation simultaneous probit model to account for the effect of electoral system knowledge on voter turnout. This model is meticulously specified in such a way that it allows for knowledge to be endogenous. We find that knowledge of the electoral system is indeed endogenous and, in both SMD and PR voting, higher knowledge level of the new MMM system stimulates higher probability of voting after taking into account endogeneity of knowledge. This finding of course also implies that lower knowledge level leads to lower propensity to vote.

Some implications of our researching findings are noteworthy. Unlike previous studies of political knowledge, one major contribution of this paper is to examine the difficulties of each electoral system knowledge item to be answered correctly. By examining the discrimination power of the four questions about electoral system's knowledge, we demonstrate that a simple sum of respondents' answers to each knowledge question is not adequate. It is necessary to take the difficulty of the question into account when we use political knowledge variable to analyze citizens' voting behaviors.

Moreover, we find that electoral knowledge indeed plays a crucial role in voter turnout. Citizens who are more aware of the institutional designs of the new MMM electoral system are more likely to vote. Previous studies suggest that citizens who are male and with higher education level are more likely to vote. However, our find-

ings indicate that when electoral knowledge and its endogeneity are taken into account, the relationship between voter turnout and education and gender turn opposite to what conventional wisdom suggests.

In addition, we also find that though those who identify with small parties have higher knowledge level than their major party counterparts, they tend to be less likely to vote. One explanation for this phenomenon is that as the knowledge level of the MMM system increases, small parties' supporters become more aware of the difficulties of crossing the institutional hurdle. Some of them may still vote sincerely while others vote strategically, and still others simply decide not to vote. However, independent voters are perhaps the most negatively affected group. They tend to be less aware of the new MMM system and, after controlling for knowledge level, are also less likely to vote. In short, according to our research findings, electoral knowledge apparently is one of the most important factors affecting citizens' voting participation when a new electoral system is introduced.

Furthermore, most previous studies analyzing the relationship between electoral knowledge and voting behavior under the mixed electoral system focus on the cases of the MMP system such as German and New Zealand (Jesse 1988; Scheon 1999; Karp 2006). This study serves to fill the vacancy in the literature. Our research findings confirm that people' electoral knowledge also plays a significant role under the MMM system.

Appendix Variable List

| Variables | Survey Questions | Coding of Variables |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Dep. Variables | | |
| Vote or not vote | (SMD) Which district candidate did you vote for? (PR) In terms of the party list vote, which party did you vote for? | 0. Not vote 1. Vote |
| Knowledge of electoral system | 1. Do you know how many legislators will be elected in your district in this Legislative Election? 2. Do you know, besides referendum ballots, how many ballots you can cast in this Legislative Election? 3. Do you know the threshold of the list vote that a party must reach in order to participate in allocation of seats by party lists? 4. Do you know how long is the term of office of the new legislators? | 0. Wrong answer and no idea 1. Correct answer |
| Ind. Variables | | |
| Gender | Respondent's gender | 0. Male 1. Female |
| Age | Year of birth | Continuous variable: 2007-(year of birth) |
| Education | Education level | 1. Elementary school or illiterates 2. Junior high school 3. Senior high school 4. College 5. University and above |
| Ethnicity | Father's ethnic background | 1. Hakka 2. Minnan 3. Mainlander (Recoding 'aboriginal' as missing value due too few cases) |

| Variables | Survey Questions | Coding of Variables |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Party identification | Among the main political parties in our country, including KMT, DPP, PFP, NP and TSU, do you think of yourself as supporting any particular party? | 1. KMT 2. DPP 3. NP 4. PFP 5. TSU 6. Independents |
| Independence / Unification | Concerning the relationship between Taiwan and mainland China, which of the following six positions do you agree with: 1) immediate unification, 2) immediate independence, 3) maintain the status quo, move toward unification in the future, 4) maintain the status quo, move toward independence in the future, 5) maintain the status quo, decide either unification or independence in the future, 6) maintain the status quo forever | Recoding the original answers as 1. prefer unification 2. prefer status quo 3. prefer independence |
| Identification of Taiwanese/Chinese | In Taiwan, some people think they are Taiwanese. There are also some people who think they are Chinese. Do you consider yourself as Taiwanese, Chinese or both? | 1. Taiwanese 2. Both 3. Chinese |
| Media exposure | When watching election news on TV, did you pay very close attention, pay moderately close attention, not pay very close attention, or not pay attention at all? | 1. Very close attention 2. Moderately close attention 3. Not very close attention 4. No attention at all |
| Wave of interview | | 1. first wave 2007/12/13~2007/12/18) 2. second wave (2007/12/19~2007/12/24) 3. third wave (2007/12/25~2007/12/30) 4. fourth wave (2007/12/31~2008/01/05) 5. fifth wave (2008/01/06~2008/01/11) |

Data source: TEDS2008L-T

Note: Political parties' acronyms: KMT, Nationalist Party (Kuomintang); DPP, Democratic Progressive Party; NP, New Party; TSU, Taiwan Solidarity Union; NPSU, Non-Partisan Solidarity Union.

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選制知識對投票參與的影響

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摘要

立法院在2008年第七屆立法委員選舉中，首次採用了單一選區兩票制（Mixed-Member Majoritarian Electoral System, MMM），其結合了單一選區多數決與政黨名單比例代表制兩種席次分配方式，與過去採用的「複數選區單記非讓渡投票制」（Single Non-Transferable Vote with Multi-Member-District system, SNTV-MMD）在制度特性上截然不同。本文主要目的是檢視選民對於新選制的瞭解，亦即選制知識的高低，是否將對選民之投票參與產生影響。

從既有的文獻中發現，傳統研究或者假定選民對選制有充分的理解而無須納入分析，或者即便探討選制知識高低對投票行為之影響，往往將選民的選制知識本身視為外因變數（exogenous variable）。本文與過去既有之研究有三點主要的差異。首先，本文並不貿然假定選民對於兩票制的新選舉制度擁有充分的資訊與瞭解，而是以四個問卷題目來測量選民對新選舉制度的瞭解程度。第二，在選制知識的測量方法上，既有研究常直接加總選民答對題目的數目，作為選制知識高低的變數，本文則進一步運用項目反應理論（item response theory），建構一個「二參數項目反應模型」（two-parameter item response model）來估計各個測量項目對選制知識的區

辨能力，進而建立一個屬於連續變數的選制知識測量。第三，本文認為選制知識在對投票行為的影響上，應是一個內因變數（endogenous variable），基於此一理論設定，本文結合兩個方程式同時估計選制知識高低的成因及其對選民投票的影響。分析結果顯示，選民的選制知識的確屬於內因變數，而在充分考量此一內因性後，證實選制知識對投票參與有顯著的正效應：選民對新MMM選制越瞭解，參與投票的機率也越高；反之，對新選制越不瞭解，參與投票的機率也越低。

關鍵詞：選制知識、投票、項目反應理論、內因解釋變數