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策略式方法在投票賽局實驗中的使用

The Use of Strategy Methods in Experimental Pivotal-Voting Game

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首先我必須感謝我的指導教授王道一老師。很感謝老師願意收我為指導學生，加入 TASSEL 是我這兩年中做出最正確的選擇，或許未來不會再從事學術研究，但從老師身上學到的思考方式以及做事態度是一輩子受用。感謝我的父母在我念書的二十六年中對我的無條件支持，要脫離米蟲身分的我終於可以讓他們鬆了一口氣了。感謝實驗室的同窗們：廖偉廷、陳瑋、李易珊、陳之翰、還有劉書彧。能跟各位一起待在同一個實驗室是我的榮幸，跟你們一起的回憶是我的寶貴資產，也祝福大家以後都能有好的發展。感謝口試委員：黃貞穎老師、張勝凱老師以及蔡崇聖老師的珍貴意見。最後我要感謝洪可欣，與妳一路走來有點坎坷但也是漸入佳境，感謝妳對我精神上的支持，以及協助我論文的校稿，未來很長久的人生中，希望我們能繼續分享彼此的喜悅及悲傷。碩士班新生說明會那天，王道一老師說了一句讓我一直記得的話。他說他沒有甚麼成就（這當然不是事實），唯一有的是一個很棒的老婆以及三個可愛的孩子。我太羨慕老師了，所以當下我決定有一天也要能像老師一樣說出這樣的話（我想我能比老師更有資格說出我沒有甚麼成就這句話）。兩年過去了，希望我離這個目標更近了一些。

策略式方法在投票賽局實驗中的使用

郭彥、王道一

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中文摘要

為了解決投票矛盾問題，已經有很多論文發表。在我們的文章中，我們以策略式方法模仿 Levine and Palfrey 在 2007 年的投票賽局。我們的資料支持弱勢者效果以及競爭效果，但無論我們使用直接回應方法或是策略式方法，皆無法複製 Levine and Palfrey 在 2007 年的結果。我們也發現受試者並不使用嚴格的斷點策略。最後我們發現受試者的確會針對歷史的關鍵事件做出回應，這也是理性選擇模型最重要的意涵。

關鍵字：理性選擇模型，關鍵選民賽局，策略式方法，投票矛盾，實驗經濟學

The Use of Strategy Methods in Experimental Pivotal-Voting Game

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Abstract

Many papers have been published for solving paradox of voter turnout. In this paper, we adopt the strategy method to mimic Levine and Palfrey (2007)' voting games. We find the underdog effect and competition effect supported by our data, but we cannot replicate the Levine and Palfrey (2007)' result for neither the strategy method, nor direct response method. We also find evidences indicates that subjects don't use fixed cut-off strategies. Finally, out data shows that voters are highly responsive to historical pivotal event, which the most important implication of rational choice model.

J.E.L. classification codes: C71, C91

Keywords: Rational Choice Model, Pivotal Voter Game, Paradox of Voter Turnout, Strategy Method, Experimental Economics

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1. Introduction

Why do some people vote and others don't? As Dhillon and Peralta (2002) note, this question gives economists and political scientists a chance to examine the power of their theories. Many theories have been published to solve this problem. The rational choice theory (or the pivotal voter model), originally formulated by Downs (1957), caught economists' attention with its purest instrumental rationality approach, and became the most extensively used framework in explaining voter turnout problem.

But there is a saying in English that goes: "You must take the good with the bad.". As noted by Aldrich (1997), "*The rationality of voting is the Achilles' heel of rational choice theory in political science*." The theory affirmed that a voter only obtains utility if and only if its vote changes the result. Since the probability of casting the pivotal vote decreases when the size of electorate increase, a rational citizens should not vote in a large size election. The prediction is contrary to the result we observe in real world, and this contradiction is called "paradox of voter turnout."

Many empirical papers have been published, but most of them provide at most weak tests due to the difficulty of controlling other extraneous factors in field data, such as preferences, cost distribution, etc. (Scharam and Sonnemans, 1996; Levine and Palfrey, 2007).

Levine and Palfrey (2007) overcome this difficulty by using laboratory experiments. In particular, they conduct series of simple plurality voting games based on Palfrey and Rosenthal (1983)'s model with heterogeneous costs, and find that theory works well at both the aggregate level and the individual level.

In this paper, we adopt the strategy method instead of the direct response method used by Levine and Palfrey (2007), and force subjects to use a monotonic cut-off strategy. This modification allows us to observe subjects' cut-offs for each round directly and provides us a chance to further investigate subject behaviour, especially regarding learning. To ensure comparability, we use the same parameters and terms as the nine-player game in Levine and Palfrey (2007).

Brandts and Charness (2011) survey whether the strategy method leads to different experimental results. The survey of empirical comparisons suggests that the strategy method and the direct-response method produce similar results. However, they find two possible factors that can lead to different results between the two methods. First, in environments involving the use of punishment, they do find differences between the two elicitation methods. Second, situations involving a lower number of decisions lead to more differences in behaviour than situations with more decisions. Since those two factors does not exist in the experimental design of this paper, we expect the strategy method to give us similar results as Levine and Palfrey (2007).

In this paper, our goal is to replicate the result in Levine and Palfrey (2007) by using strategy method, and get further understanding about subject's behaviour in experiment.

The remainder of this paper is organized as follows. Section 2 explains the design of our experiments. We formulate some theoretical pre dictions and propose a set of hypotheses in section 3. Section 4 analyzes our experimental results and section 5 concludes.

2. The Pivotal-Voting Game

Our model is based on the Levine and Palfrey (2007)'s model of simple plurality voting game with heterogeneous costs. The game consists of two groups, A and B, and each group supports different candidates. The size of group A is denoted by N_A. The size of group B is denoted by N_B and $N_A < N_B$. Hence, group A is the minority group and group B is the majority one. The candidate who receives more votes wins the election. If both candidates receive the same amount of votes, the winner of the election is decided by flipping a fair coin. The supporters of the winner will receive a payoff of H, and supporters of the loser will receive a payoff of $L < H$. Voting is costly. The cost for each voter is drawn independently from the same distribution and the cost is always positive. The group size, the payoff, and the density function of the cost distribution are common knowledge to all voters. Each voter knows his real cost privately before making his decision.

A rational voter chooses between voting and abstaining by evaluating which decision brings him a higher payoff. Since the reward of abstaining is zero, a rational voter will choose to vote only when his vote brings him non-negative payoffs. We assume that each member of the same group uses the same cut-off strategy and apply the quasi-symmetric Nash equilibrium as in Levine and Palfrey (2007). The cut-offs used by group A and B are denoted by (c_A^*, c_B^*), and they are the maximum cost voters will accept to vote. Intuitively, the cut-offs must make voting indifferent from abstaining, and imply the equalities:

$$(2.1)\quad \frac{H-L}{2}\cdot \pi_A^* = c_A^* \qquad (2.2)\quad \frac{H-L}{2}\cdot \pi_B^* = c_B^*$$

The left hand side is the expected payoff of voting. A vote brings payoff of $\frac{H-L}{2}$ if and only if it changes the result (makes or breaks a tie), since tying leads to a payoff of $\left(\frac{H+L}{2}\right)$. Therefore, the expected payoff of voting is $\frac{H-L}{2}$ multiplied by the probability of being pivotal in equilibrium.

The probabilities of changing the results can be presented as the following two equations, the sum of the probability that the number of votes in one's group is exactly one less than the number of members voting in the other group and the probability that the two groups:

$$(2.3)\quad \pi_A^* = \sum_{k=0}^{N_A-1} \binom{N_A-1}{k}\binom{N_B}{k} (p_{\mathrm{A}}^*)^k (1-p_{\mathrm{A}}^*)^{N_A-1-k} (p_{\mathrm{B}}^*)^k\,(1-p_{\mathrm{B}}^*)^{N_B-k} + \sum_{k=0}^{N_A-1} \binom{N_A-1}{k}\binom{N_B}{k+1} (p_{\mathrm{A}}^*)^k (1-p_{\mathrm{A}}^*)^{N_A-1-k} (p_{\mathrm{B}}^*)^{k+1}\,(1-p_{\mathrm{B}}^*)^{N_B-1-k}$$

$$(2.4)\quad \pi_B^* = \sum_{k=0}^{N_A} \binom{N_A}{k}\binom{N_B-1}{k} (p_{\mathrm{A}}^*)^k (1-p_{\mathrm{A}}^*)^{N_A-k} (p_{\mathrm{B}}^*)^k\,(1-p_{\mathrm{B}}^*)^{N_B-1-k} + \sum_{k=0}^{N_A} \binom{N_A}{k}\binom{N_B}{k-1} (p_{\mathrm{A}}^*)^k (1-p_{\mathrm{A}}^*)^{N_A-k} (p_{\mathrm{B}}^*)^{k-1}\,(1-p_{\mathrm{B}}^*)^{N_B-k}$$

where p_{A}^{*} and p_{B}^{*} represents the aggregate probability of voting, which is the probability that the voting cost is less than the cut-off.

$$(2.5) \quad p_{\mathrm{A}}^{*} = \int_{-\infty}^{c_{\mathrm{A}}^{*}} f(c)dc = F(c_{A}^{*}) \qquad (2.6) \quad p_{\mathrm{B}}^{*} = \int_{-\infty}^{c_{\mathrm{B}}^{*}} f(c)dc = F(c_{B}^{*})$$

By solving the above six equations, we obtain the equilibrium values of p_{A}^{*}, p_{B}^{*}, c_{A}^{*}, c_{B}^{*}, π_{A}^{*} and π_{B}^{*}.

In order to ensure comparability between the direct response method and the strategy method, we use the same terms and parameters as Levine and Palfrey (2007). Each election has 9 voters, with (N_A, N_B) being either (3, 6), in which is the election would be a "landslide", or (4, 5), in which the election would be a "toss-up." Members in the winning group received payoff $H = 105$, and members in the losing group received payoff $L = 5$. When a tie occurs, everyone receives a payoff of $\frac{H-L}{2} = 55$. The costs were drawn independently from the uniform distribution between 0 and 55.

Since in our experiment we do not vary the total participants in one election, we cannot test the size effect hypothesis. Nonetheless, we can use turnout rate and average cut-offs to test the underdog effect and competition effect hypothesis. We mainly follow the same notation as Levine and Palfrey (2007): We denoted the minority turnout rate in a landslide (tossup) election as $P_{A}^{L}(P_{A}^{T})$, the minority group's average cut-off as $c_{A}^{L}(c_{A}^{T})$, the frequency of pivotal events(the outcome is either a tie or one vote away from a tie) as

$\pi^L(\pi^T)$, and the upset rate (in which the minority group ties or wins the election) as $Q^L(Q^T)$. The group suffix A indicates the minority group and B the majority group. We examine the following four hypotheses:

H1. (Competition Effect) The turnout rates and average cut-offs in toss-up elections are higher than that in landslide elections.

1. $p_A^T > p_A^L$ and $p_B^T > p_B^L$
2. $c_A^T > c_A^L$ and $c_B^T > c_B^L$

H2. (Underdog Effect) The turnout rates and average cutoffs of the minority group are higher than that of the majority group.

1. $p_A^L > p_B^L$ and $p_A^T > p_B^T$
2. $c_A^L > c_B^L$ and $c_A^T > c_B^T$

H3. (Competition Effect on the Frequency of Pivotal Events) The probability of pivotal events is higher in toss-up elections than in landslide election.

$$\pi^T > \pi^L$$

H4. (Upset Rates) The upset rate is lower in landslide elections than in toss-up elections.

$$Q^T > Q^L$$

3. Experimental Design and Procedure

Since the strategy method and the direct response method are just different ways to elicit the participant's decision, we expected to see similar result with Levine and Palfrey (2007). However, the strategy method is much more complicated than direct response, a failure to replicate results of Levine and Palfrey (2007) could be due to insufficient understanding of the strategy method. Therefore, we designed three types of experiments, Baseline, Quiz and Training. “Baseline” experiments mimic Levine and Palfrey (2007) and consist of two 50-round sessions, one with toss-up elections and the other with landslide elections. Half of the experiments have the landslide treatment first, while the other half has the toss-up treatment first. In “Quiz” experiments, we add a quiz related to the strategy method before starting the first session of strategy method. “Training” experiments are similar to “Quiz” ones, but a direct-response session of 50 rounds is added before the quiz, in which we conduct the same toss-up or landslide treatment as the first strategy-method session (but eliciting direct responses).[1]

We conduct 4 experiments with 9 subjects for each type of experiment and compare results from the strategy-method sessions. Therefore, we have 4 landslide sessions and 4 toss-up sessions for each type. All 12 experiments were conducted in Chinese using Z-Tree (Zurich Toolbox for Readymade Economic Experiments) developed by Fischbacher (2007) at the Taiwan Social Science Experimental Laboratory (TASSEL) in National Taiwan University (NTU). Subjects were recruited via online flyers posted on BBS and via email sent to NTU students who registered on TASSEL’s website. A total of 108 NTU undergraduate/graduate students participated in the experiments. Average

[1] To familiarize the participants with direct response method, we also administer a quiz about the direct response at the beginning of this direct-response session.

earnings(including showup fee NT$100) were NT$547.6 (approximately US$18.27), ranging from NT$434.95 to NT$744.55 (US$14.51 to US$24.85), and the exchange rate is 20 Experimental Standard Currency (ESC) for NT$1.

Each subject received a copy of the experimental instructions that were also read aloud to the subjects to ensure that the information contained in the instructions is induced as common knowledge among the subjects, and screenshots of the experimental software interface were projected along the way.

For a given session, in each of the 50 rounds, subjects were randomly assigned to either group A (minority) or group B (majority). Then, subjects were asked to choose X (vote) or Y (abstain). The group with more subjects choosing X would win the election. Each member in the winning group would receive 105 Experimental Standard Currency (ESC), and each member in the losing group would receive 5. When a tie occurs, all subjects receive 55.

The opportunity cost of voting was referred to as a "Y bonus," drawn independently from a uniform distribution between 0 and 55. If a subject chooses Y, he receives a payoff equal to his "Y bonus." In the direct response sessions, subjects see their "Y bonus" before making a decision, while in the strategy method sessions, subjects are required to enter a cut-off (termed "Baseline Value") before learning their "Y bonus." The "Y bonus" was shown after entering the cut-off, and the computer program makes the decision for the subject by comparing the cut-off and the "Y bonus." If the "Y bonus" is smaller or equal to the cut-off, the computer will choose X. If the "Y bonus" is larger than the cut-off, the computer will choose Y. Therefore, the cut-off elicited can be viewed as the subject's cut-off strategy.

4. Experimental Results

4.1 Aggregate Results

We compare the results across different types of experiments to investigate the influence of quizzes and training sessions on the results of strategy method sessions. In particular, we focused on average cut-offs, observed turnout rates, probabilities of pivotal events and upset rates and see if these numbers fit the theoretical predictions.

Table 1 presents the average cut-offs for each group in each treatment for each experiment type. We treat subject's average cut-off for each group in each treatment as a single observation, and employ the Kruskal-Wallis test to examine the effect of quizzes and training direct response sessions on strategy method sessions. We fail to reject the null hypothesis (p-value=0.832). This result allows us to pool all data together in the following analysis.

Table 1. Comparison of Average Cut-offs Across Experiment Types

Treatment	Landslide		Toss-up	
Group	Minority	Majority	Minority	Majority
Baseline	29.79(.849)	22.733(.567)	32.978(.739)	27.17(.651)
Quiz	26.107(.788)	24.073(.518)	31.371(.626)	30.092(.548)
Training	27.678(.833)	22.068(.508)	32.703(.643)	27.811(.625)

Table 2 displays the average cut-off and turnout rates of the 12 experiments with their standard errors in parentheses. Nash equilibrium values for each party and treatment are also reported.

Table 2. Average Cut-offs and Turnout Rates

Average Cut-offs				
Treatment	c_A	c_A^{Nash}	c_B	c_B^{Nash}
Landslide	27.85** (0.476)	22.715	22.958* (0.307)	20.615
Tossup	32.05*** (0.39)	25.300	28.39** (0.353)	24.860
Turnout Rates				
Treatment	p_A	p_A^{Nash}	p_B	p_B^{Nash}
Landslide	0.516** (0.012)	0.413	0.417* (0.008)	0.374
Tossup	0.59*** (0.010)	0.460	0.517** (0.009)	0.452

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In order to avoid underestimating the standard error, We also treat subject's average cut-off and turnout rates for each group in each treatment as a single observation to conduct a t-test. The value of average cut-offs observed and turnout rates are all significantly higher than the theoretical predictions(p-values are noted in Table 2). When examining the hypotheses of underdog effect (H1) and competition effect (H2), we treat every subject's average cut-off for each treatment and group as a single observation, and conduct a paired t test. H1 and H2 (p-values are all close to 0)are all supported by our data.

In order to understand whether the strategy method cause underestimating of cut-off, we show the turnout rates of 4 direct response session in Table 3. Similar to the result we collect by using the strategy method, the turnout rates display the an pattern of underdog effect and a competition effect, but are all higher than theoretical predictions.

Table 3. Turnout Rates of Direct Response Sessions

Turnout Rates				
Treatment	p_A	p_A^{Nash}	p_B	p_B^{Nash}
Landslide	0.47 (0.028)	0.413	0.446 (0.020)	0.374
Tossup	0.513 (0.025)	0.460	0.54 (0.022)	0.452

Table 4 displays observed frequencies and theoretical probabilities of pivotal events and upset rates (standard errors are also shown in parentheses).

The observed probability of pivotal outcome is close to the theoretical prediction for the two treatments, but the upsets rates in both treatments are significantly higher than what theory predicts. We conduct a t-test (every single round as an observation) to examine the competition effect on pivotal events and upset rates (H3, H4) and they are still supported by our data(p-values are .0042 and .0000).

Table 4. Probability of Pivotal Events and Upset Rates

Probabilities of Pivotal Outcome		
Treatment	π	π^*
Landslide	0.598 (0.007)	0.599
Tossup	0.672 (0.006)	0.666
Upset Rates		
Treatment	Q	Q*
Landslide	0.378 (0.007)	0.146
Tossup	0.598 (0.007)	0.280

4.2 Individual Results

After examining the data at the aggregate level, we turned to examine how the rational choice model works at the individual level. If a subject's behavior matches the following conditions, we define this subject as complying with the corresponding hypothesis:

Condition 1: A subject exhibits an underdog effect if his/her average cut-off as a minority is higher than that as a majority under both treatments.

Condition 2: A subject exhibits a competition effect if his/her average cut-off in the toss-up treatment is higher than that in the landside treatment.

Table 5 shows the proportions of subjects satisfying each condition. All numbers are higher than 50%. This result shows that the rational choice model also works well at the individual level.

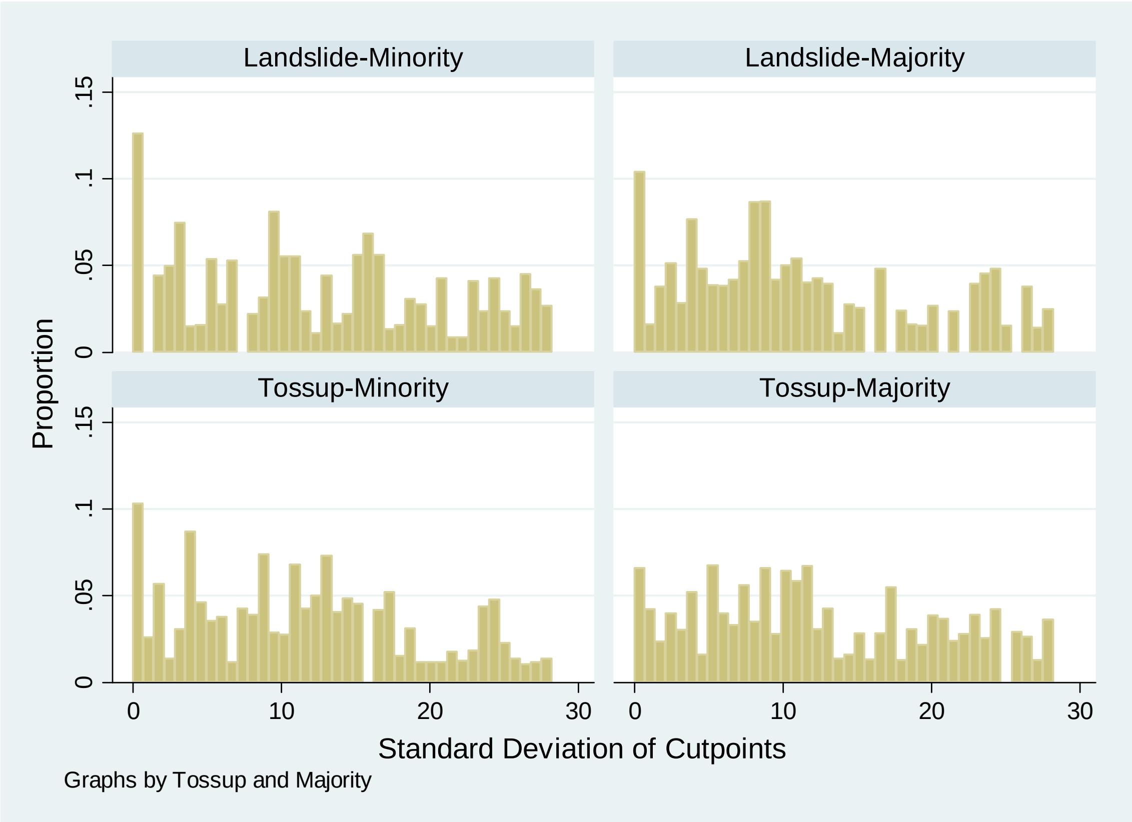
Table 5. Proportion of Satisfying Condition 1 and 2

1 - Competition Effect		2 - Underdog Effect	
Minority	Majority	Tossup	Landslide
0.574	0.676	0.583	0.611

To examine whether each subjects indeed use a strict cut-off strategy, we calculated the standard deviation of their cut-offs in each treatments and group. The results are showed in Figure 1. As can be seen, subjects were not consistent in making decisions. Most of them varied their cut-offs dramatically. Our findings are contrary to Levine and Palfrey (2007), and indicate that subjects do not literally use consistent deterministic cut-off strategies across the 50 rounds of a session.

This result rejects the assumption of quasi-symmetric equilibrium in favor of a learning story where subjects adjust their cut-offs round by round.

Figure 1 Standard Deviation of Cut-offs



4.3 Multivariate Analysis

As we mentioned in the introduction, one advantage of using strategy method is that we can observe how subjects can adjust their behavior more precisely. With this advantage, we conduct a series of regressions with random effects to further understand subject behavior. We ask two questions: First, do subjects respond to being pivotal?

Second, if they do, how do they respond?

Table 6 shows that subjects indeed respond to history. Model 1 is the baseline model and tests for competition and underdog effects. We use three independent variables in Model 1, which are Tossup (for treatments that are toss-ups), Majority (for subjects in the majority group) and Round (for the round number). From column (1) of Table 6, we see that the hypotheses of competition effect and underdog effect are strongly supported by the data. But contrary to previous studies, the round number has a positive effect on subjects' cut-offs. In other words, subject behaviors do not converge toward equilibrium. Instead, they drift away.

Since history matters, Model 2 and 3 investigates how subjects adjust their cut-offs after the occurrence of pivotal events. We defined the variable IsPivotal(t-1) as whether the voter was pivotal last time in the same group. Similar to Duffy and Tavits (2008), we find subjects increasing their cut-offs after being pivotal. This result indicates subjects might be using some form of reinforcement learning throughout the experiment.

In Model 4, we add the variable PivotalFrequency(t-1), or the historical frequency of pivotal conditional on group. Contrary to Duffy and Tavits (2008), the results are consistent with the model. Subjects increase their cut-offs when they perceive that they are more likely to be pivotal.

Table 6. Random Effect Model of Cut-off

	(1) Cut-off	(2) Cut-off	(3) Cut-off	(4) Cut-off
Tossup	4.949***	4.551***	4.054***	3.592***
	(0.338)	(0.344)	(0.359)	(0.346)
Majority	-4.301***	-4.364***	-4.563***	-4.330***
	(0.349)	(0.355)	(0.371)	(0.351)
Round	0.0345**	0.0337**	0.0260	0.0350**
	(0.0116)	(0.0122)	(0.0137)	(0.0121)
IsPivotal(t-1)		3.467***	3.432***	
		(0.345)	(0.357)	
IsPivotal(t-2)			2.718***	
			(0.357)	
IsPivotal(t-3)			1.949***	
			(0.356)	
PivotalFreq(t-1)				15.90***
				(0.863)
_cons	26.58***	25.18***	23.63***	19.92***
	(0.887)	(0.915)	(0.989)	(0.972)
N	10800	10368	9504	10368

Heteroscedastic and clustered standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Conclusion

There are five main finding from our experiment.

First, we find the underdog effect and competition effect supported by using average cut-offs, probabilities of pivotal outcome and upset rates. This confirm Levine and Palfrey (2007). Second, we cannot replicate the Levine and Palfrey (2007)' result for neither the strategy method, nor direct response method. The average-cut-offs and turnout rates are all significantly higher than the theoretical predictions. Third, we also find evidences which affirm that rational choice model works well in individual level. The proportions of following underdog effect and competition effect are all higher than .5. Fourth, our results indicate that subjects don't use fixed cut-off strategies. Fifth, voters are highly responsive to historical pivotal event. This result shows that subject raises his/her cut-off when they perceive the probability of being pivotal voter goes higher, which is the most important implication of rational choice model.

The biggest problem we face is failure of replicating Levine and Palfrey (2007)'s confirming equilibrium turnout rate result. A possible reason is there are some group oriented subjects (see Feddersen and Sandroni 2001) in our experiments. They may put more value on group utility than their individual benefits, and make turnout rates higher than predictions of rational choice model. Another possibilities is our selection of Taiwanese subjects are more enthusiastic in politics(the political culture in Taiwan is generally enthusiastic, having voter turnout rate 70~80% in presidential). In conclusion, although it underestimates cuff-offs and turnout rates in our experiments, the rational choice model still shows it generates correct comparative statics results. Instead of calculating theoretical cut-off at the beginning, subject seems to learn through rounds and react to frequency of pivotal event.

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7. Appendix: Experimental Instructions

TASSEL Experiment Instruction p.1

Experimental Payoff

Welcome to attend this experiment! You can earn NT dollars which is exchanged by Experimental Standard Currency with different rate in addition to NT$100 show-up fee after completing of this experiment. The amount you can earn depends on your decisions, others' decisions and is affected by random variables. Everyone who is paid individually might get different payoffs. In addition, you do not owe to tell others how much money you make.

Instruction - The First Part

This experiment is a muti-subject simultaneous game. The first session consists of 2 practice rounds and 50 paid rounds. During this session, every subject will be assigned to group A or B randomly in each round. That is to say that the group you belong may not be the same. **There are 3 subjects in group A and 6 subjects in group B.**

At the beginning of each round, the computer will generate a **"Y-bonus"** for each subject. **Everyone's Y-bonus is independent.** This Y-bonus is a random integer between 0 and 55 and the probability of generating each number is equal. Then you have to choose X or Y. The computer will calculate your points after everyone has made his decision. Each round, your point will be determined by the sum of two parts.

1. The first part is determined by the number of members choosing X in both groups. If your group has **more** members choosing X than the other group, you will earn **105 points**. If your group has **fewer** members choosing X then the other group, you will earn **5 points**. If both groups have **the same** number of members choosing X, then you will earn **55 points.**

2. The second part depends on your choice. **If you choose Y, you will get a Y-bonus**. If you choose X, you will not earn the Y-bonus.

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	You choose "Y"	**You choose "X"**
Your group has more members choosing X	「Y-bonus」＋105	105
Your group has fewer members choosing X	「 Y-bonus」＋5	5
Both groups have the same number of members choosing X	「 Y-bonus」＋55	55

To familiarize you with the calculation of payments, here is an example:

Suppose that you belong to group A and your Y-bonus is 47. You choose Y. The other two members in your group choose X and there are 3 members in group B choosing X.

The first part: Group A has **2** members choosing X and group B has **3** members choosing X. B**ecause you are in group A, you earn 5 points in this part.**

The second part: Because you choose Y in this round, **you will earn the Y-bonus of 47 points**. Your total payment in this round is **5+47=52 points**.

If you choose X instead of Y, the number of members choosing X in group A will become **3**, so you will earn 55 points in the first part (because now the number of members choosing X in each group is equal). However, you will not earn the Y-bonus in the second part. Your total points in this round will be **55+0=55 points.**

When you make the choice, the screen will show you your group and your Y-bonus. You have to click on X or Y button to make a choice. Please note that you cannot change your decision after clicking the button. After you and the other participants have all made your choices of X or Y, the computer will start to calculate the points you earned in this round. The bottom of the screen contains a history panel. During the this session, this panel will be updated to reflect the history of your past rounds.

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At the end of each round, the screen will display the result in current round, including your Y-bonus, your choice of X or Y, the number of members choosing X in each group, the group you belong to and the points you earned. You have 10 second to read all the information. Afterwards, please click on the "OK" button.

Quiz

Now, a quiz has popped up on your screen. Please read each question and answer it carefully. After successfully completing all the quiz, you will enter the practice rounds. If you have difficulty with quiz or have other questions please raise your hand.

Practice Rounds

There are 2 practice rounds in this session. The purpose is to allow you to get familiar with the experiment and your computer. Please note that you will not be paid in this session. After the practice rounds, the experimenter will announce "the paid rounds begins!" and the experiment starts. If you have any questions please raise your hand.

Paid Rounds

Now the paid rounds begins. There are 50 paid rounds in this session. You dollar earnings are determined by multiplying your earnings in points by a conversion rate. In this experiment, the conversion rate is 0.05 meaning that 20 points is worth 1 dollar. Please make your decision carefully.

Instruction - Second Part

The second session consists of 2 practice rounds and 50 paid rounds. During this session, each round ,every subject will be assigned to group A or B randomly. That is to say that the group you belong may not be the same. **There are 3 subjects in group A and 6 subjects in group B.**

The rule of payment in this session is the same as in the previous session but the method of choosing X or Y is different. In this session, you do not know the Y-bonus at the beginning. Instead, you have to enter a "Baseline Value", which is an integer between 0 and 55. After everyone has entered his Baseline Value, **the computer will show you your Y-bonus and make a choice for you based on your Baseline Value and your Y-bonus**. If your Y-bonus is **smaller or equal to** your Baseline Value, the computer will choose X for you. If your Y-bonus is **bigger** than your Baseline Value, the computer will choose Y for you.

Determining the Baseline Value:

The screen will show you the group you belong to and you have to enter your Baseline Value. After making your decision, please click on the "OK" button. Please note that you cannot change your Baseline Value after clicking the button. The bottom of the screen contains a history panel. During this session, this panel will be updated to reflect the history of your past rounds.

At the end of each round, the screen will display the result in this round, including your Baseline Value, your Y-Bonus, your choice of X or Y, the number of members choosing X in each group, the group you belong to, and the points you earned. You have 10 second to read all the information. Afterwards, please click on the "OK" button.

Quiz

Now, a quiz has popped up on your screen. Please read each question and answer it carefully. After successfully completing all the quiz, you will enter the practice rounds. If you have difficulty with quiz or have other questions please raise your hand.

8. Appendix: Experimental Instruction (Chinese version)

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實驗報酬

本實驗結束後，您將得到定額車馬費新台幣 100 元，以及您在實驗中獲得的「法幣」所兌換成之新台幣。（「法幣」為本實驗的實驗貨幣單位。）您在實驗中能獲得的「法幣」會根據您所做的決策、別人的決策，以及隨機亂數決定，每個人都不同。每個人都會獨自領取報酬，您沒有義務告訴其他人您的報酬多寡。**請注意：本實驗的「法幣」與新台幣兌換匯率為 20:1。**(法幣 20 元=新台幣 1 元)

實驗說明—第一部份

本實驗為一多人一組的共同決策實驗，第一部份的實驗共有兩個練習回合與五十回合的正式實驗。在此部份的實驗中，每回合所有受試者將隨機被分配到甲組或乙組，也就是說每回合您所屬的組別不一定相同。**甲組共有 3 名受試者，乙組共有 6 名受試者。**

每回合的一開始電腦會個別對每位受試者產生一個「選擇Y的額外報酬」，每個人的額外報酬不一定相同也不會互相影響。此額外報酬是由介於 0 到 55 的整數中隨機抽出，抽中每一數字的機會均相同。**接著您必須決定要選擇「X」或「Y」**，所有人都完成決策之後，電腦會自動計算報酬。**每回合您的報酬是由兩項報酬加總而得：**

1. 第一項報酬將由甲、乙兩組內選擇「X」的人數決定。若您在選擇「X」的人數較多的那一組，您會獲得法幣 105 元。若您在選擇「X」的人數較少的那一組，您會獲得法幣 5 元。若兩組選擇「X」的人數相等，您會獲得法幣 55 元。

2. 第二項報酬將視您的決策而定。若您決定選擇「Y」，您將獲得與「選擇Y的額外報酬」相等之法幣。反之，若您決定選擇「X」，您於此部份將不會獲得任何報酬。
每回合您的報酬是由上述兩項報酬加總而得：

	您選擇「Y」	您選擇「X」
您這一組選擇「X」的人數較多	「選擇Y的額外報酬」＋105	105
您這一組選擇「X」的人數較少	「選擇Y的額外報酬」＋5	5
兩組選擇「X」的人數相等	「選擇Y的額外報酬」＋55	55

TASSEL 實驗說明 p.2

為使您能更了解每回合您的報酬計算方式，接下來將舉例說明。

假設在本實驗的某回合中，您屬於甲組且電腦產生給您的額外報酬是 47，您選擇「Ｙ」。同時其餘兩名甲組成員皆選擇「Ｘ」。而乙組中共有三名成員選擇「Ｘ」。

第一項報酬：電腦會先統計各組中選擇「Ｘ」的人數。在此例中，甲組有 2 名受試者選擇「Ｘ」，乙組有 3 名受試者選擇「Ｘ」。由於您所屬的甲組選擇「Ｘ」的人數較少，您於此項報酬會獲得法幣 5 元。

第二項報酬：由於本回合您選擇「Ｙ」。故您將獲得「選擇Ｙ的額外報酬」，也就是法幣 47 元。總計本回合您的報酬為 5＋47=52 法幣。

若您改為選擇「Ｘ」，甲組選擇「Ｘ」的人數會變為 3 人。故於第一項報酬您會獲得法幣 55 元（兩組選擇「Ｘ」的人數相等），但於第二項報酬您不會獲得任何法幣。總計本回合您的報酬會變為 55+0=55 法幣。

在您做決策時，電腦會在螢幕上方告知您所屬的組別以及您「選擇Ｙ的額外報酬」，**您必須點選畫面中「Ｘ」或「Ｙ」的按鈕來做決策。請注意，點選後您將不能再更改您的決策。**當所有受試者都點選按鈕後，電腦會開始計算報酬。銀幕最下方的表格會顯示本部份實驗每回合的歷史紀錄。

每回合結束後，螢幕上會顯示這回合的實驗結果，包括本回合您「選擇Ｙ的額外報酬」、您選擇「Ｘ」或「Ｙ」、兩組選擇「Ｘ」的人數，您所屬的組別以及您所獲得的報酬。您有 10 秒的時間來閱讀所有資訊，閱讀完後請您點選畫面中「確認」的按鈕，當所有受試者都確認後，實驗將提前進入下一回合。

問答階段

在正式實驗開始之前，螢幕上會先顯示一些問題並請您輸入正確答案。這些問題的目的是為了確認您了解此實驗的規則。**所有問題都被正確回答後，您將進入練習階段。**如果您對這些問題或本實驗有任何疑問，請在此時舉手。實驗者會過來解答。

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練習階段

此階段共有兩回合，目的為幫助您熟悉正式實驗的操作介面及計分方式。請注意，練習階段的得分僅供您熟悉本實驗的進行方式，與您最後的現金報酬無關。練習結束後，實驗者會宣佈「實驗正式開始！」，然後才進入正式實驗。如果您對本實驗有任何疑問，請在此時舉手。實驗者會過來解答。

第一部份實驗正式開始

現在第一部份實驗正式開始，本部份實驗共有五十回合！**在正式實驗中所獲得的「法幣」都會在實驗結束後，按照 20:1 的匯率（法幣 20 元=新台幣 1 元）兌換成新台幣支付給您。**因此請慎重選擇、慎重決定。

TASSEL 實驗說明 p.4

實驗說明─第二部份

第二部份的實驗共有兩個練習回合與五十回合的正式實驗。在此部份的實驗中，每回合所有受試者將隨機被分配到甲組或乙組，也就是說每回合您所屬的組別不一定相同。**甲組共有 3 名受試者，乙組共有 6 名受試者。**

本部份實驗的報酬計算方式與第一部份的實驗相同，但選擇「X」或「Y」的方式不同。在本部份實驗中，一開始您不會知道「選擇 Y 的額外報酬」為多少，您必須輸入一個「基準值」，此基準值必須為一介於 0 到 55 的整數，接著電腦會根據您的基準值以及「選擇 Y 的額外報酬」來替您做出選擇。**若您的「選擇 Y 的額外報酬」小於或等於此基準值，電腦會替您選擇 X，反之若您的「選擇 Y 的額外報酬」大於此基準值，電腦會替您選擇 Y。**所有人都輸入基準值後，電腦才會隨機產生給每個人額外報酬，並依照您的策略替您做出選擇。

基準值的決定方式：電腦會在銀幕上方告知您所屬的組別，您必須在畫面中輸入您的基準值，若您已經做好決定，請點選畫面中「我決定好了」的按鈕，點選之後您將不能再更改您的基準值。當所有受試者都點選此按鈕後，電腦會顯示額外報酬並計算報酬。銀幕最下方的表格會顯示本部份實驗每回合的歷史紀錄。

每回合結束後，螢幕上會顯示這回合的實驗結果，包括本回合您的基準值、您的「選擇Ｙ的額外報酬」、您選擇「Ｘ」或「Ｙ」、兩組選擇「Ｘ」的人數，您所屬的組別以及您所獲得的報酬。您有 10 秒的時間來閱讀所有資訊，閱讀完後請您點選畫面中「確認」的按鈕，當所有受試者都確認後，實驗將提前進入下一回合。

問答階段

在正式實驗開始之前，螢幕上會先顯示一些問題並請您輸入正確答案。這些問題的目的是為了確認您了解此實驗的規則。所有問題都被正確回答後，您將進入練習階段。如果您對這些問題或本實驗有任何疑問，請在此時舉手。實驗者會過來解答。

練習階段

此階段共有兩回合，目的為幫助您熟悉正式實驗的操作介面及計分方式。請注意，練習階段的得分僅供您熟悉本實驗的進行方式，與您最後的現金報酬無關。練習結束後，實驗者會宣佈「實驗正式開始！」，然後才進入正式實驗。如果您對本實驗有任何疑問，請在此時舉手。實驗者會過來解答。

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第二部份實驗正式開始

現在第二部份實驗正式開始，本部份實驗共有五十回合！**在正式實驗中所獲得的「法幣」都會在實驗結束後，按照 20:1 的匯率 (法幣 20 元=新台幣 1 元) 兌換成新台幣支付給您。** 因此請慎重選擇、慎重決定。