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The Trade-Off between Equal Representation and Electoral Participation: The Effect of Redistricting on Voter Turnout[*]

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Abstract: Equal representation and electoral participation lie at the core of democracy. However, the two are sometimes contradictory. When redistricting is used to correct malapportionment, a typical example of unequal representation, it can discourage citizens from voting by increasing their anxiety about whether their interests are represented and increasing their information cost. The effect of redistricting on electoral participation has not been accurately estimated due to difficulty isolating the effect from past redistricting and other factors. Japan's upper house conducted its first redistricting in 2016, providing an ideal opportunity to identify and isolate the effect of redistricting on electoral participation by avoiding the usual methodological problems. Using an original dataset on Japan's upper house elections from 2001 to 2019 and employing a differences-in-differences design, this study reveals that redistricting reduced voter turnout by 10.3 percentage points and that the effect lasted until the second election after redistricting.

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Introduction

Equal representation and electoral participation lie at the core of democracy. However, the two are sometimes contradictory. For example, efforts to correct malapportionment, a typical example of unequal representation, can in fact discourage electoral participation. Malapportionment is 'the discrepancy between the shares of legislative seats and the shares of population held by geographical units' (Samuels & Snyder, 2001, p. 652), and it violates the principle of equal representation (Ong et al., 2017; Snyder & Samuels, 2004). While redistricting (i.e. redrawing electoral district lines) is used to equalise the value of a vote between districts and thus correct malapportionment, it can actually discourage electoral participation by increasing citizens' anxiety about whether their interests are represented and by undermining the electoral campaigns of parties and candidates.

Identifying the effect of redistricting on electoral participation is thus crucial to understanding the foundations of equal representation and electoral participation. Many previous studies have attempted to evaluate the effect of redistricting on electoral participation (Fraga, 2016; Hayes & McKee, 2009, 2012; Hunt, 2018; McKee, 2008; Pattie et al., 2012; Winburn & Wagner, 2010). However, this effect has not been accurately estimated. Electoral participation is affected by various socioeconomic, political, and institutional factors, making it difficult to isolate the effect of redistricting. Previous research generally suffered from two methodological problems.

First, in countries using single-member districts (SMDs), redistricting is regularly conducted to remedy malapportionment (e.g. Ansolabehere & Snyder, 2008; Hasen, 2003; Johnston et al., 2001), so a certain number of voters have experienced redistricting at some point, and its negative effect on electoral participation may last through several elections. Consequently, it is difficult to isolate the effect of current redistricting from that of past redistricting. Drawing an analogy to medicine, this is like trying to identify the effect of infection with a disease on health by testing the effect of reinfection on people previously infected who may have disease antibodies. In other words, identifying the effect of redistricting on electoral participation requires analysing citizens who have not previously

experienced redistricting. Indeed, redistricting occurs at intervals of about a decade (e.g. every 10 years in the US House of Representatives and every 8–12 years in the UK House of Commons), so the effect of past redistricting may not be substantial. Even so, the effect needs to be empirically tested, which this study will do.

Second, some countries hold several elections simultaneously, such as those for the upper and lower houses or national and local elections. In such concurrent elections, electoral participation in one election can be affected by the circumstances of the other elections, such as their relative importance or competitiveness. For example, since US House elections are typically held simultaneously with presidential, senatorial, or gubernatorial elections, voter turnout rates in the House elections are influenced by the electoral conditions of the other elections. Hayes and McKee (2009, 2012), McKee (2008), and Winburn and Wagner (2010) have used voter roll-off—whether voters abstain from voting in a House election after voting in other elections—to estimate the effect of redistricting on participation in the House elections. While roll-off is a necessary and sophisticated method to examine the determinants of an individual decision to vote or not to vote in US House elections, it does not account for voters who do not visit polling stations. Some voters may be dissuaded from voting, and thus, do not visit as a result of redistricting in a House election.[1] In addition, voters who already visited polling stations to vote in top-of-the-ticket elections may also vote in House elections regardless of their electoral circumstances. Therefore, a roll-off analysis may underestimate the negative effect of redistricting on electoral participation, and the findings from US House elections using this analysis cannot be directly applied to other elections.

[1] Hayes and McKee (2012) state, '[w]e assume that most individuals do not decide whether or not to turn out on the basis of the U.S. House race (although probably some do). Instead, it is the higher-profile contests (i.e., presidential, gubernatorial, and senatorial elections) that primarily drive turnout rates' (p. 120). If so, this assumption raises new questions: do voters carefully consider the benefits and costs of voting in deciding whether or not to vote in the House election of such low salience, and thus, can an analysis of roll-off accurately estimate the effect of redistricting on electoral participation? While this study acknowledges the usefulness of roll-off, its potential for development as a method to measure electoral participation should be examined in future research.

This study examines the effect of redistricting on electoral participation by focusing on Japan's upper house elections. Given their unique institutional setting, these elections present an ideal case for identifying the effect of redistricting on electoral participation. First, Japan's upper house conducted redistricting for the first time in 2016, providing an ideal opportunity to investigate the effect of redistricting on voters who had never experienced redistricting. Second, with the exception of simultaneous elections for the lower and upper houses in 1980 and 1986, as well as a few concurrences with local elections, elections to the upper house do not coincide with other elections.

Using an original dataset on Japan's seven upper house elections from 2001 to 2019 and employing a differences-in-differences design, this study reveals that redistricting reduced voter turnout by 10.3 percentage points, and the effect lasted until the second election after redistricting. This study thus makes several contributions to the literature on political representation and participation. First, it accurately estimates the effect of redistricting on electoral participation using a quasi-experimental design by focusing on citizens who had never experienced redistricting. Second, it finds that the negative effect of redistricting on electoral participation lasts through the second elections following redistricting, indicating that voters, candidates, and parties need a certain amount of time to adjust to redistricting and new electoral districts. Third, it clearly shows the trade-off between equal representation and electoral participation, demonstrating that redistricting remedies malapportionment and encourages equal representation but discourages electoral participation.

The remainder of the paper is organised into four sections. The first section theorises the effect of redistricting on electoral participation and formulates a hypothesis for the study. The second section briefly describes disparities in the value of a vote and redistricting in Japan. The third section introduces the data and methods used to test the hypothesis. Finally, the fourth section tests the hypothesis by analysing the association between redistricting and changes in district-level voter turnout in Japan's upper house elections.

Theory and hypothesis

Building on existing research, this section discusses the theoretical effects of redistricting on electoral participation. As meta-analyses of aggregate-level research on voter turnout by Blais (2006), Cancela and Geys (2016), Geys (2006), Smith (2018), and Stockmer (2017) indicate, voter turnout is mainly affected by a) the probability that voters' voting will affect the election result, b) the differential benefit voters receive from the success of their preferred candidate over other candidates, c) the feelings of identification and solidarity within voters' local community, d) the costs of acquiring information on parties and candidates, e) the civic duty of voting, and f) social pressure to vote. These factors are structured by electoral systems, registration requirements, compulsory voting, concurrent elections, election importance, campaign expenditures, election competitiveness, political fragmentation, population size, population stability, population homogeneity, past turnout, and economic developments or conditions. The literature on redistricting shows that redistricting decreases voter turnout by influencing the probability that voters' voting will affect the election result, their feelings of identification and solidarity within their local community, the differential benefit they receive from the success of their preferred candidate over other candidates, and the costs to acquire information on parties and candidates.

First, by implementing gerrymandering, redistricting can reduce the levels of electoral competition, and thus, can decrease the probability that voters' voting will affect the election result (Hunt, 2018). One form of partisan gerrymandering (typically bipartisan gerrymandering) is used to protect incumbents, and thus, create electorally safe districts in the US Congress and state legislatures (Cottrell, 2019; Lublin & McDonald, 2006; Lyons & Galderisi, 1995).[2] In addition, racial gerrymandering creates majority-minority districts to enhance minority representation. These districts tend to be less competitive because they are ideologically distinct and compact (Lublin & McDonald,

[2] Abramowitz et al. (2006) find little effect of partisan gerrymandering on competitiveness. Gelman and King (1994) find a positive effect.

2006; Preuhs & Juenke, 2011). Second, Pattie et al. (2012) suggest that redrawing district lines divides communities across districts, decreasing voters' sense of attachment to their respective communities, and thus, also decreasing the benefits of voting to represent the community interests. Third, Pattie et al. (2012) propose that redrawing district lines may also compel parties to restructure their local organisation, thereby splitting their resources and supporters across districts. This can induce voters' anxiety about whether their interests are represented. Fourth, redistricting can increase information costs. The decline and restructuring of parties' local organisations caused by redistricting can reduce the degree of voter mobilisation by parties and candidates. Because this means that voters are less likely to be contacted by parties and candidates, there is an increase in voters' costs to obtain information about these candidates. Moreover, redistricting relocates voters to new electoral environments and changes the district's party composition (i.e. the partisan balance of voters in the district). This potentially limits voters' use of information shortcuts to learn about their candidates, as some voters rely on party identification as a cue for their voting decisions (Hunt, 2018). In addition, community split caused by redistricting leads to less information on candidates and elections for those voters redrawn into the small end of a split community (Winburn & Wagner, 2010). Furthermore, some voters are drawn into the district of a new incumbent with whom they are unfamiliar, which may incur a higher cost in acquiring information about that incumbent (Hayes & McKee, 2009, 2012; Hunt, 2018; McKee, 2008; Winburn & Wagner, 2010).

In short, redistricting will decrease voter turnout by decreasing the probability that voters' voting will affect the election result, decreasing voters' sense of community attachment, causing voter anxiety about whether their interests are represented, and increasing voter costs for information about candidates and parties. This study suggests the following testable hypothesis:

> *Hypothesis 1*: Voter turnout will be higher in districts that were redrawn than in districts that were not.

Malapportionment and redistricting in Japan's upper house elections

The hypothesis is tested using the case of Japan's upper house elections. Japan has a bicameral system consisting of the lower house and the upper house. Upper house elections are important to the political process in Japan as the upper house has a significant influence on policy-making and government formation and survival.[3] The term of office of lower house members is four years with dissolution, while that of upper house members is six years without dissolution. The lower house has featured a combination of SMDs and semi-open list proportional representation (PR) since 1996. Meanwhile, the upper house has featured a combination of prefectural districts and nationwide open list PR since 2001. From 2001 to 2016, the upper house had a total of 242 members on six-year terms with half facing election every three years. Under this system, 146 members (73 members every three years) were elected from 47 prefectural districts (45 in 2016), and the remaining 96 members (48 members every three years) were elected from a nationwide PR seat. Since 2019, 148 members (74 members every three years) have been elected from 45 prefectural districts, and the remaining 100 members (50 members every three years) have been elected from a nationwide PR seat. The number of seats elected in each prefectural district has varied from one to six. Candidates can run for either a prefectural district or a PR seat. Voters cast two separate ballots: one for a prefectural district and another for a PR seat. There is no seat linkage between the two. In prefectural districts, votes cannot be pooled or transferred to another candidate.

[3] The upper house has strong veto power over the lower house on the enactment of bills, although the Constitution provides for the supremacy of the lower house. If the upper house rejects a bill passed in the lower house, the lower house may pass it again by a two-thirds majority of present members in order to enact it (Article 59). In fact, all recent governments that lacked a majority of seats in the upper house, such as the cabinets of Keizo Obuchi (1998–2000), Yasuo Fukuda (2007–2008), Taro Aso (2008–2009), Naoto Kan (2010–2011), and Yoshihiko Noda (2011–2012), had difficulty passing bills and maintaining power. Furthermore, the cabinet of Ryutaro Hashimoto (1996–1998) resigned to take responsibility for defeat in an upper house election. The cabinets of Yoshiro Mori (2000–2001) and Yukio Hatoyama (2009–2010) were forced to resign by ruling parties right before an upper house election mainly because their unpopularity was expected to have an adverse effect on election outcomes.

Serious malapportionment has occurred in SMDs in the lower house and in prefectural districts in the upper house. Figure 1 shows the disparity in vote value across districts in the lower and upper house elections since 2001. The values indicate the maximum vote value disparity between districts, calculated by dividing the population per seat of the most underrepresented district by that of the most overrepresented district in each election. In Japan, this criterion is used by politicians, government councils, the media, and courts to discuss or judge malapportionment. The Supreme Court has ruled that the vote value disparity in the 2009, 2012, and 2014 lower house elections and the 2010 and 2013 upper house elections amounted to a state of unconstitutionality, while that in the 2016 upper house election and the 2017 lower house election was constitutional. A state of unconstitutionality means that while the disparities are almost unconstitutional, the results of the elections are valid; however, if the disparities are not redressed within a reasonable period of time, they can be ruled as unconstitutional.

Malapportionment has been caused by both changes in the population and partisan manipulation of reapportionment. In Japan, the urban population has increased while the rural population has decreased, widening disparities in the vote value of urban and rural districts. In order to reduce these disparities, it is necessary to decrease the number of seats in rural districts and increase the number of seats in urban districts. However, the Liberal Democratic Party (LDP), which has been in power almost constantly since 1955, has more support and votes in rural than in urban areas (e.g. Scheiner, 2006). If the number of seats in rural districts were to be reduced, the LDP would consequently have a reduced number of seats, and some LDP legislators from rural districts would lose theirs. Therefore, the LDP and rural LDP legislators have opposed reapportionment and redistricting that would result in seats being lost in rural districts, which has hindered the remediation of malapportionment.

The upper house conducted redistricting for the first time in the 2016 election as the ruling LDP and four opposition parliamentary groups initiated and enacted the bill on the Partial Revision

of the Public Offices Election Law in 2015.[4] The SMDs in the Tottori and Shimane prefectures and those in the Kochi and Tokushima prefectures were merged into one, respectively. In the redrawn Tottori-Shimane district, the LDP incumbent Kazuhiko Aoki, who had been elected from Shimane district in the 2010 election, ran for re-election to the upper house in 2016. In the redrawn Tokushima-Kochi district, the LDP incumbent Yusuke Nakanishi, who had been elected from Tokushima district in 2010, ran for re-election. In other words, voters in Shimane and Tokushima had the same incumbent, while those in Tottori and Kochi had a different incumbent.

Redistricting significantly redressed the vote value disparity, as shown in Figure 1. In the 2013 election, before the redistricting, one seat represented 588,508 people in the most overrepresented district (Tottori) and 2,830,151 people in the most underrepresented district (Hyogo), with a maximum vote value disparity of 4.8. In the 2016 election, after the redistricting, one seat represented 799,220 people in the most overrepresented district (Fukui) and 2,441,138 people in the most underrepresented district (Saitama), with a maximum vote value disparity of 3.1. However, redistricting decreased voter turnout in three of the four redrawn districts. Figure 2 shows national voter turnout in upper house elections in Japan. The average voter turnout from 1947 to 1989 was 66.0%, while from 1992 to 2019 it was 54.0%, which indicates that voter turnout has dropped since 1992. Voter turnout was almost stable from 1998 to 2010, but it decreased in 2013, and then increased in 2016 when four districts were redistricted for the first time. Figure 3 illustrates voter turnout in the four redrawn districts. From 2013 to 2016, voter turnout fell from 58.9% to 56.3% in Tottori, from 49.3% to 47.0% in Tokushima, and from 49.9% to 45.5% in Kochi. In Shimane, however, voter turnout increased from 60.9% to 62.2%. Meanwhile, national voter turnout increased from 52.6% to 54.7%. In the 2019 election, voter turnout was 50.0% in Tottori, 54.0% in Shimane, 38.6% in Tokushima, and 46.3% in Kochi. However, these simple descriptive statistics alone do not allow us to determine how much of an effect the redistricting had on voter turnout, as district- and time-specific

[4] See Komatsu (2015) for the legislative process of the electoral reform of Japan's upper house.

factors need to be controlled for in order to identify the effect.

<Figures 1–3 about here>

Redistricting is one of the most important issues in Japanese politics in primarily two ways. First, redistricting is essentially related to the representation of local interests. In upper house elections, nominal tier districts had been prefecture-wide, with at least one seat elected from each prefecture until 2013. However, as a result of redistricting in 2016, four prefectures can no longer elect a candidate who represents only the prefecture, and two prefectures cannot elect a candidate from the prefecture to national office. Therefore, National Diet members and governors of the four prefectures are calling for the repeal of redistricting. Furthermore, in 2018, the LDP submitted to the Commission on the Constitution of the upper house a constitutional amendment proposal requiring that at least one seat must be elected from each prefecture in the upper house (*Yomiuri Shimbun*, 22 February 2018). Second, as some districts could be merged in the near future, it is essential to assess the effect of redistricting on electoral participation. In fact, although not enacted, the Democratic Party of Japan and Komeito submitted a bill to merge ten districts into five in 2015 (*Yomiuri Shimbun*, 15 July 2015), and the Constitutional Democratic Party of Japan and the Party of Hope submitted a bill to merge the Fukui and Ishikawa districts into one in 2018 (*Yomiuri Shimbun*, 9 July 2018).

Research design

To test the hypothesis, this study uses panel data from all 47 prefectures in Japan's upper house elections, and takes advantage of a subnational comparison of voter turnout. A subnational comparison is more advantageous than a cross-national comparison, as it avoids the omitted variable bias from which the latter can suffer due to difficulty in controlling for country-specific socioeconomic, political, and institutional factors that can affect both redistricting and voter turnout.

Furthermore, when assessing the effect of redistricting on electoral participation, individual- and aggregate-level analyses are complementary. An individual-level analysis offers advantages such as testing the mechanisms by which redistricting affects voters' decision to vote or abstain (Hunt, 2018), while an aggregate-level analysis is advantageous in accurately estimating the overall effect size of redistricting on voter turnout through balanced panel data and a fixed effects model, thus controlling for unit- (i.e. district-) and time-fixed effects. The present study conducts an aggregate-level analysis, leaving individual-level analysis for future research.

Hypothesis 1 is tested using the following ordinary least squares (OLS) model (Model 1):

$$\textit{Voter Turnout}_{it} = \beta_0 + \beta_1 \textit{ Redistricting}_{it} + \beta_2 \textit{ District Magnitude}_{it} + \beta_3 \textit{ Population per Seat}_{it} + \gamma_i + \delta_t + \varepsilon_{it}, \quad (1)$$

The unit of analysis is prefecture i in election year t. This model focuses on the six upper house elections held in 2001, 2004, 2007, 2010, 2013, and 2016, as redistricting was conducted for the first time in the 2016 election. Taking advantage of the panel nature of the data and using prefectures as the unit of analysis, this study employs a within-prefecture differences-in-differences design. Prefecture fixed effects (γ_i) and time fixed effects (δ_t) are included to control for prefecture- and time-specific effects, respectively. This model examines within-prefecture changes in district boundaries and voter turnout over time. The dependent variable is $\textit{Voter Turnout}_{it}$,[5] which represents the voter turnout rate.[6]

The key independent variable to test Hypothesis 1 is $\textit{Redistricting}_{it}$, a dummy variable coded

[5] Data on voter turnout rates were obtained from the website of the Ministry of Internal Affairs and Communications: http://www.soumu.go.jp/senkyo/senkyo_s/data/sangiin/ichiran.html.

[6] To test the effect of redistricting on the change in voter turnout from the previous to the current election, this study runs a model with $\Delta\textit{Voter Turnout}_{it}$, the change in voter turnout from election t-1 to election t, as the alternative dependent variable instead of $\textit{Voter Turnout}_{it}$ (see Appendix 2). In Column A2 in Table A2, $\textit{Redistricting}_{it}$, is statistically significant and positive for $\Delta\textit{Voter Turnout}_{it}$, which indicates that redistricting caused a decrease in voter turnout from the previous election.

1 if the district of a prefecture was redrawn (Tottori, Shimane, Tokushima, and Kochi) and 0 otherwise. Hypothesis 1 predicts $Redistricting_{it}$ to be negative. In addition, even among redrawn voters, as stated above, those drawn into districts with a new incumbent are likely to be unfamiliar with candidates, and thus, to incur a higher information cost in learning about candidates than those drawn into districts with the same incumbent (Hayes & McKee, 2009, 2012; Hunt, 2018; McKee, 2008; Winburn & Wagner, 2010). To test the effect on electoral participation of the extra costs incurred by voters redrawn into districts with a new incumbent, as alternative independent variables, I use *Redistricting with the Same Incumbent*$_{it}$, a dummy variable coded 1 if the district of a prefecture was redrawn and the same incumbent ran for re-election (Shimane and Tokushima) and 0 otherwise, and *Redistricting with a New Incumbent*$_{it}$, a dummy variable coded 1 if the district of a prefecture was redrawn and a new incumbent ran (Tottori and Kochi) and 0 otherwise. If voters redrawn into districts with a new incumbent incurred the extra information costs, *Redistricting with a New Incumbent*$_{it}$ will have a greater effect than *Redistricting with the Same Incumbent*$_{it}$.

Several control variables are included. As shown in the reviews and meta-analyses of Blais (2006), Cancela and Geys (2016), Geys (2006), Smets and van Ham (2013), Smith (2018), and Stockmer (2017), previous studies have identified various institutional, political, and socioeconomic determinants of voter turnout. Major institutional factors include electoral systems (e.g. majoritarian vs. proportional systems and district magnitude), registration requirements, compulsory voting, concurrent elections, and election importance (e.g. unicameralism vs. bicameralism and first-order vs. second-order elections). Major political factors include campaign expenditures, election competitiveness, and political fragmentation (e.g. the [effective] number of parties in the election). Major socioeconomic factors include population size, population stability (e.g. mobility or growth), population homogeneity (e.g. income inequality and the proportion of minority groups), past turnout, and economic developments or conditions.

Some of these factors may also affect parties' decisions about which districts should be

redrawn, and thus, they are covariates influencing both the dependent variable, *Voter Turnout*$_{it}$, and the key independent variable, *Redistricting*$_{it}$.[7] Through its differences-in-differences design, the model can control for time-invariant prefecture characteristics. Therefore, only time-variant covariates are included in the model. The only within-prefecture time-variant factors are district magnitude and the relative value of a vote in a district. In Japan's upper house, the number of seats allocated to each district changes according to shifts in prefectural populations, and the district magnitude ranges from one to six. In 2016, the SMDs in the Tottori and Shimane prefectures and those in the Tokushima and Kochi prefectures were merged into one because these four SMDs were overrepresented, but their seats could no longer be reduced. For the analysis, this study includes *District Magnitude*$_{it}$, the number of seats elected from a district, and *Population per Seat*$_{it}$, the population (in units of 1,000,000 people) per legislative seat.[8]

This study is also interested in whether the effect of redistricting on voter turnout lasts through several subsequent elections, and specifically, whether the effect of redistricting decreases from the first election after redistricting (the 2016 election in this case) to the second one (the 2019 election in this case). I use the following OLS model (Model 2):

$$\begin{aligned} \textit{Voter Turnout}_{it} = {} & \beta_0 + \beta_1 \textit{ First Election after Redistricting}_{it} + \beta_2 \textit{ Second Election after Redistricting}_{it} \\ & + \beta_3 \textit{ District Magnitude}_{it} + \beta_4 \textit{ Population per Seat}_{it} + \gamma_i + \delta_t + \varepsilon_{it}, \end{aligned} \quad (2)$$

[7] 'Omitted variable bias occurs when two conditions are true: (1) the omitted variable is correlated with the included regressor; and (2) the omitted variable is a determinant of the dependent variable' (Stock & Watson, 2014, p. 180). Electoral competitiveness, the number of candidates, and economic conditions are determinants of voter turnout. However, there is little theoretical reason to expect that these variables affect the implementation of redistricting. Therefore, the exclusion of these variables does not create omitted variable bias. Rather, they are the outcome variables of the implementation of redistricting, so their inclusion would create post-treatment variable bias. For further confirmation, this study runs a model with additional control variables for electoral competitiveness, the number of candidates, and economic conditions (see Appendix 2). Column A2 in Table A2 shows that even with these additional control variables, the effects and statistical significance of *Redistricting*$_{it}$ remains almost unchanged.

[8] The demographic data of prefectures used in this study were obtained from the website of the Ministry of Internal Affairs and Communications: http://www.stat.go.jp/data/k-sugata/

Model 2 only differs from Model 1 in focusing on seven upper house elections, including the 2019 election in addition to those in Model 1, and using *First Election after Redistricting*$_{it}$ and *Second Election after Redistricting*$_{it}$ as key independent variables instead of *Redistricting*$_{it}$. *First Election after Redistricting*$_{it}$ is a dummy variable coded 1 if the district of a prefecture was redrawn and the observation is the 2016 election, and *Second Election after Redistricting*$_{it}$ is a dummy variable coded 1 if the district of a prefecture was redrawn and the observation is the 2019 election. Table A1 in Appendix 1 reports the summary statistics of the variables.

Results

Table 1 presents the results. In Column 1, *Redistricting*$_{it}$ is statistically significant at the 0.001 level and negative. Figure 4 indicates the marginal effect of redistricting on voter turnout. Points and error bars indicate the effect and 95% confidence intervals, respectively. Redistricting reduced voter turnout by 10.3 percentage points. As the average and standard deviation of voter turnout across 47 prefectures from 2001 to 2016 are 57.4% and 4.7%, respectively (Table A1 in Appendix 1), the 10.3 percentage point decrease in voter turnout caused by redistricting exceeds two standard deviations in voter turnout, showing that redistricting has a substantial negative effect on voter turnout. Hypothesis 1 is thus strongly supported (see Appendix 2 for the parallel trends assumption).

In Column 2, both *Redistricting with the Same Incumbent*$_{i}$ and *Redistricting with a New Incumbent*$_{it}$ are significant at the 0.001 level and negative. Figure 4 indicates that in redrawn districts where the same incumbent ran for re-election, redistricting decreased voter turnout by 9.0 percentage points, while in redrawn districts where the same incumbent did not run, redistricting decreased voter turnout by 11.8 percentage points. These results suggest two findings. First, even though the same incumbent ran for re-election, redistricting discouraged electoral participation. This can be explained by the fact that redistricting decreases voters' sense of attachment to their communities, increases

anxieties about the representation of their interests, and increases information costs as a result of new electoral environments and a decline in mobilization by parties and candidates (Hunt, 2018; Pattie et al., 2012). Second, the negative effect of redistricting is 2.9 percentage points greater in redrawn districts where a different incumbent ran for re-election than in those where the same incumbent ran. An F-test rejected the null hypothesis of no difference in the effect of *Redistricting with the Same Incumbent*$_{it}$ and *Redistricting with a New Incumbent*$_{it}$ ($p < 0.001$). This difference can be attributed to the extra cost incurred by voters to acquire information about a new incumbent (Hayes & McKee, 2009, 2012; McKee, 2008; Winburn & Wagner, 2010).

In Column 3, both *First Election after Redistricting*$_{it}$ and *Second Election after Redistricting*$_{it}$ are statistically significant at the 0.001 level and negative. Figure 4 indicates that redistricting reduced voter turnout by 10.3 percentage points in the 2016 election and by 9.4 percentage points in the 2019 election. These results reveal two findings. First, the negative effect of redistricting on voter turnout lasted until the second election after redistricting. Second, the effect of redistricting slightly decreased from the first to the second election, with a 0.9 percentage point difference in voter turnout between the two elections. An F-test rejected the null hypothesis of no difference in the effect of *First Election after Redistricting*$_{it}$ and *Second Election after Redistricting*$_{it}$ ($p < 0.001$). These findings imply that voters, candidates, and parties may gradually adjust to redistricting and new electoral districts. Voters need some time to develop a sense of attachment to their districts and reduce anxiety about whether their interests are represented, and candidates and parties need some time to realign their local campaign organisations and run an efficient electoral campaign. Even in the second election after redistricting, redistricting continued to have a negative effect on voters' sense of attachment and anxiety and on candidates' and parties' electoral campaigns, greatly discouraging electoral participation.

<Table 1 and Figure 4 about here>

Conclusion and discussion

This paper has taken advantage of the first redistricting in Japanese upper house elections to examine the effect of redistricting on electoral participation. The within-prefecture differences-in-differences analysis has shown that redistricting reduced voter turnout by 10.3 percentage points. In addition, redistricting reduced voter turnout by 9.4 percentage points even in the second election after redistricting. In contrast, previous studies have not necessarily accurately isolated the effect of redistricting on voter turnout because they have not fully controlled for the effects of past redistricting or other elections. Partly for this reason, studies have shown that changes in voters' electoral environment caused by redistricting have less or no effect on roll-off or voter turnout. For example, Hayes and McKee (2009, 2012) showed that roll-off in precincts drawn into a district with a new incumbent was 3–7% or 1.6 percentage points lower than in those that remained in districts with the same incumbent in US House elections. Winburn and Wagner (2010) find no effect of the degree of overlap between county and congressional district on voter turnout or roll-off in US House elections. Pattie et al. (2012) found that the magnitude of boundary changes had no or (contrary to the theoretical expectations) positive effects on voter turnout in UK general elections. These weak results can be partly attributed to the fact that studies suffered from the above methodological problems. This study calls for a reconsideration of the effect of redistricting on voter turnout and a method to estimate it.

These findings have important academic and policy implications, particularly in the choice of electoral systems. There are a variety of electoral systems in the world. Electoral systems significantly influence the transformation of votes into seats; the incentives and behaviour of voters, politicians, and parties; and policy outcomes. Thus, the choice of electoral system is critical for countries. Electoral systems can be generally divided into majoritarian and proportional systems. A majority of previous studies have shown that majoritarian systems, such as an SMD system, are more likely to be associated with lower voter turnout than proportional systems, such as a PR system, because lower

proportionality in the translation of votes into seats can reduce voters' sense of political efficacy (e.g. Banducci et al., 1999; Jackman, 1987; Jackman & Miller, 1995; Karp & Banducci, 1999; Karp et al., 2007; Powell, 1986). The results of this study indicate another mechanism by which majoritarian systems reduce voter turnout. Majoritarian systems are associated with a higher level of malapportionment because they divide the country into dozens or hundreds of small electoral districts, and it is difficult to equalise the value of one vote (i.e. population per seat) between districts (Samuels & Snyder, 2001). Under majoritarian systems, therefore, malapportionment can only be corrected by redistricting, and not by reapportionment, because the number of seats elected per district is fixed at one. In other words, majoritarian systems are more likely to be associated with lower voter turnout not only because they are non-proportional but also because they entail higher levels of malapportionment, which is addressed through redistricting. As such, this article provides a new perspective on the relationship between electoral systems and voter turnout.

Despite its numerous contributions, this study has several limitations. First, it has assumed that redistricting decreases the probability that voters' voting will affect the election result, decreases voters' sense of attachment to their communities, raises voters' anxiety about whether their interests are represented, and increases voters' costs to acquire party and candidate information. However, this mechanism is not directly tested, as the primary goal of this study is to estimate the causal effect of redistricting on voter turnout via aggregate-level analyses while controlling for effects specific to the electoral district. In order to elucidate the exact mechanism by which redistricting decreases voter turnout, future research should undertake individual-level analyses, particularly using an experimental design. Second, the study analysis focuses on a single country, Japan, because it aims to take advantage of a subnational comparison that allows for controlling for country-specific effects. However, a single-country study is limited in its generalisability. Therefore, to assess the generalisability of the study findings, they should be tested using other countries' data.

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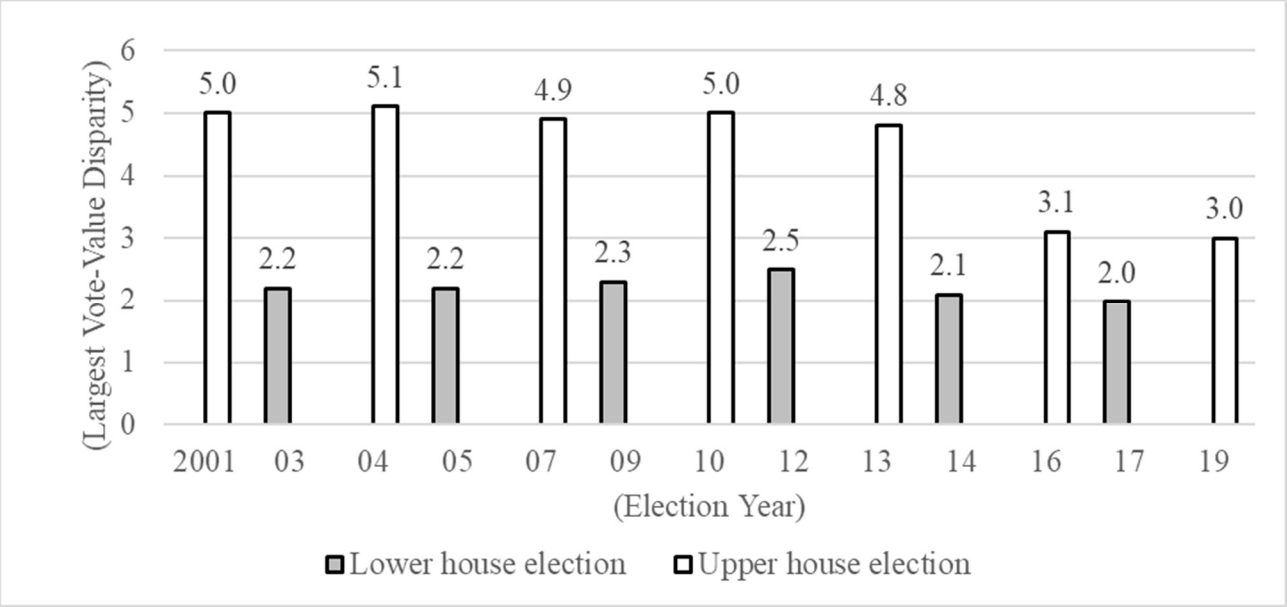
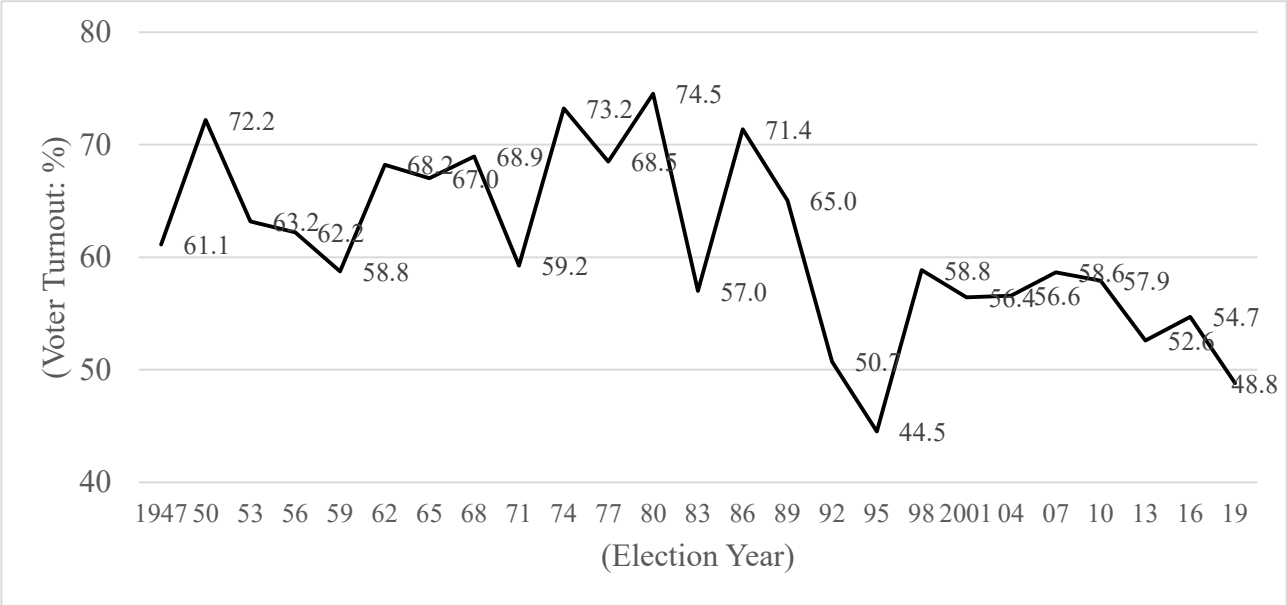
Figure 1. Malapportionment in Japan



Note: The values indicate the largest vote value disparity between districts, calculated by dividing the population per seat of the most underrepresented district by that of the most overrepresented district.

Figure 2. Voter turnout in upper house elections.



Source: Ministry of Internal Affairs and Communications

https://www.soumu.go.jp/main_content/000255919.pdf

Figure 3. Voter turnout in redrawn districts.

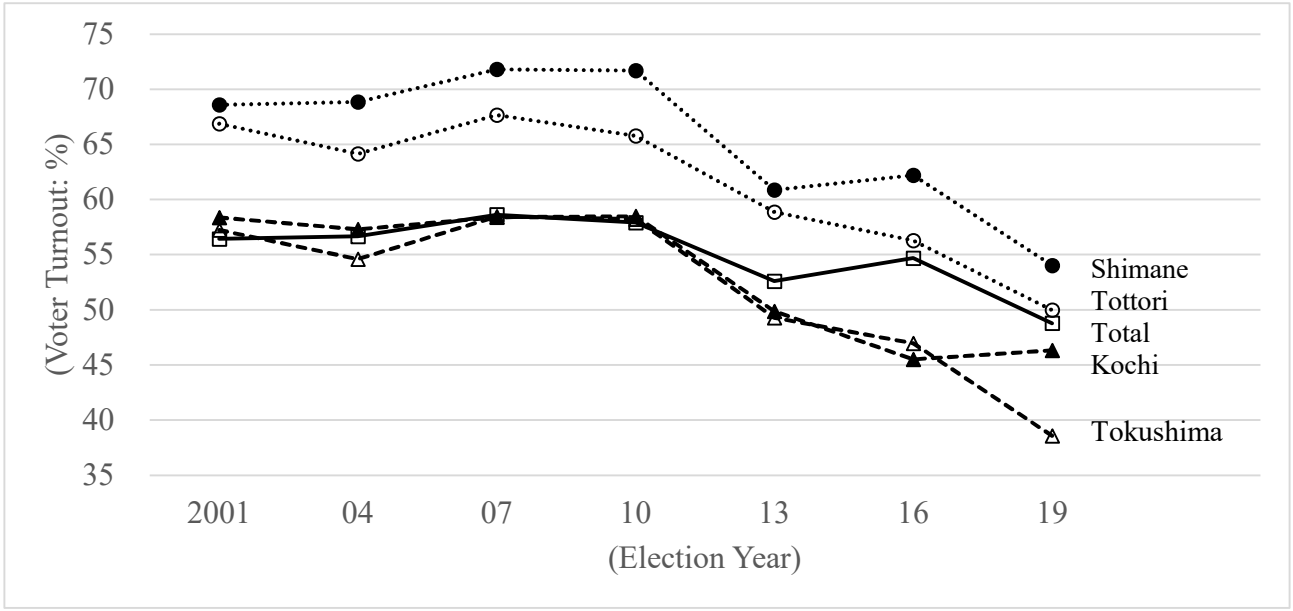
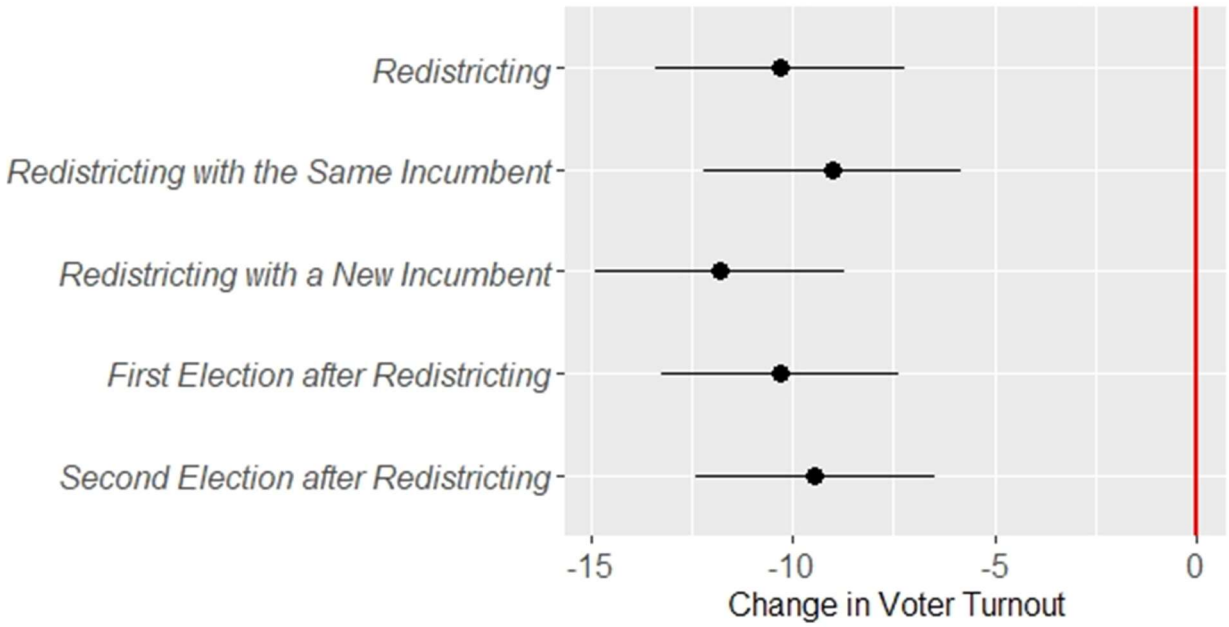


Table 1. Effect of redistricting on voter turnout.

	Column 1	Column 2	Column 3
		Coefficient (Standard Error)	
Redistricting $_{it}$	−10.316***		
	(1.532)		
Redistricting with the Same Incumbent $_{it}$		−8.996***	
		(1.582)	
Redistricting with a New Incumbent $_{it}$		−11.807***	
		(1.529)	
First Election after Redistricting $_{it}$			−10.306***
			(1.460)
Second Election after Redistricting $_{it}$			−9.445***
			(1.464)
District Magnitude $_{it}$	6.767***	6.880***	6.329***
	(1.413)	(1.448)	(1.210)
Population per Seat $_{it}$	6.759***	6.896***	6.714***
	(1.671)	(1.701)	(1.511)
Constant	37.610***	37.224***	38.359***
	(4.615)	(4.718)	(4.026)
District Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
R^2	0.727	0.729	0.826
Number of Observations	282	282	329

Note: Standard errors are clustered by prefecture, ***$p < 0.001$.

Figure 4. Marginal effect of redistricting on voter turnout.



Appendix 1. Summary statistics of the variables

Table A1. Summary statistics of the variables.

Continuous variables

	Observation Period	Mean	S. D.	Minimum	Maximum
Voter Turnout $_{it}$	2001–2016	57.393	4.686	45.520	71.810
	2001–2019	56.169	5.514	38.590	71.810
District Magnitude $_{it}$	2001–2016	1.560	0.884	1	6
	2001–2019	1.568	0.928	1	6
Population per Seat $_{it}$	2001–2016	1.545	0.603	0.589	3.021
	2001–2019	2.709	2.597	0.566	13.741

Dichotomous variables

		Value	
	Observation Period	0	1
Redistricting $_{it}$	2001–2016	278	4
Redistricting with the Same Incumbent $_{it}$	2001–2016	280	2
Redistricting with a New Incumbent $_{it}$	2001–2016	280	2
First Election after Redistricting $_{it}$	2001–2019	325	4
Second Election after Redistricting $_{it}$	2001–2019	325	4

Appendix 2. Robustness check

Table A2 provides robustness checks. Column 1 is the same as Column 1 of Table 1. To test for omitted variable bias, Column A1 includes additional control variables: *Electoral Competition*$_{it}$, a dummy variable coded 1 if some candidates in the district of prefecture *i* are rated as 'competitive' by the *Asahi Shimbun*[9], *Number of Candidates*$_{it}$, the number of candidates running in the district of prefecture *i*, and *Unemployment Rate*$_{it}$, the unemployment rate of the district of prefecture *i*.[10] Comparing Columns 1 and A1, the effects and statistical significance of *Redistricting*$_{it}$ remain almost unchanged. The results are robust for the inclusion of the additional control variables.

To test the effect of redistricting on the change in voter turnout from the previous to the current election, Column A2 uses Δ*Voter Turnout*$_{it}$, the change in voter turnout from election *t-1* to election *t*, as the alternative dependent variable instead of *Voter Turnout*$_{it}$. *Redistricting*$_{it}$ is statistically significant and positive for Δ*Voter Turnout*$_{it}$. Redistricting causes a 5.6 percentage point decrease in voter turnout from the previous election.

[9] *Asahi Shimbun*, 24 July 2001, 5 July 2004, 27 July 2007, 9 July 2010, 19 July 2013, 8 July 2016, and 6 July 2019.

[10] The data was obtained from the Ministry of Internal Affairs and Communications. <https://www.stat.go.jp/data/roudou/pref/index.html>

Table A2. Models with additional control variables or the alternative dependent.

	Column 1	Column A1	Column A2
Dependent Variable	*Voter Turnout* $_{it}$	*Voter Turnout* $_{it}$	$\triangle$*Voter Turnout* $_{it}$
		Coefficient (Standard Error)	
Redistricting $_{it}$	−10.316***	−10.741***	−5.558**
	(1.532)	(1.483)	(1.731)
District Magnitude $_{it}$	6.767***	7.719***	1.769
	(1.413)	(1.216)	(1.216)
Population per Seat $_{it}$	6.759***	7.477***	2.473
	(1.671)	(1.472)	(1.555)
Electoral Competition $_{it}$		0.954***	
		(0.205)	
Number of Candidates $_{it}$		−0.123	
		(0.064)	
Unemployment Rate $_{it}$		0.014	
		(0.295)	
Constant	37.610***	35.464***	−8.717*
	(4.615)	(4.095)	(4.064)
District Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
R^2	0.727	0.741	0.585
Number of Observations	282	282	282

Note: Standard errors are clustered by prefecture, ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.

Appendix 3. Testing the parallel trends assumption

The differences-in-differences design used to evaluate the effect of a treatment requires the parallel trends assumption, i.e. that the average outcomes for the treated and control groups would have followed parallel paths over time in the absence of the treatment. Figure A1 presents the average values of voter turnout in the prefectures that experienced redistricting in 2016 (Tottori, Shimane, Tokushima, and Kochi) and in those that did not. Although voter turnout in the treatment group (prefectures whose districts were redrawn) was higher than that in the control group (other prefectures), voter turnout for the two groups followed parallel paths until 2013. For both groups, voter turnout decreased slightly in 2001–2004, increased slightly in 2004–2007, decreased slightly in 2007–2010, and decreased sharply in 2010–2013. However, in 2016, voter turnout dropped sharply in the four prefectures whose districts were redrawn but increased remarkably for the other prefectures. In addition, while voter turnout in the treatment group was lower than that in the control group in 2016 and 2019, voter turnout for the two groups followed a parallel path in this period. Therefore, the parallel trends assumption is justified in this case. The turnout rate for the four prefectures whose districts were redrawn in 2016 would have increased had they not been redrawn; therefore, the difference between the counterfactual and real turnout rates can be attributed to redistricting.

Figure A1. Trends in voter turnout between redrawn districts and other districts.