# Do Voters Punish Governments for Natural Disasters?
## Evidence from the 2015 Kinu River Flood and the 2016 Kumamoto Earthquake in Japan

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**Abstract**

This paper examines how natural disasters affect people's attitudes toward their politicians, governments, and communities. To this end, we designed and implemented two original surveys in Japan, one in Joso City, which experienced severe flooding in 2015, and the other in Kumamoto, which experienced devastating earthquakes in 2016. Our analysis of the data demonstrates that citizens who live in more severely damaged areas are less likely to vote for candidates from the governing parties. Moreover, those who are satisfied with administrative and financial support from the government are more likely to vote for candidates from the governing parties. These results are largely consistent with the existing findings that voters punish incumbent leaders for the occurrences of natural disasters but reward them for disaster relief efforts.[1]

[1]Prepared for Midwest Political Science Association, April 4, 2019, Chicago, IL. Working draft.

## 1. Introduction

Recent research suggests that natural disasters, such as floods, earthquakes, and typhoons, generate a variety of social and political responses. For example, victims of natural disasters tend to lose trust in their governments (Lazarev et al., 2014), and disapprove of their political leaders (Flores and Smith, 2012). Such shifts in political attitudes often lead to significant changes in electoral outcomes (Ben-Ezra et al., 2013; Achen and Bartels, 2002). This paper seeks to contribute to this literature by examining how natural disasters affect people's attitudes toward their politicians, governments, and communities in the political and social context of Japan.

In a series of their working papers (Achen and Bartels, 2002, 2004, 2006, 2007), which later became part of their long-awaited book (Achen and Bartels, 2016), Achen and Bartels put forward an innovative argument that natural disasters will have negative impacts on an incumbent president's vote share in a coming election. This argument instantly captured the attention of scholarly minds and has produced a slew of empirical studies checking the argument in various contexts and further extending the argument to incumbent head executives at different levels of government. The US State Governors, for example, who do not try to financially help the victims, are negatively impacted in upcoming election by natural disasters (Gasper and Reeves, 2011; Reeves, 2011).

Do these arguments hold among Japanese voters? We tackle this question using two different natural disaster cases which Japan has recently experienced. One is the flood of Kinu River in Joso city, which was the worst hit by Typhoon No. 18 in September 2015. A large area of Joso was flooded when its left bank was destroyed after heavy rainfall, which resulted in a large number of flood victims. The other is the devastating earthquake which hit Kumamoto Prefecture in April 2016. A sequence of two magnitude 7-level earthquakes caused serious damages and disruption to the Kumamoto area. In both cases, we conducted original mail surveys in order to examine how the extent of damages and economic losses affect victims' attitudes toward the government and voting behavior. Both survey results tell us that voters who live in more severely

damaged areas are less likely to vote for the incumbent in the coming election. Another and more important finding is that those who are more satisfied with the governmental compensation are more likely to vote for the incumbent.

These findings make two contributions to the field of public opinion. First, we investigate the hypothesized relationship between an incumbent leader's political fate and natural disasters with individual level data, e.g. a combination of survey data and geographical data, unlike many other studies that employ aggregate-level data. Our individual-level evidence provides stronger evidence for the existing arguments about the relationships between natural disasters, leaders' response to them, and public opinion and behavior. Second, employing the same analytical scheme in the different types of natural disasters make a comparison possible in the relationships between voters and political leaders, which is affected by the disaster and the government's responses to it.

In the next section, we review the classic retrospective voting literature, which is basic to Achen and Bartels' argument and point out the importance of individual level analyses in this area. In the third section, we introduce the details of two disasters and describe our research design. The findings and discussions follow accordingly.

## 2. Retrospective Voting and Natural Disasters

Christopher Achen and Larry Bartels (2016) argue that unexpected natural disasters the like of floods, tornados, and droughts reduce an incumbent's vote share in upcoming elections. Why would natural disasters be related to incumbents' vote shares? The underlying logic behind this hypothesis stems from retrospective voting theory. The public is known to respond to incumbents' performance by rewarding or punishing them in an election with their votes (Key, 1966). This classic theory is demonstrated in various contexts. Focusing on economic issues, most studies of retrospective voting have demonstrated that a bad economy reduces the chance of incumbents being reelected (Fiorina, 1981, for example). Furthermore, voters are also known to respond in a

similar fashion to noneconomic issues, including national security (Karol and Miguel, 2007) and educational issues (Berry and Howell, 2007). These are all sound and reasonable findings for democratic accountability. If the government does well with major political, economic, and social issues, it will be rewarded accordingly; otherwise, by the same token, it will be punished.

The retrospective voting theory depicts traditional rational voters who decide whom they vote for on the basis of information about politics. While the literature on natural disasters shares the same premise about retrospective voting, it depends from those traditional views on retrospective voting in one crucial respect: the reward or the punishment by voters can be arbitrary and even irrational. It argues that people do not care about whether the government is really responsible for events. Obviously, the government is not attributable for the occurrences of natural disasters. The literature contends that people will punish the government in elections whether a mishap occurs to them regardless of whether the government is responsible for it. If true, this would be a serious blow to democratic accountability.

The accountability, however, has been explained from the viewpoint of voters in voting behavior literature. People do not always blame governments. Even in a bad economy, for example, voters do not tend to punish divided governments and coalition governments where its responsibility is fragmented or diffused (Powell and Whitten, 1993; Rudolph, 2003). If true, voters do not blame the government for the occurrences of natural disasters but punish the government's handling of the post-disaster situation. In support of this hypothesis, some studies provide a counterargument to Achen and Bartels' natural disaster hypothesis (Ashworth and Bueno de Mesquita, 2014; Velez and Martin, 2013). More specifically, some studies suggest that natural disaster effects can be moderated if the incumbent can provide financial aid to help the afflicted (Healy and Malhorta, 2009; Gasper and Reeves, 2011; Reeves, 2011).

These two hypotheses seem conflicted. As Achen and Bartels argue, do voters blame the incumbent for the occurrences of natural disasters? Or do voters punish the incumbent because they are not satisfied with the government handling of the devasted areas? This topic requires

further studies; our paper aims to contribute to this debate on the natural disaster hypothesis with individual level survey data and geographical data.

## 3. Survey Data

Our project focuses on two natural disasters in Japan. One is the Kinu River flood in September 2015 and the other is the Kumamoto earthquake in April 2016. We conducted two mail surveys in the serious damaged areas in Joso City in May 2016 and in Mashiki, Mifune, and Kashima Towns of Kumamoto Prefecture in December 2017, respectively.

### 3.1 The 2015 Kinu River Flood in Joso City

In early September 2015, Japan was hit by a heavy rainfall brought by a tropical storm known as Typhoon No. 18. The heavy rain severely affected three prefectures, Ibaraki, Tochigi, and Miyagi, and caused 14 deaths, left 80 injuries, and destroyed more than 7,000 houses.[2] The hardest-hit area is Joso City of Ibaraki Prefecture, through which Kinu River flows. The rainfall increased the level of the Kinu River and caused the river to overflow its left bank at one location and break through a flood berm at another in Joso City, ultimately swamping one side of the city. As a result, Joso City became the worst damaged area. About one-third of the city (the east side) was flooded and it took about 10 days just to pump the flood water out of the city.

We chose the Kinu River flood case for our test of the disaster hypothesis for two principal reasons. First, the case is ideal as the human and financial harm caused by the flood was quite serious. For example, in this flood case, two deaths and 44 injuries were reported, over 5,000 houses were damaged,[3] more than 6,000 residents were forced to evacuate the area, and its agricultural and business sectors suffered extensive losses of 7,770 million JPY (68 million USD)

[2] http://www.fdma.go.jp/bn/2015/detail/926.html

[3] 53 houses completely collapsed, 1,581 were considered large-scale destroyed, and 3,491 were partially destroyed.

and 16,700 million JPY (152 million USD), respectively.[4] Given the extent of human and financial impact, we have determined that this case is qualified for testing the natural disaster hypothesis.

Second, this case can also be used to address one fundamental challenge in studying the effects of natural disasters on public opinion. Although the occurrences of natural disasters are unexpected, individual exposure to disasters are often not random, making it difficult to distinguish between correlation and causation in the study of the natural disaster hypothesis. We address this problem by taking advantage of the circumstances of the Kinu River flood case. The overflow of the river water affected the east side of the city, and not the west. This was mainly due to a failure of the flood berm caused by the massive rainfall, which caught Joso City hall in 2009. The hazard map (Figure 1) shows which areas of the city might be flooded in the event of a Kinu River flood. The map demonstrates that both the east and west are under flood risk. In particular, in the area which we chose for our study (in a red circle in Figure 1), both the east and west were estimated to be flooded. Thus, we contend that a variation in the exposures to flood damages can be considered effectively random, which we will support with more empirical evidence later (see Appendix A).

[4] http://www.city.joso.lg.jp/ikkrwebBrowse/material/files/group/6/kensyou_houkokusyo.pdf, http://www.city.joso.lg.jp/ikkrwebBrowse/material/files/group/13/dai1kaihigaijyoukyou.pdf

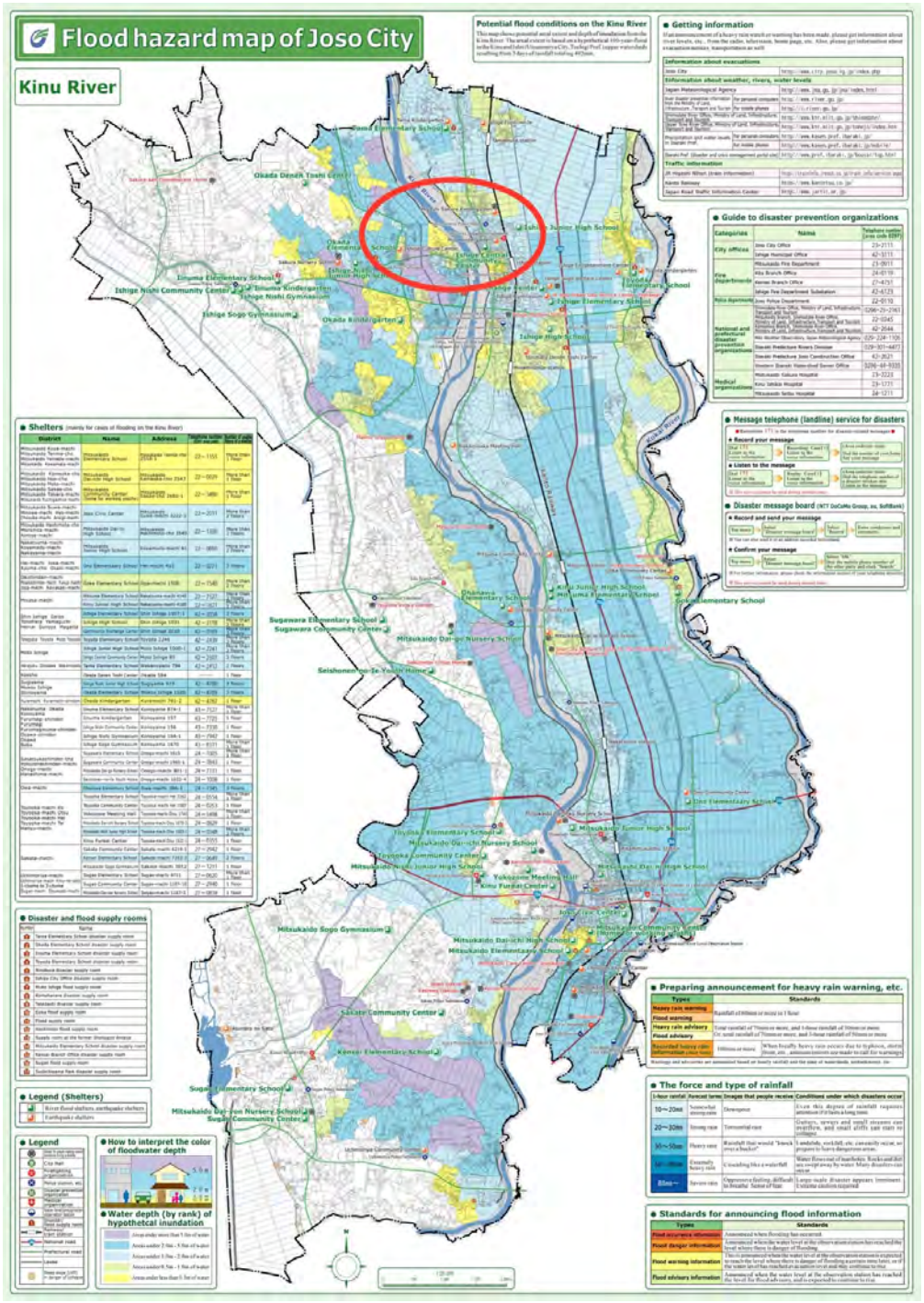


Figure 1: Flood Hazard Map of Joso City
note: http://www.city.joso.lg.jp/ikkrwebBrowse/material/files/group/6/00705.pdf

The data for this paper was obtained our own mail survey.[5] We chose three precincts, two from the flooded area on the east side of the Kinu River (the 25th and 26th precincts) and one from the west side of the river, an area unaffected by the flood (the 32nd precinct). We randomly selected a total of 1,500 registered voters from the Joso City registration list. We conducted the survey in May 2016, that is, 7 months after the flood. Our survey included 28 questions, including those asking about their view on their local government, the extent of flood damage to their properties, their views on the community and economy, and demographic information. The response rate was 17.4 percent (see Table 1).

Table 1: Response Rates in Joso Flood Survey

| | precinct | | | |
|---|---|---|---|---|
| | 25th | 26th | 32th | total |
| non-respondents | 289 | 516 | 429 | 1,234 |
| % | 83.1 | 79.9 | 85.8 | 82.6 |
| respondents | 59 | 130 | 71 | 260 |
| % | 17.0 | 20.1 | 14.2 | 17.4 |
| total | 348 | 646 | 500 | 1,494 |
| % | 100 | 100 | 100 | 100 |

Figure 2 shows the flood inundation depth at respondents' living places, and Figure 3 shows the distribution of the flood depth by each precinct. Obviously, the 32th precinct, which is located in the west side of Kinu River, was not flooded, while the 25th and 26th precincts in the east side of the river were severely flooded. Notably, the median of the flood depth in the 26th precinct exceeds 1 meter, which suggests many houses of the respondents in the 26th precinct were inundated above the floor level.

[5] Although all respondents received paper questionnaires through the mail, they had a choice between sending back the questionnaires with their answers and answering questions on our webpage. While most respondents just filled out the paper questionnaires, 14 respondents (5%) answered survey questions online.

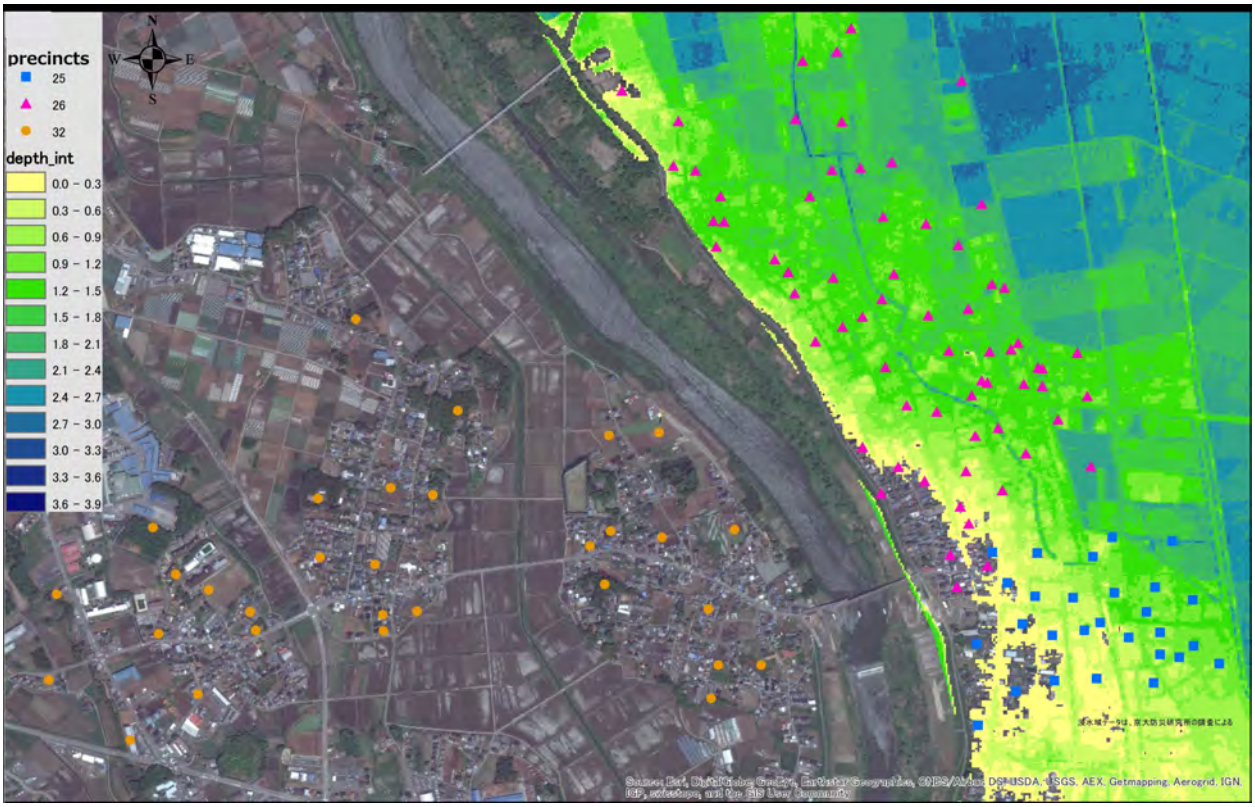


Figure 2: Flood Depth and Respondents

note: flood depth data come from Disaster Prevention Research Institute, Kyoto University ( http://www.dpri.kyoto-u.ac.jp/news/5693/ )

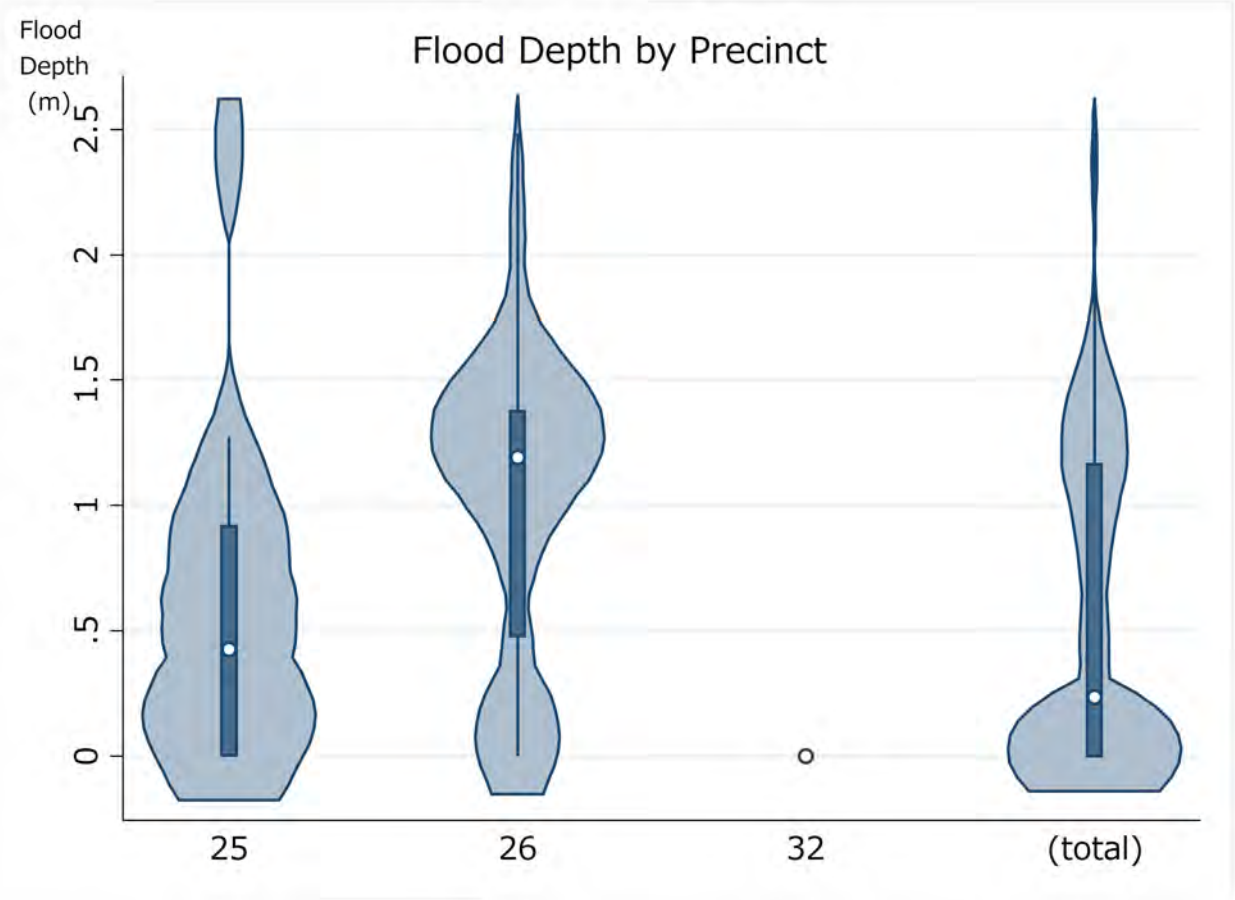


Figure 3: Flood Depth by Precinct

Figure 4 shows the scatterplots between the flood inundation depth and the damage amounts of the respondents. Both 25th and 26th precincts have a positive relationship between the flood depth and the damage amount. In a regression with the damage amount as a depending variable and the flood depth as an independent variable, a 10 centimeter increase in the flood depth is associated with a 316,000 JPY increase in the damage amount on average in the 25th precinct ($p<0.05$) and a 10 centimeter increase in the flood depth is associated with a 394,000 JPY increase in the damage amount on average in the 26th precinct ($p<0.01$).

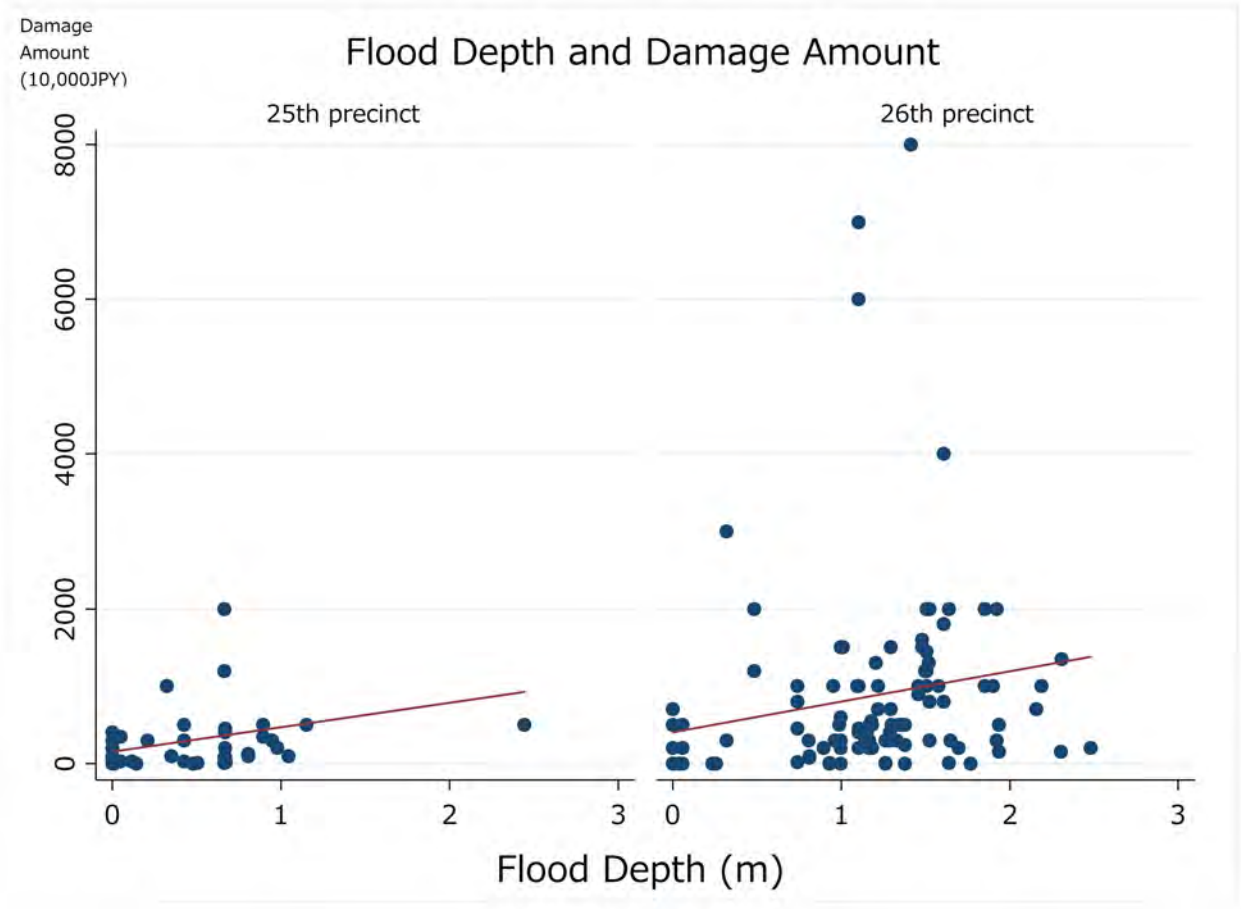


Figure 4: Flood Depth and Damage Amount

### 3.2 The 2016 Kumamoto Earthquakes

Kumamoto experienced two huge earthquakes in April 2016. One is the foreshock with magnitude 6.2 on April 14 and another is the main shock with magnitude 7.0 on April 16. A series of these shocks caused 270 deaths (including the disaster-related deaths), left 2734 injuries, and destroyed more than 40,000 houses severely and over 150,000 houses partially. More than 180,000 residents were evacuated from their homes.[6] The most severe damaged area was Mashiki Town with 20 deaths just after the earthquakes.

We chose Mashiki Town and its two neighbor towns for our test of the disaster hypothesis for the same reasons as the above. First, the damages in these three towns caused by the Kumamoto earthquakes were quite serious.[7] Second, because Kumamoto area was said to be relatively free from big earthquakes, most of the residents equally did not expect the unprecedented earthquakes.[8] This enables us to consider that a variation in the exposures to earthquakes is effectively random. Because of the comparison, we chose Mashiki Town and its neighbors, Mifune Town and Kashima Town within the same county, which means these three towns are located in the same district of both Lower and Upper House Elections. For this reason, we excluded Kumamoto City, the capital city in Kumamoto Prefecture.

The data come from our own mail survey in three towns: Mashiki, Mifune, and Kashima Towns. We randomly selected a total of 3,000 households from a phone book in these three towns and asked an individual who has the nearest birthday among the household members to respond to our survey. We conducted the survey from December 2017 to January 2018. Our survey included 31 questions, including those asking about their views on their local government, the extent of the earthquake damage to their properties, their views on the community and economy,

[6] The numbers are reported by Kumamoto Prefecture, as of February 13, 2019. https://www.pref.kumamoto.jp/common/UploadFileOutput.ashx?c_id=3&id=15459&sub_id=275&flid=183593

[7] http://www.earth-planets-space.org/wp-content/uploads/2017/09/KEQ.pdf

[8] Before the 2016 Kumamoto earthquakes, Kumamoto Prefecture used to explain that Kumamoto had not experienced a magnitude 7-level earthquake for a recent 120-year period and stressed that Kumamoto was free from big earthquakes. https://mainichi.jp/articles/20160515/ddm/001/040/195000c

and demographic information. The response rate was 32.8 percent in total (see Table 2).

Table 2: Response Rates in Kumamoto Earthquake Survey

| | town | | | |
|---|---|---|---|---|
| | Kashima | Mifune | Mashiki | total |
| non-respondents | 669 | 687 | 660 | 2,016 |
| % | 66.9 | 68.7 | 66.0 | 67.2 |
| respondents | 331 | 313 | 340 | 984 |
| % | 33.1 | 31.3 | 34.0 | 32.8 |
| total | 1,000 | 1,000 | 1,000 | 3,000 |
| % | 100 | 100 | 100 | 100 |

We measure the earthquake shocks on the respondents' houses by peak ground velocity (cm/s), which is known to be highly correlated with the damage of buildings. Peak ground velocity (PGV) data are obtained from ShakeMap developed by U.S. Geological Survey. Figure 5 shows a map of the respondents and PGV in the area on April 16. Figure 6 shows PGV distributions for each town. These two figures tell us that Mashiki Town experienced the largest shocks.

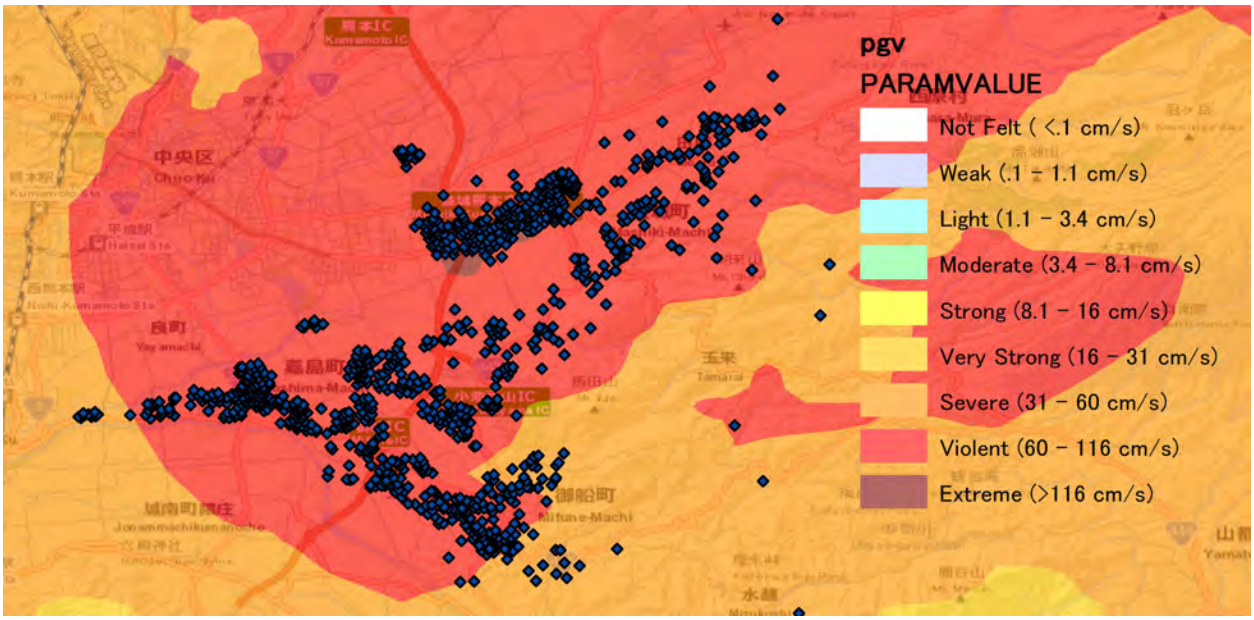


Figure 5: Peak Ground Velocity and Respondents
note: PGV data come from USGS ShakeMap ( https://earthquake.usgs.gov/data/shakemap/ )

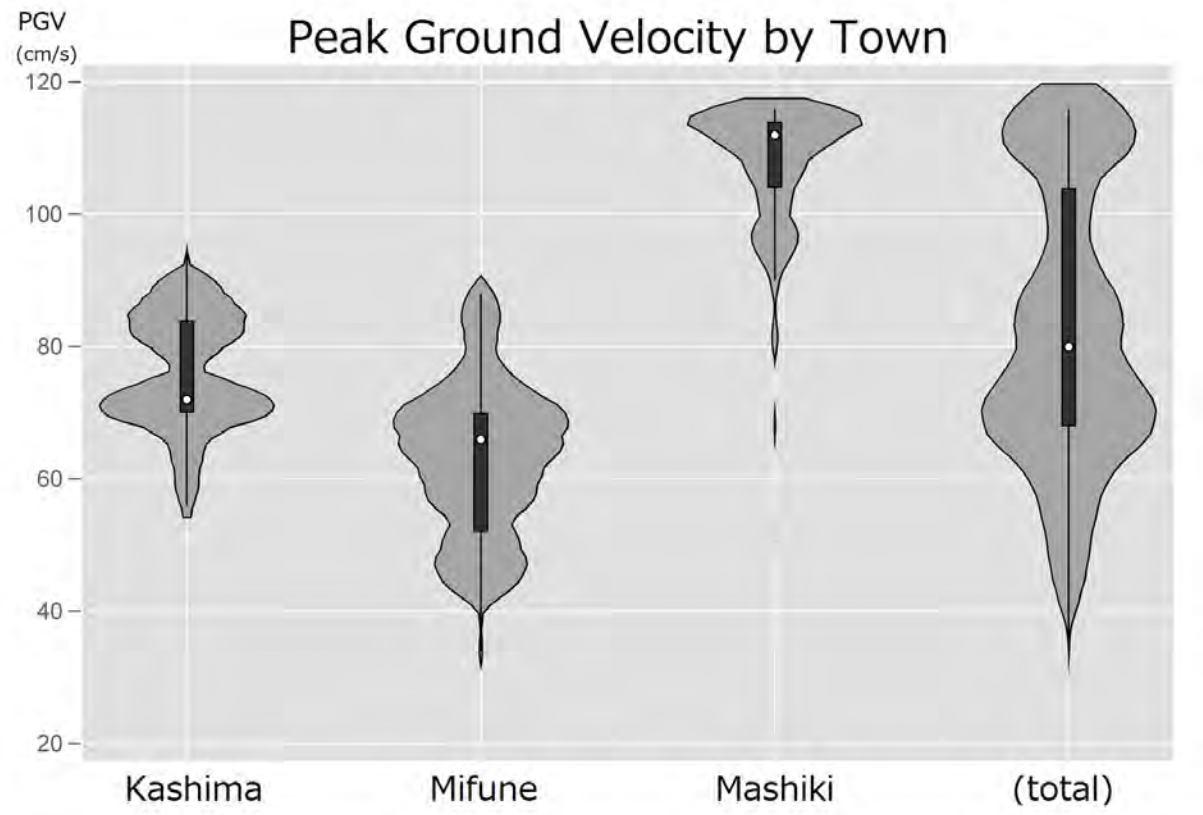


Figure 6: Peak Ground Velocity by Town

Figure 7 shows a relationship between PGV and damage amount. A one cm/s increase in PGV is associated with a 100,000 JPY increase in damage amount in Mashiki Town on average ($p<0.10$) and 160,000 JPY in damage amount in Mifune Town on average ($p<0.05$). There is no statistical relationship between these two in Kashima Town, which might have possible outliers.

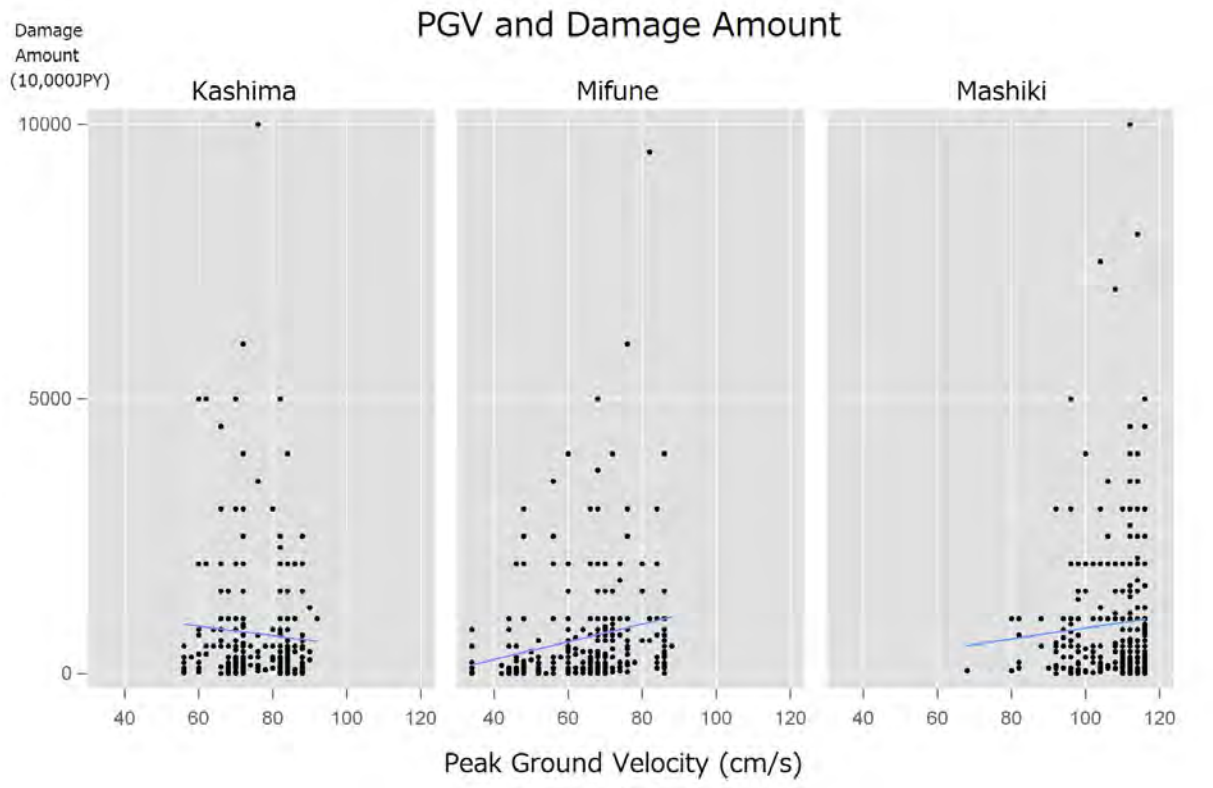


Figure 7: PGV and Damage Amount

In the next section, using these data sets, we test the counter-hypothesis that voters punish the incumbent because they are not satisfied with the government handling of the post-disaster situation.

### 3.3 Variables

The dependent variable of the Joso Flood case, *Incumbent Vote*, is drawn from the answers to the survey question that asks respondents whether they will vote for the incumbent mayor of Joso City in the coming election. The answers to this question are dichotomous with 1 indicating vote for the incumbent and 0 otherwise. The dependent variables of the Kumamoto Earthquake case, *Ruling Parties Vote*, are drawn from the answers to the survey question that asks respondents whether they did vote for a candidate or a party from ruling parties, specifically Liberal Democratic Party (LDP), in 2016 Upper House Election and in 2017 Lower House Election. The answers to these questions, too, are dichotomous with 1 indicating vote for ruling parties and 0 otherwise.

To examine the effect of disaster damage on incumbent vote share, we prepared two independent variables. The first variable is *Flood Depth* (meter) in the Joso Flood case and *PGV* (cm/s) in the Kumamoto Earthquake case, respectively. These variables objectively capture the disaster damage on the respondents' living places. Despite houses being not the only property that was destroyed by these disasters, damage to them typically carry the most serious financial consequences. Moreover, these variables are a variation in the exposure to house damage can be considered quasi-random, which we demonstrate in Appendix A. That is, we show that there are no obvious differences on, at least, observables between those who had their houses damaged and those who did not.

The second variable is *Satisfaction with Governmental Support*. The answers to the survey question that asks respondents to assess the satisfaction with the administrative and financial support from the governments. The answers to this question are based on a 5 point-scale with +2 indicating the most satisfied and -2 the least satisfied. We coded the variable as missing when a respondent found it difficult to answer.

Additionally, in order to examine the genuine effect of satisfaction with governmental support, we control the satisfaction with compensation paid by insurance companies. This

variable, too, is coded on a 5 point-scale with +2 indicating the most satisfied and -2 the least satisfied.[9]

## 4. Findings

We now turn to the test of our key hypothesis that voters punish the incumbent because they are not satisfied with the government handling of the disasters affected area. We regress our dependent variable on the independent variables to estimate the causal effect of disaster damage. Table 3 provides the results of our probit regression of individual future vote for the incumbent in the flood case. The result shows that higher flood depth is associated with lower likelihood of voting for the incumbent in the coming mayoral election. In other words, those whose houses were severely inundated by the Kinu River flood have lower likelihood of voting for the incumbent than those whose houses are not severely impacted. In addition, a greater satisfaction with governmental support is associated with higher likelihood of voting for the incumbent in the coming mayoral election. Those who are more satisfied with the administrative and financial support from the governments are more likely to vote for the incumbent in the coming election.

Table 3: Probit Model: Will Vote for the Incumbent in Flood Case

| *Will Vote for the Incumbent* | Coeff. | Rob.S.E. | p-value |
|---|---|---|---|
| Flood Depth | -0.31 | 0.08 | 0.00 |
| Sat Gov Support | 0.25 | 0.03 | 0.00 |
| Sat Ins Compensation | -0.06 | 0.06 | 0.27 |
| Constant | -0.77 | 0.11 | 0.00 |
| n | 260 | | |

Likewise, Table 4 provides the results of our probit regression of individual vote for LDP in the earthquake case. The result shows that higher PGV is associated with lower likelihood of voting for the LDP candidate, Yoshifumi Matsumura, in 2016 Upper House Election (left column in Table 4) and lower likelihood of choosing LDP in proportional representation vote in 2017

[9]Because our data in these models are randomized, we did not include other control variables.

Lower House Election (right column in Table 4). There is no statistical effect of PGV on the LDP vote in the Kumamoto 3rd Lower House district in 2017 (middle column in Table 4). This might be related to the fact that there were only two candidates from LDP and Japanese Communist Party, which possibly made voters think no alternative exists. As a whole, those whose houses were severely damaged by the Kumamoto earthquakes have lower likelihood of voting for LDP than those whose houses are not. In addition, like the flood case, a greater satisfaction with governmental support is associated with higher likelihood of voting for ruling parties. Those who are more satisfied with the administrative and financial support from the governments are more likely to vote for a candidate and a party from the ruling parties.

Table 4: Probit Model: Voted for Ruling Parties in Earthquake Case

| | 2016HC | | | 2017HR(district) | | | 2017HR(PR) | | |
|---|---|---|---|---|---|---|---|---|---|
| *Voted for Ruling Parties* | Coeff. | Rob.S.E. | p | Coeff. | Rob.S.E. | p | Coeff. | Rob.S.E. | p |
| PGV | -0.005 | 0.00 | 0.01 | -0.001 | 0.00 | 0.59 | -0.005 | 0.00 | 0.00 |
| Sat Gov Support | 0.047 | 0.01 | 0.00 | 0.006 | 0.03 | 0.84 | 0.054 | 0.02 | 0.02 |
| Sat Ins Compensation | 0.059 | 0.06 | 0.33 | 0.104 | 0.06 | 0.06 | 0.041 | 0.06 | 0.49 |
| Constant | -0.245 | 0.20 | 0.22 | 0.144 | 0.28 | 0.61 | 0.129 | 0.09 | 0.16 |
| n | 937 | | | 965 | | | 984 | | |

These findings suggest that those who were affected by the disaster tend to view the government less favorably than those who were not *and* that those who were satisfied with the governmental support to view their government more favorably than those who were not. While the former finding provides support for Achen and Barelts' argument for the link between natural disasters and the government, the latter finding suggests the government handling of the disaster victims affects both citizens satisfaction with the government and, *thus*, the incumbent vote share.

Lastly, we develop our argument and see the interaction effect between disaster damage and satisfaction with governmental support in both cases. Table 5 shows a probit model including the interaction term between flood depth and satisfaction with governmental support in Joso Flood case. Table 6 shows a probit model including the interaction term between PGV and satisfaction

with governmental support in Kumamoto Earthquake case.[10] To understand the interaction, we illustrate the predictive margins of the effect of disaster damage by satisfaction with governmental support. Figure 8 shows the effect of flood depth on incumbent vote by governmental support satisfaction level. In this prediction, among those who are very satisfied with governmental support (SatGov=+2), the relationship between flood depth and incumbent vote share is negative, while among those who are little satisfied with governmental support (SatGov=-2), the effect of flood depth on incumbent vote share is constant. Figure 9 shows the effect of PGV on incumbent vote share by governmental support satisfaction level in proportional representative votes of 2017 Lower House election. This shows that among those who are little satisfied with governmental support after the earthquakes (SatGov=-2), the relation shop between PGV and incumbent vote share is negative, while among those who are very satisfied with governmental support (SatGov=+2), the effect of PGV on incumbent vote share is constant. To sum up, both results show the effect of disaster damage on incumbent vote share, which Achen and Bartels argue, depends on voters' satisfaction with administrative and financial supports from government.

[10]We omit the 2017HR(district) model because this does not show a significant effect of the disaster damage on the incumbent vote share.

Table 5: Probit Model with an Interaction Term: Flood

| | M1 | M2 | M3 |
|---|---|---|---|
| Flood Depth | $-0.37^{***}$ | $-0.31^{***}$ | $-0.34^{***}$ |
| | (0.07) | (0.08) | (0.09) |
| Sat Gov Support | | $0.25^{***}$ | $0.45^{+}$ |
| | | (0.03) | (0.24) |
| Sat Ins Compensation | | $-0.06$ | $-0.06$ |
| | | (0.06) | (0.06) |
| Depth*Sat Gov Support | | | $-0.20$ |
| | | | (0.19) |
| Constant | $-0.77^{***}$ | $-0.77^{***}$ | $-0.76^{***}$ |
| | (0.09) | (0.11) | (0.11) |
| n | 260 | 260 | 260 |
| pseudo R-sq | 0.029 | 0.047 | 0.052 |

Clusterd Robust Standard Errors in parentheses

$^{+}$ p<0.1, $^{*}$ p<0.05, $^{**}$ p<0.01, $^{***}$ p<0.001

Table 6: Probit Model with an Interaction Term: Earthquake

| | 2016HC | | | 2017HR(PR) | | |
|---|---|---|---|---|---|---|
| | HC1 | HC2 | HC3 | HR1 | HR2 | HR3 |
| PGV (m/s) | $-0.47^{**}$ | $-0.49^{**}$ | $-0.50^{**}$ | $-0.45^{***}$ | $-0.46^{***}$ | $-0.45^{***}$ |
| | (0.17) | (0.18) | (0.16) | (0.09) | (0.08) | (0.08) |
| Sat Gov Support | | $0.05^{***}$ | 0.09 | | $0.05^{*}$ | $-0.06^{*}$ |
| | | (0.01) | (0.15) | | (0.02) | (0.02) |
| Sat Ins Compensation | | 0.06 | 0.06 | | 0.04 | 0.04 |
| | | (0.06) | (0.06) | | (0.06) | (0.06) |
| Female | | | $-0.59^{***}$ | | | $-0.33^{***}$ |
| | | | (0.12) | | | (0.10) |
| Age | | | 0.00 | | | 0.01 |
| | | | (0.00) | | | (0.00) |
| PGV*Sat Gov Support | | | $-0.05$ | | | $0.13^{***}$ |
| | | | (0.18) | | | (0.01) |
| Constant | $-0.26$ | $-0.24$ | $-0.24$ | 0.12 | 0.13 | 0.11 |
| | (0.18) | (0.20) | (0.19) | (0.08) | (0.09) | (0.09) |
| n | 937 | 937 | 937 | 984 | 984 | 984 |
| pseudo R-sq | 0.005 | 0.008 | 0.008 | 0.004 | 0.007 | 0.007 |

Clusterd Robust Standard Errors in parentheses

$^{*}$ p<0.05, $^{**}$ p<0.01, $^{***}$ p<0.001

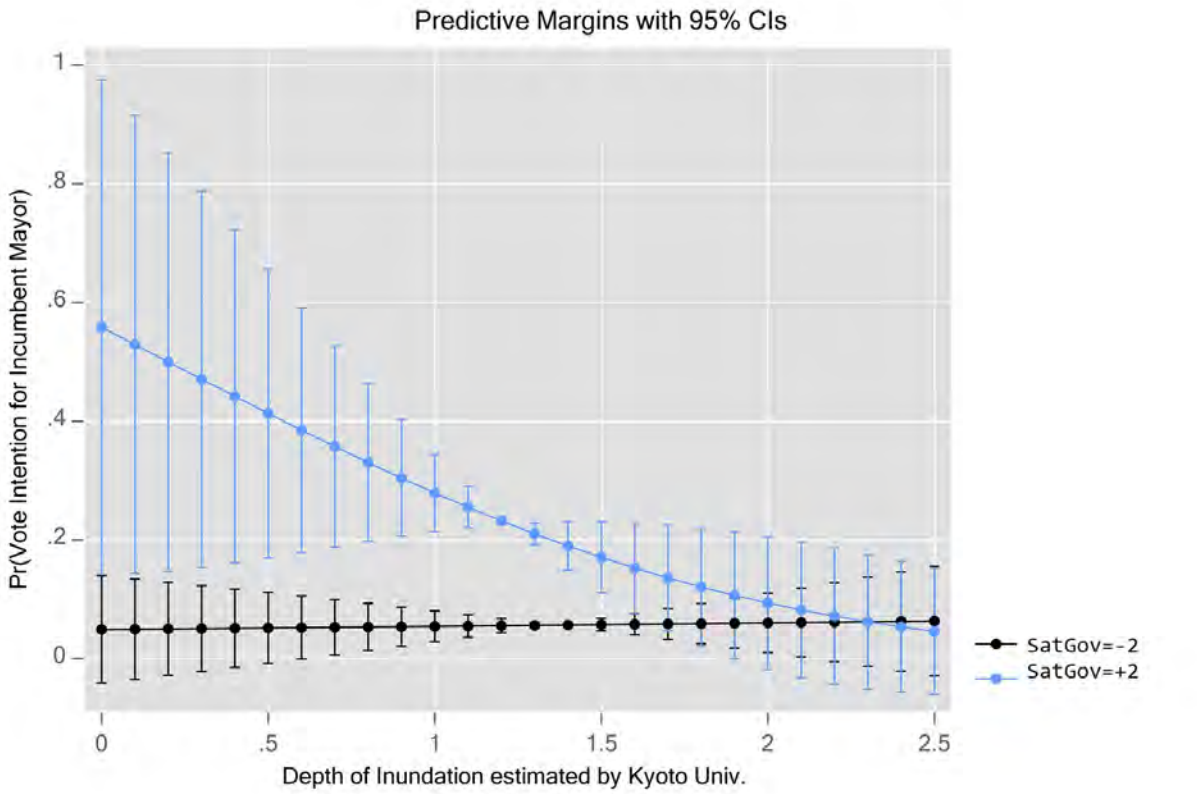


Figure 8: Effect of Flood Depth on Incumbent Vote by Satisfaction with Governmental Support

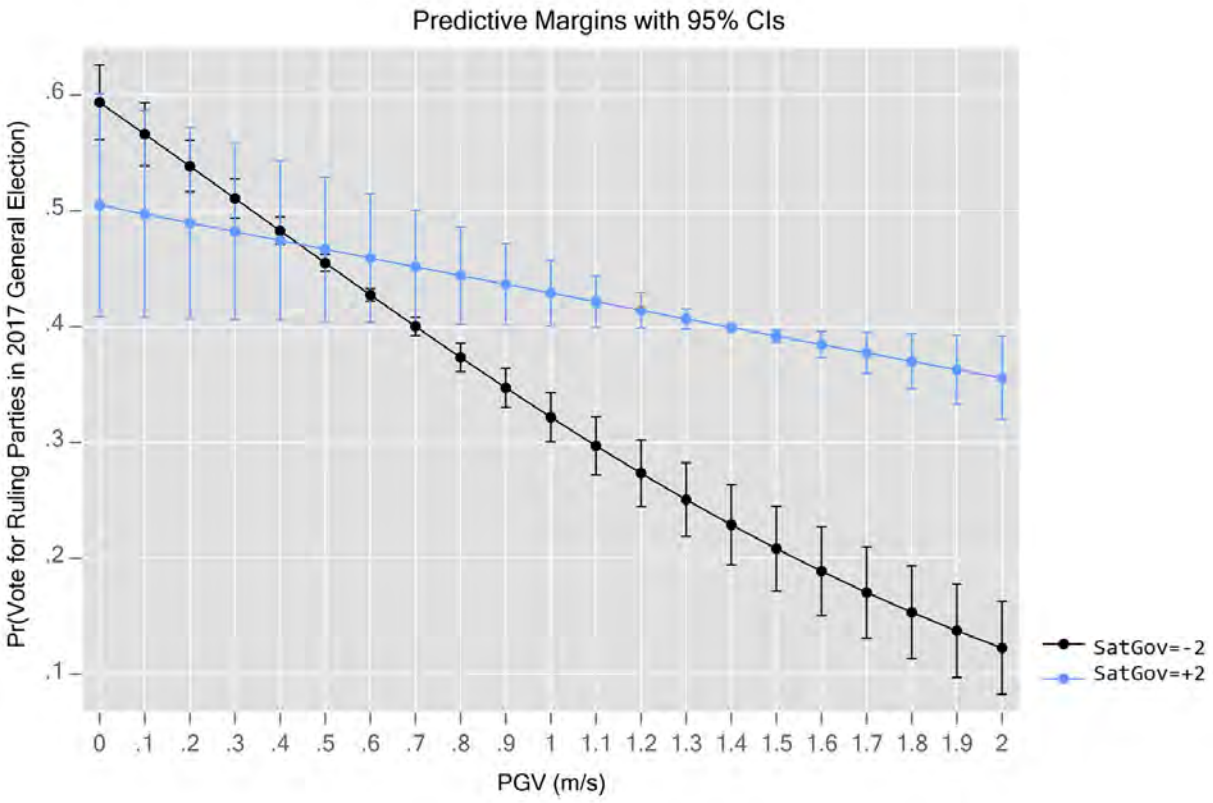


Figure 9: Effect of PGV on Incumbent Vote by Satisfaction with Governmental Support

## 5. Discussions

In this paper, our aim has been to contribute new evidence to the debate over how natural disasters affect public attitudes toward political leaders. The findings are that those who lives in more severely damaged area are less likely to vote for the incumbent and, more importantly, that those who are more satisfied with governmental support are more likely to vote for the incumbent. We also find that the relationship between natural disaster and incumbent vote share depend on citizens' satisfaction with governmental support after the disaster.

Our findings are novel in two respects. First, we test the natural disaster argument with two different types of natural disasters in the context of Japanese politics. Second, we also extend their argument and examine how natural disasters influence voters' attitudes toward the government via voters' satisfaction with governmental disaster support. Overall, our preliminary evidence gives support for Achen and Bartels' original argument and also suggest that the government handling of the disaster victims affects this relationship between voters and government. These results are largely consistent with the existing findings that voters punish incumbent leaders for the occurrences of natural disasters but reward them for disaster relief efforts.

## Appendix A: Balance Checks in Flood Case

Here we check the extent to which our treatment (flood damage) is randomized. First, we compare some of the characteristics between the east and west sides of the city as divided by the Kinu River. We took information from iSTAT MAP, a geostatistics website run by the Statistics Bureau of Japan and the National Statistics Center of Japan and these results are presented in Table 7. The results show no obvious systematic differences in observables (e.g. gender and employment, among others) between the east and west sides under study. In particular, we compared voter turnout, which is the only data available on voting at the precinct level. We find little difference between the east and west in turnout in the previous mayoral election in2012.

Second, given that we find little evidence for differences between the east and west, we further checked our survey data to see if there is any evidence for differences between those who had their houses damaged by the flood and those who did not within the west. We compared the means of the variables, including gender, education and age, between these two groups. Table 8 summarizes the results. The results confirm that there are no differences on average in gender, age, house ownership, income, and past voting behavior.

Table 7: Balance Checks (West vs. East)

| | West | East | Diff. |
|---|---|---|---|
| % of the population that are over 65 years old | 0.18 | 0.22 | 0.04 |
| Female | 0.49 | 0.50 | 0.01 |
| Unemployed Households | 0.20 | 0.20 | 0.00 |
| Employed in Manufacturing Sector | 0.37 | 0.36 | 0.01 |
| Employed in Agricultural Sector | 0.04 | 0.04 | 0.00 |
| Voter turnout in 2012 mayoral election | 0.40 | 0.42 | 0.02 |

note: Data are taken from jSTAT MAP [https://jstatmap.e-stat.go.jp/gis/nstac/]
and the Joso City website [http://www.city.joso.lg.jp/gyosei/shigikai/senkyo/kekka]

Table 8: Balance Checks (within the East)

| | House Damage | | |
|---|---|---|---|
| | Yes (N=125) | No (N=52) | Diff. |
| Gender: Female | 0.58 | 0.50 | 0.08 |
| Age (1: 20s, 2: 30s, 3: 40s, , 6: 70 or above) | 4.37 | 4.36 | 0.01 |
| House Owner | 0.95 | 0.92 | 0.03 |
| Education: College | 0.20 | 0.18 | 0.02 |
| Income (1: 0-2 mil., 2: 2-6 mil., 3: 6-10 mil., 4: $>$10 mil.) | 3.24 | 2.80 | 0.44 |
| Voted for Mayor in 2012 | 0.46 | 0.46 | 0.00 |

note: Data are drawn from our own survey.

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