Do natural disasters affect local elections? An empirical examination using subnational electoral data

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Abstract

We investigated the link between natural disasters and local elections using data for Japanese gubernatorial elections for the years 1985–2015. In the case of gubernatorial elections in Japan, a rich data set is available which includes information on who wins, the vote shares of all candidates, when the election was held, etc., relating to gubernatorial elections. We found some empirical evidence that an occurrence of disaster affects a constituency's support for an incumbent politician as pointed out by previous works. One potential policy implication from our findings is that politicians may worry too much about the election following a disaster and hence have incentives to reward their constituency not through disaster relief and recovery policies but through other ways such as economic policies and patronage public goods.

Keywords: Election, governor, natural disaster, local politics, voters' behaviors

JEL Classification Codes: D72, H71, H77

1. Introduction

In recent decades, many countries have been experiencing increasingly damaging natural disasters. There have been many policy debates regarding the relationship between politics and natural disasters, and it has been widely argued that political decision-making is a critical determinant of states' responses to natural disasters; for example, whether disaster declarations are granted and how disaster relief is allocated (e.g., Garrett et al., 2006; Garrett and Sobel, 2003; Husted and Nickerson, 2014; Reeves, 2011; Shughart, 2006). In particular, studies have found that states that are perceived as being politically important are more likely to be granted disaster declarations, and also that presidential election schedules influence decision-making regarding such declarations.

Considering such events from the opposite perspective, many scholars have examined whether natural disasters influence subsequent elections by inducing changes in voters' attitudes toward politicians; in other words, studies have examined whether voters reward or punish incumbent politicians in the aftermath of large-scale natural disasters. Gasper and Reeves (2011), a pioneering work in this regard, examined the electoral effects of extreme weather events and governors' responses to these events. They consequently found that, in general, voters punish presidents and governors after such events; however, when a president rejects a governor's requests for federal assistance, voters tend to punish the president in the subsequent election but reward the governor. Several studies support Gasper's and Reeves' view that voters generally punish incumbents in elections subsequent to natural disasters (Chang and Berdiev, 2015), but reward them if they respond effectively to the disasters (Cole et al., 2012; Nakajo et al., 2019). More recent electoral studies suggest that voters in affected areas support incumbents after disasters in cases when the incumbents secure disaster aid (Bechtel and Hainmueller, 2011; Gallego, 2018; Healy and Malhotra, 2009), demonstrate competency in regard to addressing the

disaster (Stout, 2018), or are aligned with the central government and are consequently expected to have the capacity to raise further disaster-relief funds (Cavalcanti, 2018). It has also been reported that the political effects associated with disasters, such as increased support for the incumbent party (when disaster-response efforts are effective) and changes in voting for mayoral candidates, persist longer than previously estimated (Bechtel and Hainmueller, 2011; Montjoy and Chervenak, 2020). However, some empirical studies have found no evidence of changes in approval for incumbents following natural disasters (Albrecht, 2017; Bodet et al., 2016; Bovan et al., 2018). The above shows that empirical studies in this context have produced mixed results regarding the influence of disasters on subsequent elections, and definitive conclusions cannot yet be obtained from existing empirical investigations.

The objective of the present study is to explore whether the occurrence of natural disasters influences the outcomes of subsequent local elections; this is performed by analyzing gubernatorial election data for Japan for the period 1985–2015. In Japan, gubernatorial elections at the prefecture level[1] are usually held every four years, and no term limits are applied to incumbents. In this research, we attempt to determine the effect the time between the date of a natural disaster and the date of the subsequent election on the vote share in the election. This is performed by using prefecture-level data and performing ordinary least square regression analyses. This study contributes to the literature on the disaster-election nexus in two ways. First, in the regressions we estimate the short- and long-term impacts of natural disasters on local elections; this is important because electoral effects may persist long after large-scale natural disasters. Second, we study Japanese cases. Japan has a long history of experiencing large-scale natural disasters, including

[1] Prefectures are regional jurisdictions in Japan, and are the main subdivisions in the country.

several notable tsunamis and earthquakes in the recent past; thus, there are many cases of gubernatorial elections being held soon after disasters. The high frequency of disasters in Japan means it is likely that voters have had relatively many opportunities to evaluate governors' disaster responses and policies. Hence, examination of Japanese cases may provide stronger empirical evidence for the literature when compared to data for countries where large-scale disasters are rare.

Section 2 of this paper provides a background to gubernatorial elections in Japan, the prevalence and effects of disasters in Japan, and the country's disaster-related laws. Section 3 presents the econometric specification for this study, and Section 4 provides descriptive statistics for the data used in this research. The baseline regression results and robustness checks are reported in Section 5. Section 6 concludes the paper.

2. Background

2.1 Japan's local government system

Japan is a unitary state comprising three administrative tiers: the nation, prefecture, and municipality. As of January 1, 2021, Japan contains 47 prefectures (regional governments) and 1,718 municipalities.

Prefectural authorities provide cross-jurisdictional public services such as policing, creation and maintenance of prefectural roads, and salary expenses for public schools, while municipal authorities generally provide intra-jurisdictional public services such as fire protection, creation and maintenance of local roads, waste collection, compulsory education, and public assistance. Moreover, each prefectural government also functions as an intermediary or coordinator between the national government and the municipal authorities in the prefecture, and between the authorities of different municipalities in the prefecture. For example, prefectures

sometimes inform municipalities of national policy requests, and they also occasionally collect information regarding municipalities' policy needs or states and provide this information to the national government. These roles of prefectural governments are important, especially in cases of emergencies (including natural disasters) because, in such cases, the national government needs to have up-to-date information on the affected areas in order to conduct rapid and informed policy decision-making; such information is collected by prefectural governments.

Formerly, the national–local government relationship was regarded as centralized (Doi and Ihori, 2009). The national government could order a local government (or a governor) to perform tasks on behalf of the national government. However, in 1999 the Omnibus Decentralization Act was enacted; this placed local governments on an equal level to the national government. Consequently, local governments are now considered to have greater power than before the act was enacted.

2.2 Disaster laws in Japan and the Disaster Relief Act

In Japan, besides the Basic Act on Disaster Management, which is regarded as a basic law encompassing policies for all stages of a disaster, there are several additional laws relating to disaster prevention, disaster relief, and disaster recovery. The Disaster Relief Act (DRA; (*Saigai Kyujo ho*, in Japanese) is designed to support victims and stabilize society in the early aftermath of a disaster. Specifically, prefectural governors ask the prime minister to apply the DRA to designated municipalities; the designations are based on applicability criteria[2] developed for the

[2] The criteria for designating municipalities as areas to which the DRA applies are based on the number of houses damaged beyond repair and the municipality's population size. Specifically, for municipalities with populations of < 5,000, 5,000–14,999, 15,000–29,999, 30,000–49,999,

DRA that relate to the number of damaged houses within each municipality affected by the disaster. When the DRA is applied, disaster-relief activities (i.e., establishment of shelters, rescuing of victims, provision of food and water) are conducted by the prefectural government, and municipalities affected by the disaster are not required to pay any cost for these efforts.

2.3 Natural disasters in Japan in 1985–2015

Japan consists of four main islands and approximately 7,000 smaller islands, with the latter group being dispersed both to the north and south of the main islands. There are many volcanoes distributed across the islands, and Japan also regularly experiences serious natural events such as typhoons, heavy snow, and earthquakes. Fig. 1 shows the monetary value of the damage caused by natural disasters in Japan for each year during the period 1985–2015, while Fig. 2 shows the number of victims of natural disasters in Japan for each year during the same period. As shown in the figures, these numbers vary greatly from year to year. The monetary value of the damage ranges from 206,729 million JPY(≈2 billion USD, in 2010) to 10,729,211 million JPY(≈107 billion USD, in 1995), with an average of 1,227,305 million JPY(≈12 billion USD). Meanwhile, the number of victims ranges from 5,423 (in 1992) to 1,260,543 (in 1995), with an average of 86,994. There were three major catastrophic disasters during this period: the Great Hanshin-Awaji Earthquake, which occurred on January 17, 1995; the Chuetsu Earthquake, which occurred on October 23, 2004; and the Great East Japan Earthquake, which occurred on March 11, 2011. The notable scale of these

50,000–99,999, 100,000–299,999, and ≥ 300,000, respectively, the minimum numbers of houses that must be lost for the municipality to qualify for the DRA are 30, 40, 50, 60, 80, 100, and 150.

events is clearly visible in the charts presented in Figs 1 and 2, which show spikes for the years in which these disasters occurred.

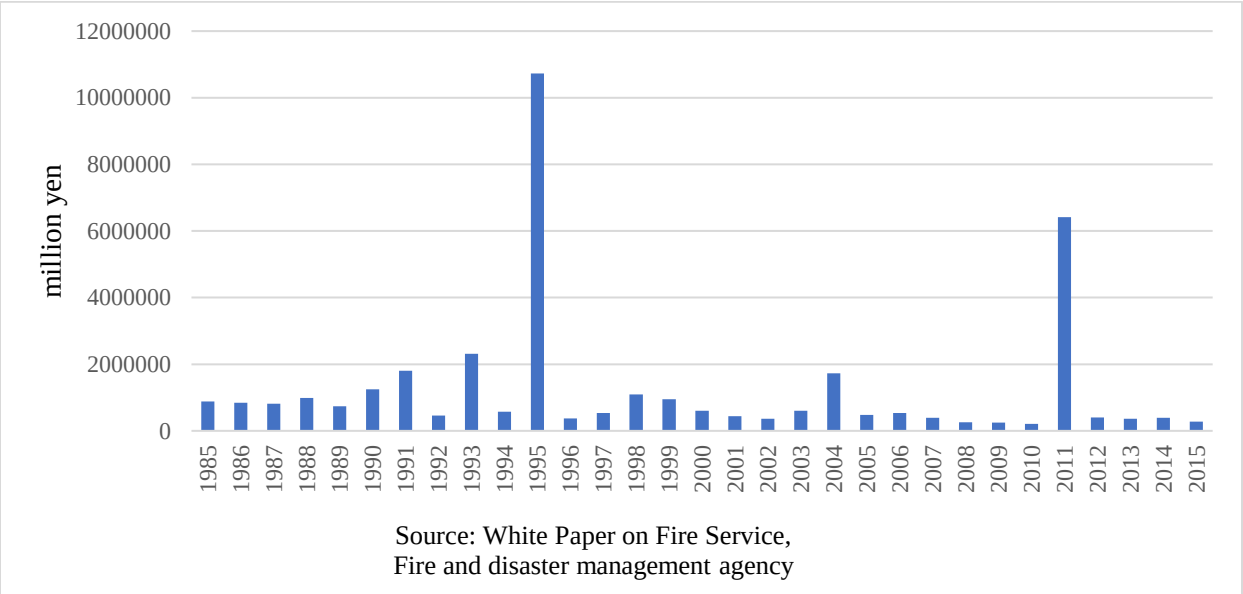

Fig. 1. Monetary value of damage caused by natural disasters in Japan for the period 1985–2015.

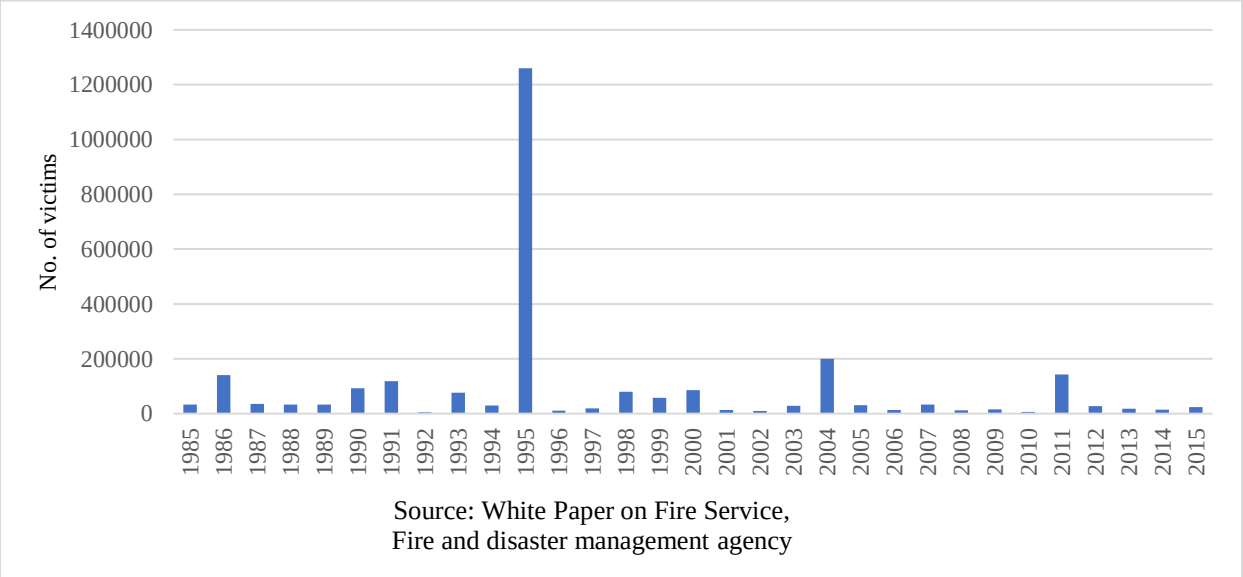

Fig. 2. Number of victims of natural disasters in Japan for the period 1985–2015.

Table 1 shows data regarding the application of the DRA for the period 2010–2015. This table shows that many types of natural disasters, including heavy rain, heavy snow, and earthquakes, occur almost annually in Japan. The table also shows that the lowest number of municipalities that received DRA status in a year was 18; in particular, in 2011, over 200 municipalities were designated as affected areas; this was largely due to the occurrence of the Great East Japan Earthquake.

	types of disasters	No. of disasters	No. of designated municipalities
FY2010	heavy rain, heavy snow, volcanic eruption, strong earthquake(East Japan Great Earthquake)	7	259
FY2011	heavy rain, typhoon, heavy snow	7	68
FY2012	strong wind, heavy rain, typhoon, heavy snow	8	43
FY2013	land slide, heavy rain, strong wind, typhoon, heavy snow	10	63
FY2014	heavy rain, typhoon, volcanic eruption, earthquake, heavy snow	8	18
FY2015	volcanic eruption, typhoon	3	28

Source: Cabinet office, Government of Japan

Table 1. Details regarding the application of the Disaster Relief Act for each year during 2010-2015.

2.4 Prefectural Governors in Japan

Both governors and representatives of local legislatures are directly elected by their constituencies, while prefectural governors are elected from a single electoral district comprising the entire prefecture. As their duration in office is four years, elections for prefectural governors are usually held every four years, as mentioned earlier; however, this schedule is altered if an incumbent

resigns or dies. No term limits are imposed on incumbent governors, meaning prefectural governors are always eligible to run for reelection. For our sample period, most governors were reelected (over 95%) and their total duration in office ranged from 0 to 21 years, with an average of 7.6 years (as of December 31, 2015). Thus, a "local incumbency advantage" (Trounstine, 2011) seems to apply in the case of prefectural governor elections in Japan.

Most candidates for prefectural governors run as independents; nonetheless, it is common for these individuals to receive support from political parties during their candidacy. Further, incumbent governors who decide to retire occasionally publicly nominate a successor; this is generally an indicator that the nominated candidate has promised to follow the incumbent's policies. Considering this, in this paper, along with focusing on the vote shares of incumbents in gubernatorial elections, we also examine the vote shares of successor candidates; this is because successor candidates are generally evaluated based on the performance of the former governors.

Prefectural governors have a wide range of powers: they can propose the prefecture's budget, dissolve the legislature, veto policy, and resolve personnel issues. In cases of disaster, they can decide whether and where the DRA should be applied, request the dispatch of the Self-Defense Forces for disaster relief, etc. As the powers of prefectural governors are now stronger than ever before, as discussed above, it is natural to think states of disaster affect constituencies' support for prefectural governors. Thus, our data on the vote share of incumbents or successor candidates in gubernatorial elections that occur immediately subsequent to natural disasters should provide a means of closely examining the nexus between natural disasters and the results of local elections.

3. Econometric Specification

We estimated the relationship between the occurrence of natural disasters and the outcomes of subsequent elections using ordinary least square regression analysis of gubernatorial election data for the period 1985–2015. The estimation equation is expressed as follows:

$$VOTESHARE_i = \delta[1/NUM\_DAYS_i] + X_i\beta + c_j + \varepsilon_i,$$

where i refers to the unit of the sample (which is the first election subsequent to the disaster), and j indexes the prefecture. $VOTESHARE_i$ denotes the vote share of the incumbent or successor candidate, while NUM_DAYS_i represents the number of days between the date of the large-scale disaster and the date of the first subsequent election; δ represents its coefficient. Here, a large-scale disaster is defined as a natural disaster that is sufficiently severe to warrant application of the DRA. The duration variable is a reciprocal because it is expected that the electoral effects of the time between the date of the disaster and the date of the election may decay as the number of days since the disaster increases. Moreover, the time variable reflects a general tendency that the time since a disaster has an influence in the short-term, but not in the long-term. The larger the number of days between the election date and the date of the disaster, the smaller the duration variable, and vice versa. Thus, if δ is negative, longer time increases the incumbent's vote share; meanwhile, if it is positive, shorter time increases the incumbent's vote share.

Note that the unit of the sample is an election; specifically, the first election after a disaster. Consequently, in each case the sample is restricted to the first election after the date of the disaster. In the regressions, limitations to the analyzed sample were introduced by adjusting the variable regarding the number of days between the date of the disaster and the election date. For example, when the time was limited to 700 days, only the elections that occurred within 700 days from the date of the corresponding disaster were sampled. Therefore, the lower the upper limit of the time variable, the smaller the sample size.

X_i represents the vector of the control variables. Control variables comprised the proportion of affected municipalities, the log of the damage in monetary terms, caused by the disaster that happened in the fiscal year the gubernatorial election was held (hereafter, "disaster damage"), the log of the number of victims by the disaster, the log of the prefecture's population, the job-offers–seekers ratio, the fiscal capability index, the number of candidates in the gubernatorial election, and an incumbent dummy. The ratio of affected municipalities was employed to control for the damage caused by the disaster, and the logs of disaster damage and of the number of victims were used to control for physical and human damages, respectively, caused by the disaster that happened in the fiscal year the gubernatorial election was held. The log of the population captured demographic characteristics. Economic condition was controlled by the job-offers–seekers ratio, which was a proxy of the unemployment ratio. Additionally, the job-offers-seekers ratio was expected to reflect the incumbent's performance in regard to economic policies from a retrospective voting standpoint. Prefectural fiscal health was captured by the fiscal capability index. The two electoral variables, the number of candidates in the gubernatorial election and a dummy for the incumbent candidate, explained political factors that could affect election outcomes. The fixed effects for the prefecture are denoted by c_j. ε_i is a conventional error. See Table A.1 in the appendix for definitions of variables, and clarifications of units used and sources of data.

In addition, we estimate another specification where the cross term of the reciprocal of the number of days and a variable on political alignment of an incumbent or successor candidate with the national ruling parties, to see the connection between local and national politics. An empirical equation is specified as

$$VOTESHARE_i = \delta[1/NUM\_DAYS_i] + \eta[1/NUM\_DAYS_i] \times ALIGNMENT_i + X_i\beta + c_j + \varepsilon_i,$$

where $ALIGNMENT_i$ is a dummy that takes a value one for a candidate that belongs to or is supported by the national ruling parties. If voters punish less severely an incumbent or successor candidate who is aligned with the ruling parties, η will be positive.

4. Data

We analyzed data for gubernatorial elections in Japan for the period 1985–2015 to examine the link between natural disasters and vote shares in subsequent local elections. Table 2 provides descriptive statistics for the maximum sample used in the regressions, which comprised elections that were held within 1,300 days from the date of a disaster. As shown in the first row, the average vote share of the incumbent or successor candidate was high, at approximately 70%. The average number of days between the date of the disaster and the date of the first subsequent election was 654, and the average share of affected municipalities was approximately 7%, meaning that the average time between a disaster and an election was long, but the share of affected municipalities was low. Regarding the fiscal capability index, only Tokyo had an average index value larger than one; as shown in the table, most prefectures had relatively low fiscal capacity; specifically, the average was less than 50%. The average number of candidates was approximately three, but the maximum was very large, at 16. In addition, incumbent candidates accounted for 87% of cases, whereas the share of successor candidate cases was 13%.

Variables	Mean	Standard Deviation	Maximum	Minimum	Number of Obs.
A. Dependent variables					
Vote share of incumbent or successor candidate	70.00	14.15	91.70	26.60	135

B. Disaster-related variables					
No. of days since the most recent disaster	654	385	1,297	18	135
Proportion of affected municipalities	6.82	13.31	103.03	0.46	135
Disaster damage	27,005	86,004	927,738	3	135
No. of victims	1,205	3,896	35,583	0	135
C. Control variables					
Population	3,068,001	2,781,407	13,200,000	694,352	135
Job offers-seekers ratio	100.45	8.96	115.00	85.00	135
Fiscal capability index	0.48	0.23	1.64	0.20	135
No. of candidates	3.09	2.13	16.00	2.00	135
Incumbent dummy	0.87	0.34	1.00	0.00	135
Subsidies for disaster recovery investment	8,080,336	12,700,000	109,000,000	262,131	120
Per capita taxable income	3,421	606	4,833	2,156	135
Per capita GDP	4.10	1.71	8.01	2.06	135
Ratio of elderly people	17.85	5.65	32.07	7.80	135
Alignment dummy	0.80	0.40	1.00	0.00	135
Approval rate for the central government	36.02	22.54	84.50	0.00	135

Note: The sample is gubernatorial elections that took place less than 1300 days after the disasters.

Table 2. Descriptive statistics for the largest sample from the data (≤1,300days after a natural disaster)

To overview the relationship between vote share and time between a disaster and an election, these two variables were plotted by prefecture. As the vote shares of incumbent and successor candidates varied among prefectures, a graph was created for each prefecture. As shown in Fig. 3, in which only the prefectures with at least three observations are listed, there was no clear trend among prefectures between vote share and disaster–election time period. However, grouping the numbers of prefectures in terms of positive and negative trends, respectively, showed that a larger number of positive trends was present; specifically, 14 positive trends to nine negative trends. This

indicates the possibility of a positive relationship between vote share and the time between a disaster and an election.

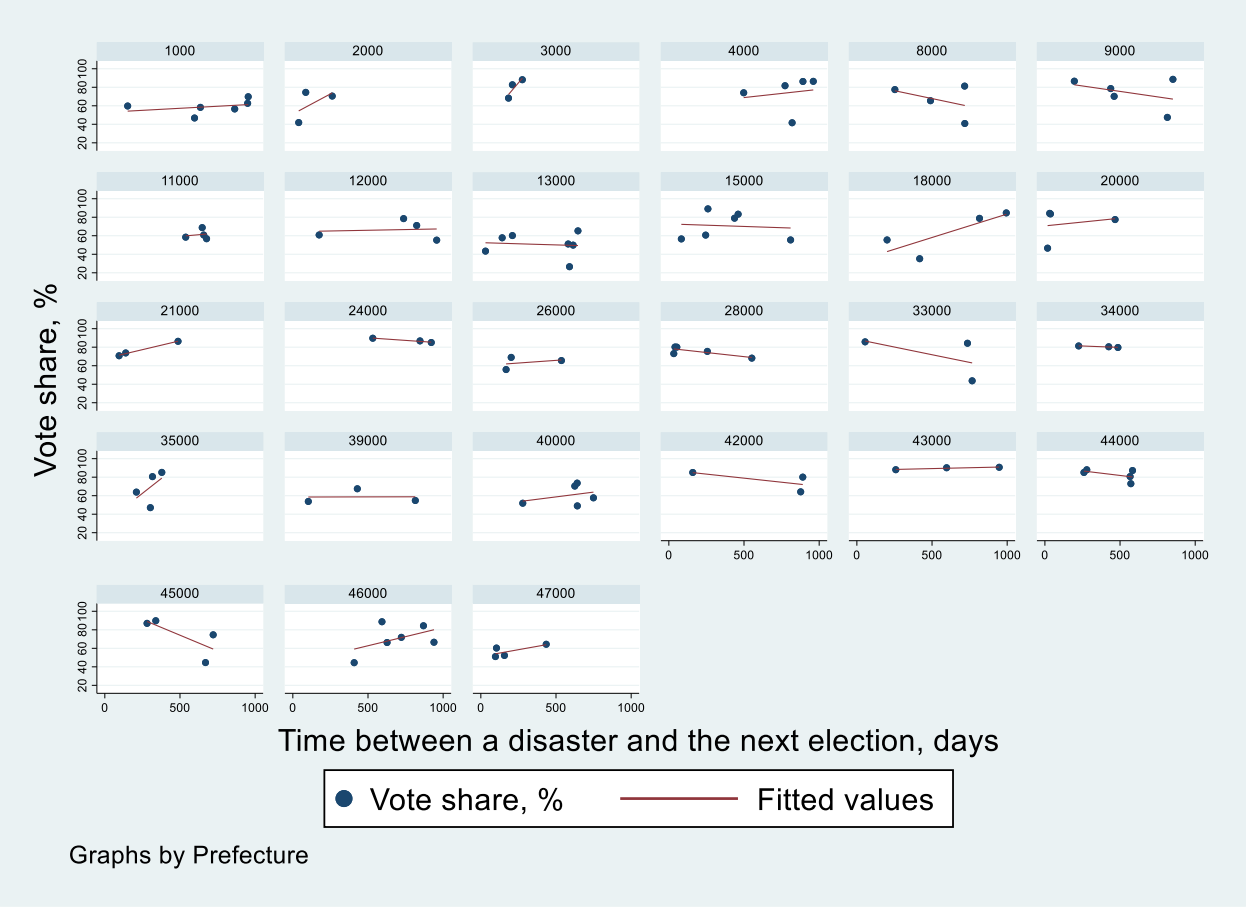

Fig. 3. Relationship between vote share and the time between a disaster and the next election.

Notes: The sample is restricted to cases for which the time since the disaster was less than 1,000 days. As the vote shares of incumbent or successor candidates varied among prefectures, graphs were created for each prefecture; only prefectures with at least three observations are presented in the figure.

5. Estimation Results

To check whether our results were robust, we ran several types of regressions with varying combinations of control variables. It is natural to assume that the effects of a disaster on the vote

shares of candidates for prefectural governor gradually decline as time elapses. Consequently, we limited samples to within 700, 800, 900, 1,000, 1,100, 1,200, and 1,300 days, respectively, from the occurrence of a disaster.

Table 3 presents the baseline estimation results, including the logged population as a control. Our key variable was the reciprocal of the time since the latest disaster. In all cases, the reciprocal of time since the disaster was negatively associated with the vote share of the incumbent or successor candidate. This means that, in elections held soon after a disaster, the effects of the disaster cause a large decrease in the vote share of the incumbent/successor candidate, but that this effect declines as time passes. This is evidence that an occurrence of a disaster affects a constituency's support for an incumbent politician, as has been highlighted in several previous works (Bodet et al., 2016; Gasper and Reeves, 2011). Regarding other variables relating to severity of damage, the proportion of affected municipalities was not statistically significant but, in some cases, disaster damage was negatively and marginally significant. On the other hand, the number of victims was positively significant in some cases. Although this result seems odd, it may be due to multicollinearity with disaster damage.

Sample	Duration since the latest disaster						
	<700	<800	<900	<1000	<1100	<1200	<1300
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reciprocal of time since the most recent disaster	-662.52**	-736.79***	-700.52***	-697.26***	-646.56***	-606.85***	-533.53***
	(252.17)	(231.50)	(222.80)	(216.64)	(212.64)	(178.86)	(181.62)
Proportion of affected municipalities	0.023	0.035	0.047	0.068	0.065	0.069	0.073
	(0.136)	(0.146)	(0.121)	(0.069)	(0.077)	(0.082)	(0.086)
Disaster damage (in log)	-4.731*	-3.871	-3.469	-3.426*	-2.801	-2.551	-2.058
	(2.697)	(2.598)	(2.273)	(1.885)	(1.720)	(1.627)	(1.542)
No. of victims (in log)	2.098**	2.740*	2.803**	2.733**	2.511**	2.312***	1.794**
	(0.895)	(1.376)	(1.112)	(1.089)	(0.979)	(0.833)	(0.717)
Population (in log)	-2.793	45.727	51.640	58.968	66.216	60.705	33.964
	(85.206)	(97.704)	(82.108)	(72.505)	(56.979)	(45.427)	(35.862)
Job-offers-seekers ratio	0.033	0.210	0.106	0.106	0.065	0.130	0.167
	(0.366)	(0.356)	(0.293)	(0.277)	(0.235)	(0.217)	(0.202)
Fiscal capability index	42.051	39.921	46.100	49.420	44.285	43.154	40.560*
	(46.419)	(44.209)	(41.367)	(33.811)	(29.061)	(25.983)	(23.886)
No. of candidates	-4.060	-4.983	-5.768	-5.914*	-4.865**	-4.553**	-4.798**
	(4.331)	(3.951)	(3.653)	(3.361)	(2.130)	(1.867)	(1.934)
Incumbent dummy	5.753	9.715	11.132	11.683*	9.700*	8.512**	8.986**
	(7.147)	(6.526)	(7.716)	(5.795)	(5.147)	(4.063)	(4.452)
Observations	71	80	93	102	114	123	135
Adjusted R^2	0.771	0.728	0.651	0.661	0.631	0.636	0.613

Notes: The dependent variable is the vote share of an incumbent or successor candidate. Standard errors are in parentheses.***,**,* indicate statistically significance at 1,5, and 10 percent, respectively.

Table 3. Estimation results, baseline.

Control variables, including job-offers–seekers ratio and fiscal capability index, were generally statistically insignificant; the only exception was fiscal capability index in the context of elections that occurred 1,200–1,300 days from the date of a disaster. This suggests that contemporary regional economic and financial situations are not related to the vote share of an incumbent or successor. The two remaining variables, relating to the number of candidates in the election and incumbents' general advantage over other candidates, were statistically significant in some cases. The number of candidates is generally negatively associated with vote share, which means that the higher the number of candidates running in an election, the lower the vote share of the incumbent/successor candidate. Meanwhile, incumbent dummy was positively associated with vote share, which means incumbent governors have an advantage in elections over other candidates; this is evidence of an incumbency advantage.

As shown in Table 4, the cross term of reciprocal of the number of days and an alignment dummy is positively associated with the vote share. Voters punish less severely an incumbent or successor who belongs to or is supported by the national ruling parties. Voters may expect a governor having a close relation to the national government to benefit them by exploiting the connection with the national government. Even if an incumbent or successor is aligned with the national ruling parties, disasters negatively affect the vote share.

Table 5 shows estimation results for analyses in which subsidies for investment in disaster recovery efforts (which was also a logged variable) was employed as a control variable; this variable can be regarded as a proxy for political efforts to help the region recover from the disaster. For all cases, the coefficients for subsidies for investment in disaster recovery efforts were insignificant, while the results for the other variables were generally unchanged when compared with the baseline results. These results indicate that politicians' interventions in the aftermath of

disasters do not influence voters' decisions in elections; hence, the theory of retrospective voting in cases of natural disasters, as argued in Gasper and Reeves (2011), does not hold for the present cases. In other words, disasters influence voters' decisions at the time of the subsequent election, but recovery and reconstruction efforts are non-factors in voters' decision-making processes.

Sample	Duration since the latest disaster						
	<700	<800	<900	<1000	<1100	<1200	<1300
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reciprocal of time since the most recent disaster	-921.74***	-1014.55***	-1001.25***	-983.09***	-943.47***	-854.28***	-815.49***
	(216.04)	(211.49)	(175.03)	(149.52)	(132.48)	(117.28)	(93.990)
Reciprocal of time x alignment dummy	559.69*	596.47**	644.78**	602.67**	612.25***	553.98**	597.332***
	(280.54)	(245.01)	(241.75)	(255.37)	(208.77)	(211.13)	(202.30)
Proportion of affected municipalities	-0.016	-0.030	-0.018	0.011	0.004	0.017	0.026
	(0.108)	(0.099)	(0.077)	(0.061)	(0.068)	(0.076)	(0.082)
Disaster damage (in log)	-4.508	-3.868	-3.702	-3.566*	-3.022*	-2.638*	-2.065
	(2.687)	(2.694)	(2.287)	(1.796)	(1.636)	(1.564)	(1.498)
No. of victims (in log)	2.283*	2.761*	2.828**	2.747**	2.399**	2.086**	1.593**
	(1.175)	(1.482)	(1.144)	(1.093)	(0.978)	(0.849)	(0.706)
Population (in log)	16.604	58.083	58.878	71.523	67.340	62.541	34.868
	(79.585)	(89.898)	(78.583)	(68.423)	(54.948)	(41.277)	(31.790)
Job offers-seekers ratio	11.310	7.265	8.477	7.467	7.679	7.271	5.505
	(13.494)	(11.619)	(9.659)	(7.857)	(6.347)	(5.683)	(5.303)
Fiscal capability index	40.406	40.167	40.363	43.320	34.467	35.857	35.064
	(41.878)	(40.980)	(36.245)	(32.208)	(26.360)	(24.690)	(20.994)
No. of candidates	-4.939	-5.689	-6.011*	-6.040*	-4.792**	-4.635**	-4.905**
	(3.654)	(3.537)	(3.391)	(3.122)	(1.943)	(1.745)	(1.865)
Incumbent dummy	5.490	9.622	11.121	12.033*	9.794*	8.200*	8.710*
	(7.192)	(6.978)	(8.257)	(6.018)	(5.090)	(4.188)	(4.635)
Ratio of elderly people	0.148	0.439	0.274	0.245	0.196	0.290	0.343
	(0.700)	(0.647)	(0.586)	(0.557)	(0.446)	(0.408)	(0.382)
Observations	71	80	93	102	114	123	135
Adjusted R^2	0.812	0.758	0.689	0.691	0.666	0.667	0.639

Notes: Dependent variable is the vote share of an incumbent or successor candidate. Standard errors are in parentheses.***,**,* indicate statistically significant at 1,5,10 precent, respectively.

Table 4. Estimation Results (Including a Cross Term)

Sample	Duration since the latest disaster						
	<700	<800	<900	<1000	<1100	<1200	<1300
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reciprocal of time since the most recent disaster	-727.10*	-883.90***	-784.16**	-788.15**	-673.84**	-653.91**	-578.26**
	(380.75)	(323.82)	(341.82)	(304.65)	(291.73)	(281.13)	(264.48)
Proportion of affected municipalities	-0.029	-0.023	-0.002	0.027	0.025	0.030	0.035
	(0.113)	(0.100)	(0.086)	(0.087)	(0.081)	(0.079)	(0.087)
Disaster damage (in log)	-4.266	-4.196	-4.226*	-4.358**	-3.365*	-3.081*	-2.578*
	(3.786)	(2.800)	(2.416)	(1.847)	(1.717)	(1.614)	(1.487)
No. of victims (in log)	2.104	3.507	3.586**	3.625**	2.965**	2.708**	2.220**
	(2.150)	(2.226)	(1.564)	(1.438)	(1.195)	(1.065)	(0.925)
Population (in log)	-67.226	34.419	77.642	90.652	87.630	81.208	83.305
	(147.42)	(116.26)	(100.82)	(81.769)	(68.582)	(59.247)	(51.970)
Job offers-seekers ratio	15.533	10.133	4.512	3.785	4.802	4.823	4.204
	(19.891)	(15.826)	(11.957)	(8.461)	(7.019)	(6.507)	(5.626)
Fiscal capability index	2.946	18.598	37.163	42.459	33.412	31.900	41.057
	(72.292)	(50.523)	(43.608)	(35.531)	(30.810)	(27.806)	(25.591)
No. of candidates	-2.895	-4.221	-5.251	-5.450	-4.265*	-4.163**	-4.788**
	(5.642)	(4.669)	(3.832)	(3.448)	(2.161)	(1.913)	(1.934)
Incumbent dummy	8.298	9.360	10.196	10.390	8.523	7.799	8.205
	(10.056)	(8.408)	(9.576)	(6.652)	(5.653)	(4.972)	(5.298)
Ratio of elderly people	0.069	0.426	0.409	0.330	0.290	0.364	0.569
	(1.002)	(0.672)	(0.672)	(0.642)	(0.518)	(0.453)	(0.488)
Subsidies for disaster recovery investment (in log)	-3.902	-3.446	-0.131	0.302	0.230	0.578	0.226
	(7.266)	(3.808)	(4.171)	(3.120)	(2.139)	(1.936)	(1.954)
Observations	65	73	85	93	105	111	120
Adjusted R^2	0.822	0.781	0.681	0.682	0.644	0.655	0.633

Notes: Dependent variable is the vote share of an incumbent or successor candidate. Standard errors are in parentheses.***,**,* indicate statistically significant at 1,5,10 precent, respectively.

Table 5. Estimation Results (Including Subsidies for Disaster Recovery)

Sample	Duration since the latest disaster						
	<700	<800	<900	<1000	<1100	<1200	<1300
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Use per capita taxable income instead of log of population							
Reciprocal of time since the most recent disaster	-676*86**	-724.99***	-694.41**	-682.85***	-632.98**	-564.42***	-492.21**
	(288.86)	(255.21)	(257.61)	(241.08)	(236.68)	(176.78)	(184.74)
B. Use per capita GDP instead of log of population							
Reciprocal of time since the most recent disaster	-677.89**	-715.09***	-685.54***	-687.02***	-636.61***	-562.71***	-477.47**
	(280.22)	(257.87)	(245.64)	(236.19)	(233.34)	(186.44)	(193.20)
C. Use lagged job offers-seekers ratio and fiscal capability index							
Reciprocal of time since the most recent disaster	-665.40**	-719.73***	-689.80***	-682.42***	-629.26***	-570.96***	-502.60***
	(285.68)	(256.00)	(241.48)	(236.51)	(225.32)	(171.59)	(177.38)
D. Include only disaster damage and no. of victims as controls							
Reciprocal of time since the most recent disaster	-694.89***	-678.46***	-635.82***	-644.57***	-640.57***	-593.50***	-517.18***
	(246.42)	(222.90)	(190.13)	(194.21)	(224.88)	(176.70)	(187.64)
E. Include the approval rate of the central government							
Reciprocal of time since the most recent disaster	-691.29*	-666.79**	-626.35**	-649.21***	-568.42**	-501.20**	-432.45**
	(312.95)	(272.79)	(241.84)	(240.11)	(246.59)	(199.47)	(184.84)
F. Sample only the elections that were held without a change in the election schedule							
Reciprocal of time since the most recent disaster	-620.639*	-676.233**	-638.970**	-646.803***	-601.037**	-564.513***	-496.141***
	(311.285)	(258.985)	(244.801)	(235.141)	(233.791)	(162.858)	(165.871)

Notes: Dependent variable is the vote share of an incumbent or successor candidate. Standard errors are in parentheses.***,**,* indicate statistically significant at 1,5,10 precent, respectively.

Table 6. Estimation Results, Robustness Checks

Table 6 shows estimation results for robustness checks. Row A in the table presents the results from the regressions that included logged per capita taxable income instead of logged population as a control. The overall results were similar to those shown in Table 3. However, per-capita taxable income was found not to be associated with vote share. Row B in the same table shows estimation results when the log of per capita gross domestic product (GDP) was used as a control instead of the log of population. However, the log of per capita GDP was not statistically significant, and the results for the other control variables also showed a similar pattern to that shown in Table 3.

Row C in Table 5 shows the estimation results when lagged job-offer–seekers ratio and lagged fiscal capability index were used as controls; this was performed in order to account for possible reverse causation from political popularity due to good economic or fiscal situations in the region. Although the overall results remained unchanged, the coefficients of the fiscal capability index became positive and statistically significant when a longer time period was used for the sample. This result may imply that fiscal health is important for the reelection of an incumbent. Row D in Table 5 shows the estimation results with only selected control variables. We have included this result because multicollinearity between explanatory variables may cause difficulties in regard to interpreting the results. In row E, the approval rate of the central government is included into the equation to capture the influence of approval rates of the national diet. Next, as shown in row F, we sample only the elections that were held without a change in the election schedule, since the schedule of gubernatorial elections may be changed by political influence. According to the results from these specifications, in all cases the coefficients for the reciprocal of time since the disaster were negative and significant at the 5% level, but the magnitude of this variable was larger than in the baseline case.

Another point we must consider is the degree to which the occurrence of a disaster decreases the candidates' vote shares. Fig. 4 shows the quantitative impact of time from the disaster on vote share using the estimates presented in column (2) of Table 3. As this figure shows, the negative impact on vote share declines as time since the disaster increases. For example, in the case of 30 days, 60 days, 180 days, and 360 days since the disaster, respectively, the disaster reduces the vote share by 24.6%, 12.3%, 4.1%, and 2.0%, respectively. These magnitudes are not necessarily negligible, because a small difference in vote share can decide close electoral races. This figure also shows that disasters not only have short-term impacts on local elections, but also long-term impacts that can persist for more than a year. For instance, even at 1,000 days from the disaster, there may be a 0.7%-decrease in the vote share of an incumbent or successor candidate. This is a new empirical finding that has not been reported in previous studies.

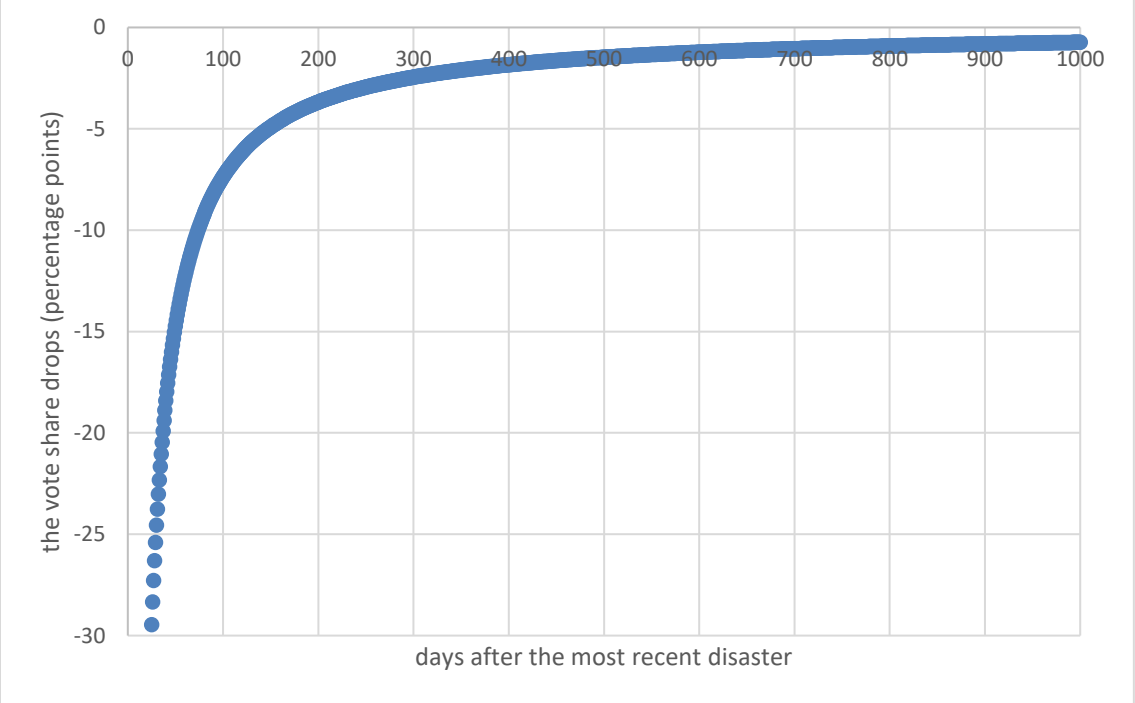

Fig. 4. Impact of the occurrence of a disaster on incumbents'/successor candidates' vote shares in the subsequent election.

6. Conclusion

We investigated the link between natural disasters and the results of subsequent local elections using data for Japanese gubernatorial elections for the period 1985–2015. In the case of Japan, a rich dataset for gubernatorial elections is available, including information on who wins, the vote shares of all candidates, when the election was held, etc. The occurrence of a disaster is completely exogenous to political variables, which meant we could easily make causal inferences from the disasters to local politics.

Our empirical analysis produced some interesting findings. First, the time since the most recent disaster is positively and significantly associated with the vote share of an incumbent or successor candidate. This means that when voters experience severe difficulties as a result of natural disasters, they tend to punish their incumbent governors or the incumbents' nominated successors. Second, the occurrence of a disaster can affect local elections not only in the short-term, but also in the long-term. This finding suggests that, in accordance with the claims of Bechtel and Hainmueller (2011) and Montjoy and Chervenak (2020), the political impacts of disasters persist and influence later elections, and that disasters may affect politicians' behaviors in the long term. Note, however, that the impact of a disaster declines over time and, thus, a disaster that occurred long in the past has a relatively small impact. Third, there is no evidence supporting the view that an incumbent's performance in response to a large-scale disaster influences whether voters punish or reward him/her or his/her successor candidate in the subsequent election. Our regressions did not show national government subsidies for investment in disaster recovery efforts

to be associated with vote share. These subsidies can be viewed as reflecting a governor's competency; thus, this result implies that, in elections that occur subsequent to disasters, voters do not base their evaluations of incumbents on the presence/absence of such subsidies; this contrasts with the existing theory espoused in the retrospective voting model. However, voters punish less severely an incumbent or successor candidate if they are political aligned with the national ruling parties. One possible reason is that those candidates who have a close relationship with the national government are expected to get more subsidies for disaster recovery and rehabilitation than those who have little connection.

To summarize, large-scale natural disasters have a negative effect on the vote share of incumbents or their successor candidates in the gubernatorial elections following the disaster, but the impact decreases over time. In addition, this influence on voting behavior is not attributable to the retrospective voting framework; instead, it seems to simply be the result of a negative impression fostered by the damage caused by the disaster. One potential policy implication of these findings is that politicians may place excessive emphasis on elections that follow disasters, and seek to improve their popularity in their constituencies not through the implementation of disaster relief and recovery policies, but through other approaches, such as economic policies and provision of patronage public goods. This behavioral change may not benefit constituencies; in fact, it may negatively impact their welfare.

There are some limitations regarding this study. First, this study focused on gubernatorial elections rather than mayoral elections. Studies of mayoral elections would enable us to employ a larger sample size; specifically, a dataset of approximately 1,700 municipalities (in comparison to just 47 prefectures). Expansion of the sample size through the use of municipal data would be beneficial, as it would contribute to improving the validity of the regressions performed in the

present study. Moreover, as mayors tend to have closer relationships with their constituencies than governors, a focus on mayoral elections would also help us further examine how voters evaluate an incumbent from a retrospective voting perspective. A second limitation is that this study only examined Japanese cases; specifically, gubernatorial elections in Japan. As gubernatorial election systems vary across countries, results from an analysis of Japanese cases may not be applicable to other countries. It is expected that more evidence of the disaster–election association will accumulate; however, such research is left for further studies.

Appendix A. Definitions of variables, and clarifications of units and sources

Variables	Definition	Unit	Source
A. Dependent variables			
Vote share of incumbent or successor candidate	Vote share of incumbents or their nominated successors in prefectural gubernatorial elections	percentage	1
B. Disaster-related variables			
Reciprocal of time since most recent disaster	Reciprocal of the number of days between the date of the disaster and the date of the first subsequent election	days	1, 2
Proportion of affected municipalities	Proportion of municipalities that were designated as eligible for the Disaster Relief Act	percentage	2
Disaster damage (in log)	Amount of physical damage caused by the disasters	million JPY	3
No. of victims (in log)	Number of disaster victims	unit	3
C. Control variables			
Population (in log)	-	unit	4
Job-offers-seekers ratio	Ratio of job offers to job seekers	unit	5
Fiscal capability index	The three-year average of basic fiscal revenues, including local taxed and commission income, divided by basic fiscal needs, which is composed of standard total expenditures	unit	6
No. of candidates	The number of candidates in the gubernatorial election	unit	1
Incumbent dummy	A dummy to account for the advantage incumbents generally shown in elections	0, 1	1

Subsidies for disaster recovery investment (in log)	National treasury disbursement (*Kokko Shishutsu Kin*) for disaster recovery investment	thousand JPY	6
Per capita taxable income (in log)	-	thousand JPY	7
Per capita GDP (Gross Domestic Product) (in log)	-	million JPY	8

Source: 1 = Prefectural Election Management Committee (1985 – 2015) *Monthly Elections*, https://www.todofuken-senkan.jp/magazines.html (accessed 16 February 2021);
2 = Disaster Relief Act;
3 = Cabinet Office Japan (1985 - 2015) White Paper Disasater Management in Japan, http://www.bousai.go.jp/kyoiku/panf/report_brochure_etc.html (accessed 16 February 2021);
4 = MIC (Ministry of Internal Affairs and Communications) (1985-2015) Basic Resident Register Population, https://www.e-stat.go.jp/ (accessed 16 February 2021);
5 = Ministry of Health, Labor and Welfare (1985-2015) General Job Placemen,t https://www.e-stat.go.jp/ (accessed 16 February 2021);
6 = MIC (1985-2015) Survey on Municipal Financial Settlement, https://www.soumu.go.jp/iken/kessan_jokyo_2.html (accessed 16 February 2021);
7 = MIC (2010) Survey on Municipal Taxation, https://www.soumu.go.jp/main_sosiki/jichi_zeisei/czaisei/czaisei_seido/ichiran09.html (accessed 16 February 2021);
8 = Cabinet Office Japan (1985-2015) Gross Regional Product, https://www.esri.cao.go.jp/index-e.html (accessed 16 February 2021);

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