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A Spatial Analysis of Local Administrative Crisis Management: Evidence from Japan

地方自治体の業務継続計画に関する空間分析：日本の事例

.

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ABSTRACT

This study empirically investigates the determinants of the development of municipal business continuity planning (BCP) in Japan. The remarkable feature of our empirical analysis is the in-depth examination of the existence of policy diffusion in crisis management and the spatial characteristics of trends in developing municipal BCP, covering Japanese municipalities. The results of a spatial probit model show the existence of prefecture-level heterogeneity in municipal BCP development, and spatial dependence in the BCP development status among municipalities which is not completely explained by the heterogeneity. The later particularly might imply the existence of the policy diffusion due to the reliance on the precedent in other governments and the necessity of cross-jurisdictional policymaking with the view of efficient and seamless actions against emergencies.

概要

この研究では，日本の地方自治体による業務継続計画（business continuity planning; BCP）の策定傾向を実証的に検証する．本研究の特徴は，日本国内の殆どの市区町村を対象として，危機管理制度における政策波及や，BCP 策定有無の空間的特性を詳細に検証することである．空間プロビットモデルによる実証分析の結果，BCP 策定傾向には都道府県レベルでの異質性があること，それら異質性で説明されない，市区町村間での空間従属性があることが示された．特に後者の結果は，他自治体による前例の踏襲や，自治体間連携に基づく BCP 策定等，空間的な政策波及の存在を示唆しうる．

1. Introduction

In light of a recent spate of terrorist attacks and natural disasters worldwide, the response mechanisms of public administrative bodies to catastrophic events that can significantly affect the regional socio-economic environment, has attracted considerable attention from researchers. As a key stakeholder in protecting the population from the effects of extreme events, there is constant focus on the performance of public administrations in terms of the (in)efficiency of their actions in the response and recovery phases. In fact, past crises, including the 9/11 attacks and Hurricane Katrina in the United States, have shed light on the problems with existing practices, calling for improvement in public crisis management. Following the 9/11 terrorist attack in 2001, particularly, there was increased interest in the research community regarding matters related to governance capacity and governance representativeness, revealing failures in crisis management (Terry & Stivers, 2002; Christensen et al., 2016). Hurricane Katrina in 2005, by contrast, promoted discussion on coping with natural hazards, which again called for a reconsideration of existing systems (Raadschelders & Lee, 2011). In particular, after 2005, there has been extensive debate regarding critical management, pre-disaster planning to minimize the damage from unexpected and large-scale accidents, and how to continue their tasks (Henstra, 2010).

However, in the literature on the role of public administration in critical management, the coverage of studies in terms of both methodology and substance should be expanded. First, the literature has largely relied on descriptive analyses by focusing on a few cases; thus, quantitative examination of pre-disaster planning and its operation by local governments is still scant. Second, while there are several studies on municipalities' response to disasters, there still is a gap in the evidence regarding the determinants of municipalities' policy adaptation and behavior. This gap appears even more serious in light of the fact that scholars have acknowledged the importance of municipalities' role in crisis management as well as of their mutual collaboration or learning *before* and after the occurrence of a crisis (Christensen et al., 2016).

This study quantitatively reveals the drivers and deterrents in developing municipal business continuity plans (BCP) based on data obtained from the Survey on Development of Municipal Business Continuity Planning, covering Japanese municipalities. Our empirical investigation has two additional advantages. First, our analysis targets Japan, one of the most disaster-prone countries in the world. As the whole territory of Japan is vulnerable to natural disasters owing to its climatic, geological, and topographical characteristics, the country is under constant threat of natural disaster. In particular, the Great East Japan Earthquake, which occurred on March 11th 2011, was a particularly complex disaster, with the effects of the earthquake compounded by a tsunami and a nuclear accident, causing enormous human and economic damage. Additionally, another huge earthquake, the Nankai Trough Earthquake, is expected to occur within the next 30 years. Therefore, this study examines the differences in the preparation of various municipalities for future earthquakes: whereas some municipalities developed their BCP immediately after the Great East Japan (3.11) earthquake, others did so only under the expectation of future shocks.

Second, we explicitly examine the spatial diffusion of BCP development among municipalities. Although the existence of policy diffusion, a phenomenon in which a government's policy choices are influenced by those of other governments, has been widely examined in the context of public administration and general political science (e.g., Shipan & Volden, 2012), to the best of our knowledge, there are few empirical investigations of policy diffusion in critical management. The examination of policy diffusion in the context of critical management can be of significance for two reasons. The first concerns the reliance on the precedent set by other governments, considered a factor influencing policy diffusion in the public administration literature. The second reason stems from a peculiar feature of critical management, namely, the necessity of cross-jurisdictional BCP to ensure efficient and seamless actions in an emergency. Therefore, this study empirically tests the existence and magnitude of the diffusion by relying on a spatial econometric technique.

The rest of this study is organized as follows. Section 2 reviews the literature regarding critical management in public administration and policy diffusion. Section 3 briefly describes recent and expected disaster shocks and the institutional background of municipal business continuity planning in Japan. Section 4 describes the dataset and the analytical framework. Section 5 reports the estimation results. Section 6 concludes.

2. Literature Review

2.1 Crisis Management in Public Administration

In the literature on public administration, the importance of local government's preparedness for recovery and continuity of administrative functions during emergencies such as natural disasters and terrorism, has been strongly recognized since the early 2000s, centering around the US. In 2002, the Public Administration Review organized a special issue with an article by George H. W. Bush, then President of the US, calling for a revisit of the various facets of democratic governance, government administration, and public management. Attention turned to the practical response and preparation in the field—hierarchical and vertical coordination, roles of the Federal Emergency Management Agency (FEMA), and local municipalities, etc.—in 2007, when the same journal organized a special issue comprehensively discussing public administration following huge disasters, motivated by the experience of Hurricane Katrina. In particular, Col (2007), one of the seminal articles included in this special issue, compared critical management systems and their consequences around Qinglong in China, which was damaged by the Tangshan earthquake in 1976, and New Orleans in the US, damaged by Hurricane Katrina. In the article, the author showed descriptively that there was no loss of life in Qinglong despite the region's proximity to the epicenter, because of detailed pre-disaster planning; however, the damage of Hurricane Katrina was magnified by imprecise and inadequate strategies.

Following the special issue, there have been several representative investigations in the public administration literature that descriptively discuss various types of local government strategies to deal with catastrophic disasters, from the practical perspective. For example, Somers and Svara (2009) discussed how to develop and operate pre-disaster planning within a universe of daily operational needs, while Henstra (2010) developed a framework to evaluate the quality of local governments' pre-disaster policies based on 30 evaluation items.

These studies, rooted mainly in practical motivations, have yielded many successful frameworks and provided guidance for grass-root applications. Nevertheless, we observe two issues that should be further explored in this field. First, quantitative examination of the actual operation of critical management by local governments has seldom been conducted. As one of the exceptions, Okura et al. (2019) assessed the association between the completion of residential evacuation planning and local socioeconomic characteristics in Japan. Our investigation complements this literature by focusing on and spatially analyzing pre-disaster planning and organizational operations inside local government.

Second, while scholars admit the importance of municipalities' roles, there is still a gap in the evidence on the determinants of municipalities' policy adaptation and behavior. Mehiriz and Gosselin (2016) investigated the level and determinants of Quebec municipalities' preparedness for weather hazards and response to related weather warnings. For preparedness, they found that municipalities' capacity, population support for weather-related policies, and the risk of weather-related disasters are important factors to explain the preparation level while discussing the direct and indirect effects of these factors. Mehiriz and Gosselin (2016) made a significant contribution in that they focused not only on the capacity to respond (financial, organizational[1], and human-resource-related) but also social determinants, such as population support for weather-related policies. We further add knowledge regarding the determinants of municipalities' preparedness, including mutual relations among municipalities. While scholars have long argued that municipalities' mutual collaboration or learning is important both *before* and after crisis occurrence (Christensen et al., 2016), the literature has not yet attempted to incorporate the social and political aspects of the relationship and the policy process of local governments, which we elaborate below.

2.2 Policy diffusion

[1] Wang and Kuo (2017) emphasized the importance of the strategic styles of public managers on organizational capacities in their crisis management.

In recent public administration literature, policy diffusion has received much attention (e.g., O'Toole & Meier, 2014) in relation to the social aspects of managing administrative organizations. As is the case in other fields of social science such as economics, policy diffusion in the context of public administration is defined as a type of social interaction such that a government's policy choices are influenced by those of other governments (Shipan & Volden, 2012). As mentioned in Brueckner (2003) and Shipan and Volden (2012), policy diffusion can emerge as, for example, the spillover of antipollution measures, tax competition between municipalities, and pressure on European Union countries facing debt crises to adopt austerity measures by other member governments.

The discussion on policy diffusion has progressed mainly from an academic perspective by examining its mechanism and effect on local government performance. In their classic quantitative study, Shipan and Volden (2008) revealed the mechanism of policy diffusion, exploiting the case of a municipal level antismoking policy in the United States. They decomposed the mechanism of diffusion into four channels—learning from earlier adopters, economic competition among proximate cities, imitation of larger cities, and coercion by state governments—and examined the effect of each channel on the duration until the development of policy. Their estimation results showed heterogeneity in the persistence and magnitude of each channel's effect on the duration depending on the size of municipalities.

The empirical model in the policy diffusion literature typically relies on the specification such that a government's policy choice as a dependent variable is regressed on independent variables including the neighboring governments' choice and a government's own characteristics. However, if one employs a simple estimation method such as the simple ordinary least squares (OLS) method to estimate the model based on this kind of specification, the estimated parameter corresponding to policy diffusion will be biased because it ignores the simultaneity of policy choice (Anselin, 1988). One of the representative countermeasures against this endogeneity problem can be the spatial econometric approach. While applied studies employing spatial econometrics have accumulated in the field of political science as well as general regional science, from the late 2000s, this technique has seldom been employed in public administration literature (Cook, An, & Favero, forthcoming)[2]. As mentioned in Section 4.2.2, we statistically examine the cross-jurisdictional policy diffusion in the development of municipal BCP using the spatial binomial probit model. In this sense, our empirical investigation can have a methodological contribution to the literature of public administration, as well as a disciplinary one.

Finally, as disasters also have geographical distributions in their occurrence, the influence of experience gained through other regions' disasters attracted Onuma et al.'s (2017) attention. While they use death tolls during both natural and technological disasters and their unit of analysis is country, a decrease in death in future disasters can be interpreted as learning from others' experiences. They found the adaptation effect only for natural disasters and its marginal impact was relatively higher for higher-income countries. Still, the estimated model in their study is a fixed-effects model, from which we expand the conventional model to the one including spatial correlations.

[2] One of the exceptions, Oyun (2017) tested the interstate diffusion of the expenditure on Home and Community Based Services with the spatial panel data model. The author showed positive interdependence in state HCBS expenditures that is contingent on similarities in citizen ideology between states.

3. Institutional Background

3.1 Recent and expected huge disasters in Japan

This section briefly summarizes the recent and expected huge disasters in Japan. One is the Great East Japan Earthquake, and the other is the expected Nankai Trough Earthquake. The tsunami damage or hazardous areas of these disasters are shown in Figure 1. The Great East Japan Earthquake, the so-called “3.11,” can be the recent representative complex disaster in Japan comparable to Hurricane Katrina. We summarize the characteristics of 3.11 based on information from Japan’s Cabinet Office (CAO, 2011). The earthquake occurred on March 11, 2011. The extensive damage over a wide area centered on the northeast coast of Japan due to both huge ground motion and a tsunami caused the loss of 22,626 lives and economic losses reaching 16.9 trillion yen. In addition, the meltdown accident at the Fukushima Daiichi Nuclear Power Plant from the huge tsunami led to the evacuation of 146,520 residents within 30km of the plant.

After the Great East Japan Earthquake, the potential risk of a substantial earthquake in the Nankai Trough area began to gather great attention. The Nankai Trough is a submarine trough located south of the Nankai region of Japan's island of Honshu and has created large earthquakes in 100- or 200-year intervals over the past 1400 years. As 70 years have passed since the last earthquake in that area (the Showa Nankai Earthquake in 1946), it has been assumed that the next huge earthquake will be within a shorter period. The rough estimation of the maximum seismic intensity shows that the damage of ground movement could spread through a wide area all over Japan. According to the Cabinet Office (CAO, 2016), the expected economic loss from a Nankai Trough earthquake can reach approximately 220 trillion yen. This estimated economic loss exceeds that of the Great East Japan Earthquake, which was approximately 16.9 trillion yen, since the earthquake hazardous area is in the Pacific belt zone, the biggest industrial zone in Japan, and includes many DIDs. In addition, the hazardous area of the expected Nankai Trough earthquake in the Shizuoka Prefecture has a nuclear power plant (the Hamaoka Nuclear Power Plant). In this respect, as is the case of the Great East Japan Earthquake, a Nankai Trough earthquake may result in a complex disaster that includes tsunami damage and a nuclear plant accident as well as ground movement.

3.2 Municipal business continuity planning

Triggered by recent big disasters including the 3.11, Kumamoto Earthquake in 2015 and several extreme typhoons, and the future risk of the Nankai Trough Earthquake, the importance of the recognition of the fragile nature of the national land against natural disasters, and policymakers to overcome this vulnerability has been strongly emphasized (Ranghieri & Ishiwatari, 2014) in Japan. In more recent policy trends, pre-disaster preparation to parry the damage, as well as post-disaster recovery, have been gathering remarkable attention (CAO, 2018). While the typical pre-disaster preparation can be business continuity planning in private sectors, district continuity planning (DCP) has also been proposed and activated as a planning framework integrating not only firms but also various organizations that take part in regional economic activities (Isouchi, 2017).

It is urgently necessary for a local government, a key actor of DCP, to develop its own municipal business continuity planning as a counterpart of private sectors' BCP. In light of the fact that 3.11 severely damaged many local government buildings, turning both leaders and public employees into disaster victims themselves, it is quite important to build their own business continuity plans to be able to continue performing their ordinary tasks (FDMA, 2015a). In this context, all the local governments have been required to develop their integrated BCP including six primary elements, the prescription of surrogate authorities and alternative facilities, the securement of stockpile and communications, data backup, and the prioritization of tasks (FDMA, 2015b). To promote the development of municipal BCP, the Japanese central government has provided various types of support, for example, a manual to develop BCP and a workshop for municipal government staff. However, despite this support, there were few municipalities that developed their BCP in the beginning, and some municipalities still have not developed a BCP even as of 2019.

4. Methodology

4.1 Data

We utilize the data from the Survey on Development of Municipal Business Continuity Planning conducted by the Fire and Disaster Management Agency in 2015 to investigate the development status of municipal BCP all over Japan. With this data, we can capture the status of whether a municipality has already developed its BCP and to what extent the developed plan is precise. The reason why we only use data from 2015 is that we attempt to mitigate the effect of unobservable (unable to capture quantitatively, in other words) coercion by higher governments such as a prefectural or national government. As mentioned above, positive intervention toward BCP development by the central government to lower governments began in earnest after 2015. In this sense, the inclusion of survey datasets after 2015 can be inadequate to examine municipalities' crisis management strategies taking account of their socio-economic conditions and regional disaster risk under the condition that we cannot precisely capture when a prefectural government strongly ordered the municipalities to develop their BCP.

In order to examine the drivers and deterrents of municipal BCP, we connect the survey data to several municipal-level statistics. As shown in Table 1, we construct variables used in the empirical analysis based on the System of Social and Demographic Statistics covering fundamental regional socioeconomic characteristics, and the National Land Numerical Information bundling various geographical information in Japan.

4.2 Empirical model

4.2.1 Probit model

In our empirical analysis, we regress a binary variable, *Q_1_1*, which is one if a municipality answered that its BCP had already been developed before 2015, on several socioeconomic attributes and regional risk environments defined in Table 1 with the binomial probit model. As below, we briefly explain the definition of each independent variable and its expected sign.

Firstly, we employ the following four independent variables to explain local governments' basic capability. To explain the soundness of the local fiscal condition, we employ the financial capability index, *FI*. The expected sign of *FI* is positive because each policy might be developed and operated more smoothly under sounder fiscal conditions. In addition to *FI*, we also explain the flexibility of fiscal management with the ordinary balance ratio, *CURRBALANCE*. The ordinary balance ratio becomes smaller if a municipality's fiscal management system is more elastic and consequently advantageous in making policies. Thus, the expected sign of the *CURRBALANCE* is negative. To control municipality size, we introduce the natural logarithm of the total population, ln*POP*[3]. Not limited to crisis management, larger municipalities might find it possible to establish diverse and dedicated departments corresponding to various administrative operations. Thus, the expected sign of ln*POP* is positive. To explain administrative cost, we employ the natural logarithm of inhabitable land per administrative staff, ln*AREAPERGOVEMP*. As the geographical range falling under the jurisdiction of a local government becomes larger, it might be more difficult to investigate potential regional risk environments and develop pre-disaster planning against each of them with limited manpower. Thus, the expected sign of ln*AREAPERGOVEMP* is negative.

Secondly, we also employ the following three independent variables to explain the regional risk environment that each municipality faces. To explain geographical closeness to the sea as a proxy of the magnitude of a tsunami and a high tide risk, we introduce the

[3] Another potential variable which can explain municipalities' capability might be, for example, a dummy variable that distinguishes cities and wards from towns and villages. However, we do not use this dummy variable because it highly correlates with ln*POP* (correlation coefficient is nearly 0.8), and ln*POP* correlates more with the dependent variable, *Q_1_1*.

number of fishing ports, *FISHPORT*[4]. The expected sign of *FISHPORT* is positive since the coastal area faces a higher risk of a tsunami and high tides. Likewise, we also introduce a flood hazard area, *FLOODAREA*, to capture the risk of floods. The expected sign of *FLOODAREA* is positive. We also use a dummy variable indicating municipalities damaged by the 2015 Cloudburst, *D_15_RAIN*. The 2015 Cloudburst is one of the more recent primary disasters in Japan, which caused widespread flood damage in the Greater Tokyo district. If damaged municipalities hurried with developing their BCP, letting the experience of the cloudburst be a lesson, the expected sign is positive. But the opposite results might occur if they could not keep up with their administrative operations. Finally, to control the regional heterogeneity of the development status which cannot be controlled by independent variables we employ, prefectural dummies are also introduced.

We exclude municipalities corresponding to the following special cases from our dataset. Firstly, we exclude all municipalities in Hokkaido (90.4% of all municipalities had already completed the BCP development before 2015), and those in Tottori (all municipalities had already completed the BCP) due to the ineligibility in examining municipalities' crisis management strategies taking account of their socio-economic conditions and regional disaster risk, as mentioned in Section 4.1, and the infeasibility of the estimation of prefectural dummies corresponding to these two prefectures. Secondly, due to the unavailability of data, six municipalities within 30km from Fukushima Daiichi Power Plant which were severely damaged by 3.11 are also excluded. Finally, we exclude 34 municipalities without valid responses[5].

[4] It must be more desirable to introduce tsunami hazardous areas as an independent variable as with *FLOODAREA*. However, unlike flood hazardous areas, geographical information about tsunami hazardous areas is available in only 24 prefectures, half of all prefectures in Japan. Thus, we are constrained to use *FISHPORT* as a proxy variable.

[5] For example, if a municipality answered that its BCP has not been developed in 2016, 2017, or 2018 whereas it answered that its BCP had already been developed in 2015, we regard this response as invalid.

4.2.2 Spatial probit model

Following the discussion in Section 2.2, the spatial diffusion of BCP development can be captured by examining the existence of the similarity of the BCP development status among neighboring municipalities. We capture this similarity (spatial dependence, in other words) with the probit model based on the random utility as follows:

$$u_i = \mathbf{x}_i\boldsymbol{\beta} + \rho\sum_{j=1}^{n} w_{ij}u_j + \varepsilon_i,$$

$$w_{ij} = \begin{cases} \dfrac{1}{d_{ij}^2} \; if \; d_{ij} < 50[\text{km}] \\ 0 \; otherwise \end{cases} \tag{1}$$

where u_i is municipality i's utility when it develops municipal BCP, $\mathbf{x}_i$ is a vector of regional characteristics, w_{ij} is a weight representing geographical proximity (spatial weight) between municipality i and j, ρ is a parameter indicating the magnitude of similarity among neighboring municipalities, ε_i is an error term which follows standard normal distribution. If $u_i > 0$, municipality i develops municipal BCP. It can be assumed that ρ is positive if the development status is similar among neighboring municipalities. We define w_{ij} as the inverse distance squared by analogy with the gravity model, and the spatial weight matrix is row-standardized when we estimate the model. For avoiding the imprecise estimation of parameters due to a dense spatial weight matrix, we set a 50km threshold. We employ generalized method of moments (GMM) proposed by Pinkse and Slade (1998) because the GMM is a more robust method than the maximum likelihood in the sense that it does not require the normality assumption in the process of parameter estimation.

5. Result

5.1 Drivers and deterrents of BCP development

We summarize the descriptive statistics of variables used in the probit model estimation in Table 2. To save space, we do not show the descriptive statistics about prefectural dummies. The average of the dependent variable *Q_1_1* is 0.283. This result shows that only less than 30% of all 1504 municipalities had already developed their BCP in 2015. The variance inflation factor (VIF) is less than three for each variable, so we have little concern about the problem of multicollinearity.

In Table 3, we show the regression result of the a-spatial probit model. We first summarize the results of municipal capability. The regression coefficient of the financial capability index *FI* is not statistically significant in any level of significance. On the other hand, the ordinary balance ratio of the *CURRBALANCE* is negatively significant at a 5% level, and this result can indicate the positive association between the likelihood of BCP development and the flexibility of the local fiscal management system. The natural logarithm of the population ln*POP* is positively significant at a 1% level, so there can be a strong relationship between the municipality size and the likelihood. The natural logarithm of inhabitable land per administrative staff ln*AREAPERGOVEMP* is negatively significant at 10%. Thus, it might be said that higher an administrative cost is associated with a lower BCP development status. To summarize, the hypotheses about independent variables related to the municipal capability that we presented in Section 4.2.1 are supported except for the financial capability index.

Secondly, we explain the results regarding regional disaster risk environments. The number of fishing ports *FISHPORT* is not statistically significant. This result shows that there cannot be a remarkable association between the proximity to the sea and the probability that municipal BCP had already been developed. On the other hand, the flood hazardous area

FLOODAREA is positively significant at a 5% level, and this result indicates a positive relationship between a larger flood hazardous area and a higher BCP development status. The dummy variable indicating municipalities damaged by the 2015 Cloudburst *D_15_RAIN* is not statistically significant. Thus, we cannot observe a remarkable association between the actual experience of a flood hazard and the likelihood of BCP development. Eventually, the hypotheses about regional risk environments in Section 4.2.1 are not supported except for flood hazards.

We plot the regression result of prefectural dummies in Figure 2, and also show the estimation result of statistically significant prefectural dummies in Table 4. In this estimation we use municipalities in Tokyo (69.4% of all municipalities had already completed the BCP development before 2015) as a reference group. Except for a few exceptions, estimated coefficients are negative, and this result can imply that there is a regional difference in the BCP development status between Tokyo and other prefectures. Although it is difficult to find out a consistent spatial trend, it can be prefectures facing the Sea of Japan and the East China Sea or inland prefectures that have a strongly negative coefficient. On the other hand, prefectural dummies are not significant in prefectures located in Western Japan and facing the Pacific Ocean like the Miyazaki, Kouchi, Tokushima, and Shizuoka prefectures, and these prefectures can be roughly included in the hazardous area of the Nankai Trough Earthquake. In addition, the estimated coefficient is statistically insignificant in Miyagi and Iwate damaged by 3.11. However, we can observe a negatively significant coefficient even in prefectures included in damaged or hazardous areas, which implies that there can be an interesting variation of BCP development status even within damaged or hazardous areas.

5.2 Spatial diffusion of municipal BCP development

5.2.1 Spatial trend of BCP development

In advance of the regression estimation of the spatial probit model, we visually show the spatial trend of BCP development status in 2015 with Figure 3. As observed, in many cases, neighboring municipalities developed their BCP in a lump, rather than developing it in isolation. In particular, we can observe a large spatial cluster of municipalities whose BCP had already been developed in the coastal area of the Chubu district and in the southern part of the Kanto district. On the other hand, we cannot observe the case that all municipalities in a specific prefecture had already developed their BCP.

5.2.2 Estimation result of the spatial probit model

We show the regression result of the spatial probit model in Table 5. Compared with the result in the a-spatial probit model shown in Table 3, there is no remarkable change in the magnitude, significance, and condition of the estimated regression coefficients except for the natural logarithm of inhabitable land per administrative staff ln*AREAPERGOVEMP*.

In Table 5, the estimation result of coefficient ρ corresponding to BCP development action in neighboring municipalities is additionally shown. In consideration of the property of parameter ρ that it takes a value within the range of $0 < \rho < 1$ if the trend of the outcome is similar among neighboring samples, the estimates of ρ is not so large. However, the estimated ρ is positively significant at the 5% level, which can imply that there is a remarkable similarity of BCP development patterns between neighboring municipalities even after controlling the difference of regional capabilities and risk environments, as well as the prefectural fixed effect. To summarize, the hypothesis we presented in Section 4.2.2 is supported[6].

As is the case of the a-spatial probit model, we plot the regression result of prefectural dummies in Figure 4. Although the spatial pattern of estimates does not change from that

[6] The magnitude and significance of the estimated ρ does not change remarkably even though we use an alternative cutoff of distance. For more information, see Appendix.

with the a-spatial probit model shown in Figure 2, the absolute value of the estimated coefficient becomes entirely smaller. In addition, the number of statistically significant estimates decreased, comparing Table 6 with Table 4. This result can imply that the prefecture-specific trend is partially controlled by the spatial effect additionally introduced by the spatial probit model.

5.3 Discussion

Based on both estimation results of the a-spatial probit and that of the spatial probit, two variables related to regional capability, the total population ln*POP* and the ordinary balance ratio *CURRBALANCE*, are robustly significant while the financial capability index *FI* is not statistically significant in any empirical model. These results can imply that it is the flexibility of the local fiscal management system and administrative capability in terms of scale that are significantly associated with municipal BCP development, rather than the soundness of the fiscal condition.

About variables related to regional risk environments, only the flood hazardous area *FLOODAREA* is robustly significant. There might be two reasons why the number of fishing ports *FISHPORT* is insignificant. The first reason is that *FISHPORT* is simply an inadequate variable to explain the risk of a tsunami and high tide in the coastal area. Unless we can find an alternative proxy variable, we must dare to accept the loss of sample size and implement the empirical analysis on limited municipalities where the information of a tsunami hazardous area is available. The second reason is that the coastal area effect is partially controlled by introducing the prefecture fixed effect, as mentioned below. Although we cannot observe a significant association between the experience of the 2015 Cloudburst *D_15_RAIN* and BCP development in 2015, we cannot entirely reject the existence of the lagged effect of the experience. To examine this lagged effect, we need to further employ the panel data model which can eliminate the effect of unobservable coercion by a higher government because the coercion can strongly correlate with BCP development and it is time-varying and unobservable.

From the result of prefectural dummies, it can be implied that there is a particular cross-prefectural difference in the BCP development status even after controlling the difference of regional capability and risk environments. Compared to municipalities in Tokyo as a reference group, the BCP completion rate is remarkably low in municipalities in prefectures facing the Sea of Japan and the East China Sea or inland prefectures. These municipalities can correspond to the regions where a catastrophic disaster has not occurred recently. In addition, they are geographically distant from 3.11 damaged regions or the Nankai Trough hazardous regions and have quite a different natural condition. Therefore, these factors might be associated with lower BCP development status. On the other hand, the BCP completion rate of prefectures located in Western Japan and facing the Pacific Ocean is not significantly different from that of Tokyo. Since these prefectures can be roughly included in the hazardous area of the Nankai Trough Earthquake, it can be implied that earlier crisis management planning toward future disaster risk has progressed in these prefectures. We can also observe the insignificance in Miyagi and Iwate that was damaged by 3.11. This result can imply the earlier development of BCP letting the experience of a huge disaster be a lesson.

Finally, the estimation result of the spatial probit model can show the significant similarity of the BCP development status among neighboring municipalities even after controlling the regional attributes mentioned above. One of the reasons why we obtain this result can be the cross referenced among neighboring municipalities. This can support policy diffusion stemming from the reliance on the precedent in other governments and the necessity of a cross－jurisdictional policy making with the view of efficient and seamless actions against emergencies. In addition, the manual for local administrative staff to develop BCP, FDMA (2015b), had already proposed that neighboring municipalities should cooperate to develop their BCP taking advantage of regional collaboration in daily administrative operations. This fact might support the existence of early cases of cross‐jurisdictional BCP development before 2015.

6. Conclusion

The literature on crisis management has grown in the past couple of decades as the vulnerability of public administrative bodies in the face of catastrophic events has attracted considerable attention following large-scale natural disasters and terrorist attacks in the 2000s. However, the literature has been relying on descriptive analysis by exploiting a few cases, and thus, a quantitative examination of crisis management and its operation by local government, remains scant. To fill this gap, we empirically investigated the drivers and deterrents in developing municipal business continuity planning with data obtained from the Survey on Development of Municipal Business Continuity Planning, covering Japanese municipalities. This study makes two additional contributions to the literature. First, it analyzes the case of Japan, among the most disaster-prone countries in the world, but one that has hardly been examined in the literature regarding public administration. Second, it comprehensively analyzes two issues, crisis management and policy diffusion, which constitute part of the central debate in recent public administration literature.

The results obtained with the (spatial) probit model can be summarized as follows. First, we empirically showed the positive association between the likelihood of BCP development and local capability, based on municipality size and the flexibility of fiscal management. Regarding regional risk environments, we also showed a positive association between the likelihood and the magnitude of flood hazards. Second, there was a remarkable prefecture-level difference in the BCP development status among municipalities even after controlling for differences in regional capabilities and risk environments. In particular, a relatively higher level of BCP development in the Nankai Trough hazardous prefectures might be reflected in earlier BCP completion, and that of the 3.11 damaged prefecture might be due to lessons learnt from the experience of 3.11. In contrast, in inland prefectures and those geographically distant from these damaged or hazardous prefectures, the level of BCP development was significantly lower. Finally, even after controlling for differences in regional characteristics as mentioned above, we could observe significant spatial dependence in the BCP development status among neighboring municipalities. This result might support the existence of spatial policy diffusion in the context of crisis management by the local government.

Future investigations will focus on the following. First, an in-depth examination of the quality of the developed BCP is necessary, as well as that of the completion of BCP development. As mentioned earlier, we can also access information on how many primary elements are included in each municipality's BCP. To precisely analyze the quality of the developed BCP, further discussion regarding the priority ranking of the primary elements is required. In addition, an examination of the quality in terms of feasibility might be also necessary. Second, there is significant potential to rigorously identify policy diffusion. Another reason for spatial dependence in BCP development status is the effect of unobservable characteristics common to neighboring municipalities. This problem in identification is inevitable as long as we employ a weight that only relies on geographical distance (Topa & Zenou, 2015). Network information capturing social proximity among municipalities, for example, through some agreement for cooperative administrative operations such as disaster prevention agreement or the inter-municipal transaction network, can be a good alternative to illustrate the relationship among municipalities related to policy making.

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Figures and Tables

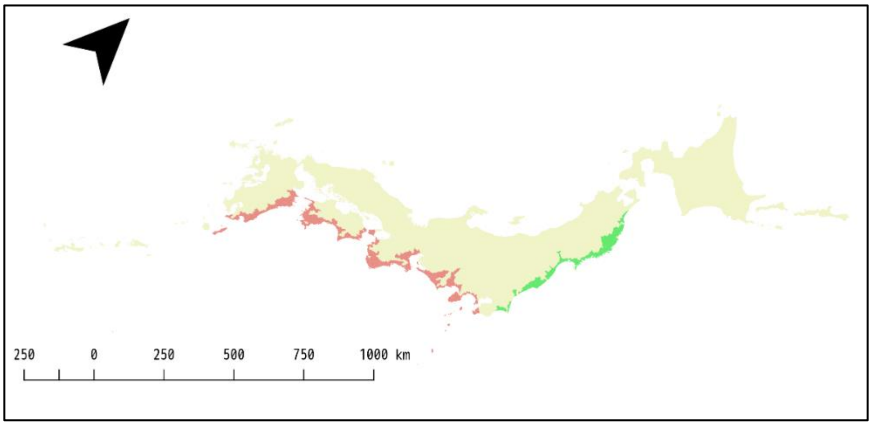


Figure 1 Regions damaged by the tsunami following the Great East Japan Earthquake (green) and regions facing potential tsunami hazard from the Nankai Trough Earthquake (red)

Table 1 Definition of variables

Variable name	Definition	Source
Q_1_1	1 if a municipality has already developed BCP	FDMA (2015)
FI	Financial capability index	MIC (2015a)
CURRBALANCE	Ratio of the current balance	MIC (2015a)
lnPOP	Natural logarithm of population	MIC (2015b)
lnAREAPERGOVEMP	Natural logarithm of inhabitable land [ha] per administrative staff member	MIC (2015a), MIC (2015b)
FISHPORT	Number of fishing ports	MLIT (2006)
FLOODAREA	Flood hazard area	MLIT (2012)
D_15_RAIN	1 if a municipality was damaged by the 2015 Cloudburst	CAO (2015)

FDMA (2015): Survey on Development of Municipal Business Continuity Planning
MIC (2015a): Annual Statistics on Local Public Finance
MIC (2015b): National Census
MLIT (2006): National Land Numerical Information (Fish Ports)
MLIT (2012): National Land Numerical Information (Flood Hazard Area)
CAO (2015): Application Situations of Disaster Relief Act

Table 2 Descriptive statistics

	n	mean	sd	min	max	vif
Q_1_1	1504	0.283	0.45	0	1	
FI	1504	0.529	0.28	0.05	2.09	2.74
CURRBALANCE	1504	86.758	6.484	48.9	113.6	1.628
lnPOP	1504	10.22	1.48	5.182	15.131	2.652
lnAREAPERGOVEMP	1504	2.964	0.884	−0.305	5.894	3.1
FISHPORT	1504	0.515	1.672	0	22	1.23
FLOODAREA	1504	16.484	41.48	0	664.063	1.398
D_15_RAIN	1504	0.015	0.12	0	1	1.25

Table 3 Estimation result of the a-spatial probit model

	beta	margins	zval	
FI	0.11	0.03	0.487	
CURRBALANCE	−0.015	−0.004	−1.971	**
lnPOP	0.252	0.068	5.643	***
lnAREAPERGOVEMP	−0.136	−0.037	−1.791	*
FISHPORT	−0.017	−0.004	−0.672	
FLOODAREA	0.002	0.001	2.159	**
D_15_RAIN	−0.393	−0.106	−1.169	
(Intercept)	−0.945		−1.323	
Prefecture dummies		YES		
PseudoR2		0.196		
AIC		1544.3		
n		1504		

Notes: The dependent variable is a dummy variable that takes 1 if a municipality had already developed its BCP in 2015. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels. “Margins” represents the average marginal effect.

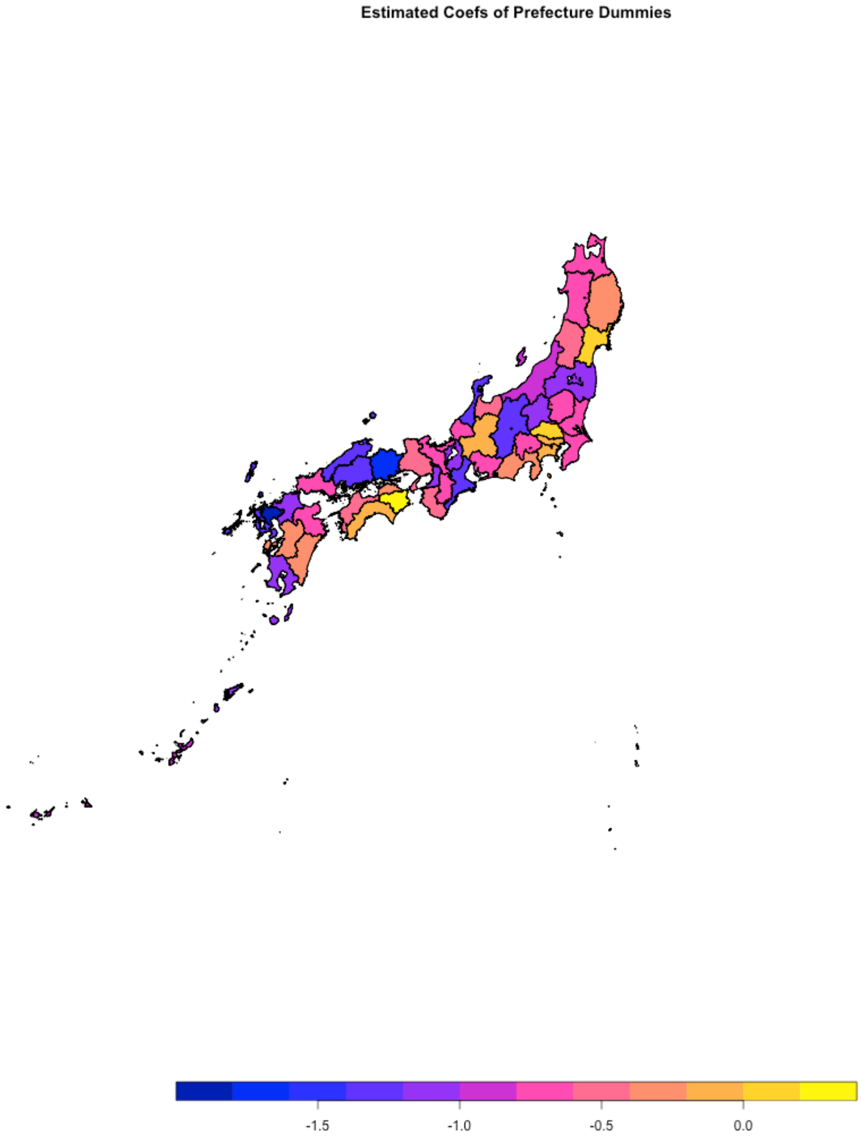


Figure 2 Estimated coefficients of prefectural dummies with the a-spatial probit model

Note: The dependent variable is a dummy variable that takes 1 if a municipality had already developed its BCP in 2015. The detailed model specification is shown in Table 2. The reference group consists of municipalities in Tokyo.

Table 4 Statistically significant prefectural dummies

	beta	margins	zval	
DP_Saga	−1.967	−0.531	−3.125	***
DP_Okayama	−1.769	−0.477	−3.48	***
DP_Mie	−1.389	−0.375	−3.46	***
DP_Ishikawa	−1.357	−0.366	−2.88	***
DP_Shimane	−1.31	−0.354	−2.438	**
DP_Nagasaki	−1.313	−0.354	−2.853	***
DP_Hiroshima	−1.253	−0.338	−3.051	***
DP_Nagano	−1.222	−0.33	−3.928	***
DP_Shiga	−1.156	−0.312	−2.701	***
DP_Fukushima	−1.122	−0.303	−3.146	***
DP_Fukuoka	−1.087	−0.293	−3.681	***
DP_Kagoshima	−1.067	−0.288	−2.882	***
DP_Gunma	−1.021	−0.276	−2.789	***
DP_Osaka	−1.016	−0.274	−3.488	***
DP_Okinawa	−0.915	−0.247	−2.73	***
DP_Niigata	−0.804	−0.217	−2.123	**
DP_Akita	−0.791	−0.214	−1.956	*
DP_Nara	−0.789	−0.213	−2.413	**
DP_Tochigi	−0.754	−0.204	−1.944	*
DP_Fukui	−0.754	−0.203	−1.812	*
DP_Yamanashi	−0.74	−0.2	−2.128	**
DP_Aomori	−0.73	−0.197	−2.039	**
DP_Chiba	−0.706	−0.191	−2.454	**
DP_Kyoto	−0.705	−0.19	−2.03	**
DP_Oita	−0.684	−0.185	−1.652	*
DP_Ibaraki	−0.662	−0.179	−2.016	**
DP_Aichi	−0.608	−0.164	−2.203	**

Notes: The dependent variable is a dummy variable that takes 1 if a municipality had already developed its BCP in 2015. The detailed model specification is shown in Table 2. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels . “Margins” represents the average marginal effect. The reference group consists of municipalities in Tokyo.

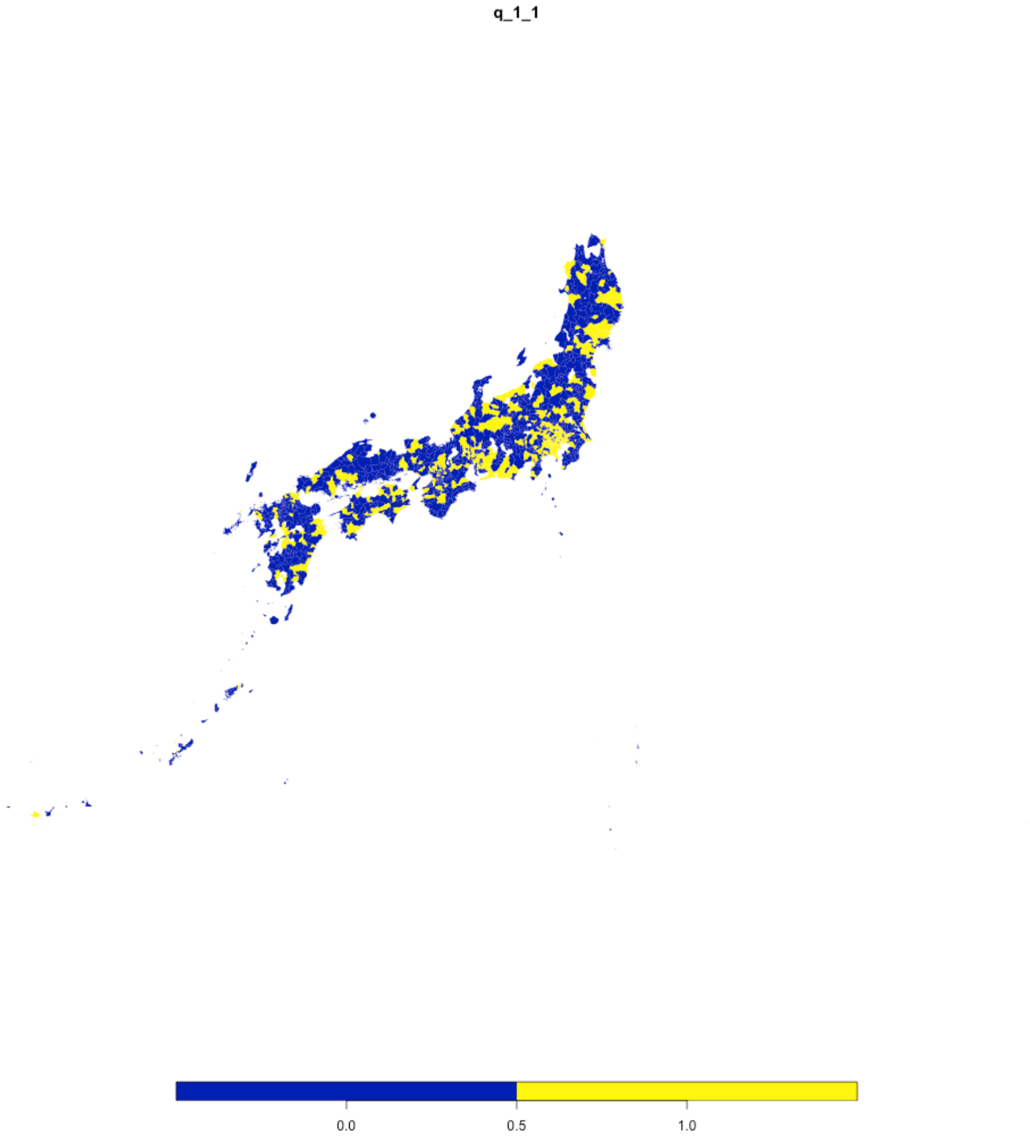


Figure 3 Spatial trend of BCP development status

Notes: Municipalities in yellow had already developed their BCP, those in blue had not.

Table 5 Estimation result of the spatial probit model

	beta	zval	
FI	−0.049	−0.211	
CURRBALANCE	−0.014	−1.859	*
lnPOP	0.247	5.427	***
lnAREAPERGOVEMP	−0.059	−0.778	
FISHPORT	−0.005	−0.200	
FLOODAREA	0.002	2.436	**
D_15_RAIN	−0.441	−1.495	
ρ	0.393	2.520	**
(Intercept)	−1.082	−1.556	
Prefecture dummies	YES		
PseudoR2	0.194		
AIC	1451.2		
n	1493		

Notes: The dependent variable is a dummy variable that takes 1 if a municipality had already developed its BCP in 2015. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels. Isolated municipalities with no neighbor based on spatial weight defined in Eq. (1) (i.e., $w_{ij} = 0, \forall j$) are excluded from the sample. The spatial weight matrix is row−standardized.

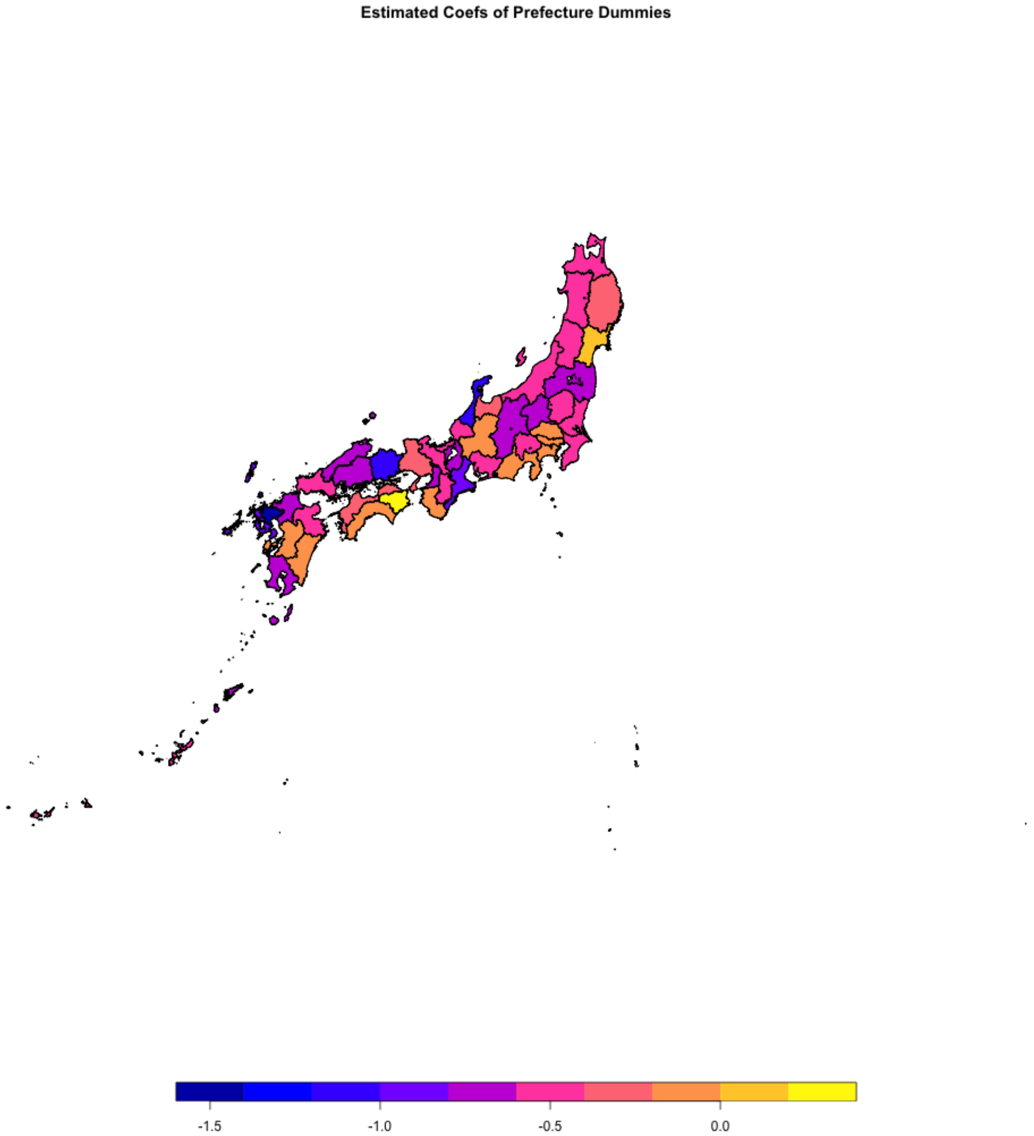


Figure 4 Estimated coefficients of prefectural dummies with spatial probit model

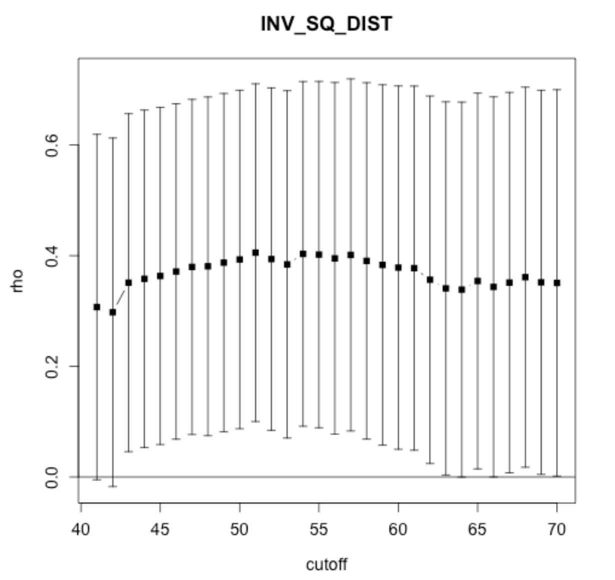
Note: The dependent variable is a dummy variable that takes 1 if a municipality had already developed its BCP in 2015. The detailed model specification is shown in Table 5. The reference group consists of municipalities in Tokyo.

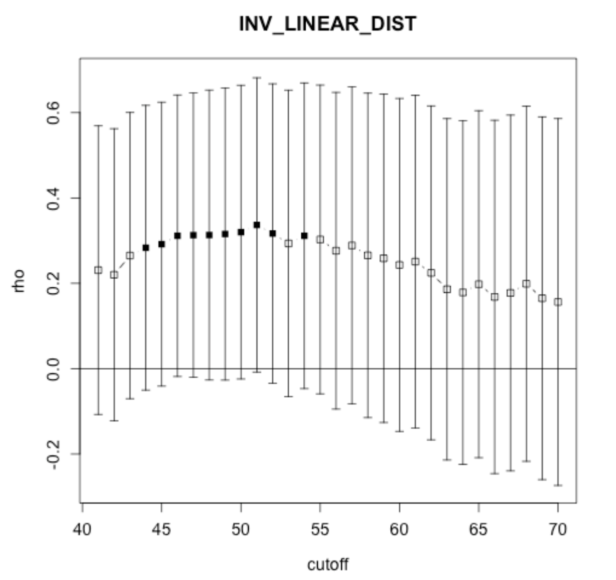
Table 6 Statistically significant prefectural dummies

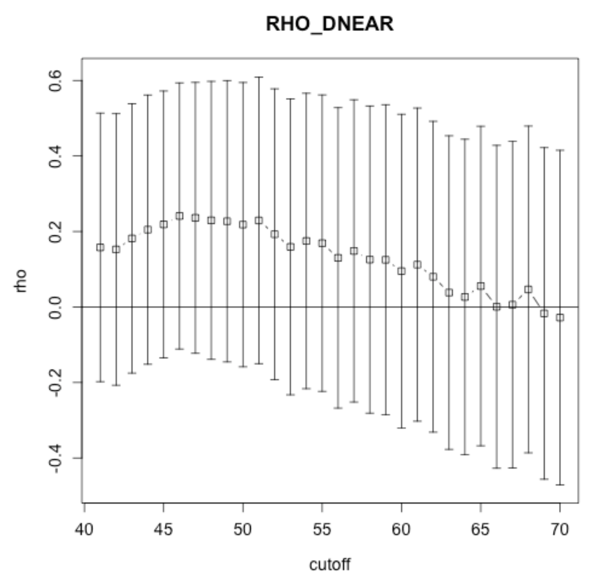
	beta	zval	
DP_Saga	−1.496	−2.931	***
DP_Ishikawa	−1.081	−2.639	***
DP_Okayama	−1.042	−2.421	**
DP_Mie	−0.928	−2.687	***
DP_Nagasaki	−0.816	−2.024	**
DP_Shiga	−0.792	−2.113	**
DP_Shimane	−0.769	−1.802	*
DP_Kagoshima	−0.733	−2.321	**
DP_Hiroshima	−0.733	−2.159	**
DP_Nagano	−0.708	−2.422	**
DP_Fukushima	−0.692	−2.248	**
DP_Gunma	−0.681	−2.248	**
DP_Osaka	−0.672	−2.411	**
DP_Fukuoka	−0.659	−2.278	**
DP_Okinawa	−0.582	−2.072	**
DP_Chiba	−0.571	−2.429	**
DP_Fukui	−0.554	−1.719	*
DP_Niigata	−0.528	−1.692	*
DP_Yamanashi	−0.519	−1.758	*
DP_Ibaraki	−0.477	−1.734	*
DP_Aichi	−0.412	−1.830	*

Notes: The dependent variable is a dummy variable that takes 1 if a municipality had already developed its BCP in 2015. The detailed model specification is shown in Table 5. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels. The reference group consists of municipalities in Tokyo.

Appendix: estimated spatial parameter ρ based on alternative definitions and cut-offs of spatial weight matrix







$$w_{ij}^{SQ} = \begin{cases} \dfrac{1}{d_{ij}^2} \; if \; d_{ij} < 50[\text{km}] \\ 0 \; otherwise \end{cases}$$

$$w_{ij}^{L} = \begin{cases} \dfrac{1}{d_{ij}} \; if \; d_{ij} < h[\text{km}] \\ 0 \; otherwise \end{cases}$$

$$w_{ij}^{DN} = \begin{cases} 1 \; if \; d_{ij} < h[\text{km}] \\ 0 \; otherwise \end{cases}$$

Notes: Plot ■ represents that estimated spatial parameter and is statistically significant at least 10% level, □ represents “not significant”. Vertical arrows represent the 95% confidence interval of the estimated spatial parameter.

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