RIETI Discussion Paper Series 14-E-029

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RIETI Discussion Paper Series 14-E-029
June 2014

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Abstract

This paper reviews the impacts of natural disasters on firm location choice and real estate prices. More specifically, we first study if awareness of possible natural disasters affects location choice. Then, we investigate the impacts of natural disasters on land prices. We collect a unique micro dataset from firms operating in central Thailand, where firms located in the Chao Phraya flood plains incurred direct losses during the 2011 floods. The empirical evidence suggests that more firms located in the Chao Phraya flood plains were unaware of the flooding risk before the 2011 floods than those located elsewhere. The 2011 floods have substantially affected awareness among firms—in particular, firms incurred direct losses, and the changes in land prices suggest that an increasing number of firms have been choosing locations outside the flood plains in the aftermath of the 2011 floods.

Keywords: Firm location choice, Land price, Natural disaster.
JEL classification: D22, Q54, R30.

[1] This study is conducted as part of the Project "Post-disaster Recovery Policies and Insurance Mechanisms against Disasters: Case Studies on Earthquakes in Japan and Floods in Thailand" undertaken at Research Institute of Economy, Trade and Industry (RIETI). The authors appreciate Akito Kamei and Yoko Okuyama for their excellent research assistantship. We are also grateful for helpful comments and suggestions from the Discussion Paper seminar participants at RIETI – in particular, Atsushi Nakajima, Masahisa Fujita and Masayuki Morikawa. However, the usual disclaimers apply.

1 Introduction

In October 2011, areas along the lower Chao Phraya River in Thailand were hit by serious floods. The floods were indeed the worst for decades if not for centuries. The estimated total economic losses to the Thai economy amounted to THB 1,425 billion (USD 45.7 billion). The manufacturing sector was hit the worst, with losses totaling THB 1,007 billion (USD 32 billion; World Bank, 2011).

The 2011 Thailand floods showed us that unexpected, severe, adverse events could occur in an otherwise steadily growing middle-income country such as Thailand. These are namely catastrophes such as natural and man-made disasters—technological disasters, economic crises, and violence-related disasters such as wars and conflicts (Sawada, 2007). A catastrophic event can destroy people's lives whether it occurs in a developing or developed country. Based on data from the Centre for Research on the Epidemiology of Disasters (CRED), Asia was the continent worst hit by natural disasters in the past 10 years in terms of the number of disasters and victims and economic damage (Guha-Sapir et al., 2013). In particular, 40% of the world's natural disasters occur in Asia, and Asia accounts for 90% of the number of victims and 40% of economic damage caused by such natural disasters (Guha-Sapir et al., 2013).

The 2011 Thailand floods seriously affected seven industrial estates (IEs) along the lower Chao Phraya River between Ayutthaya and Bangkok. Because firms operating in these IEs are supposed to have made the location choice voluntarily, it is important to identify the determinants of initial location choice. However, location choice is somewhat irreversible because relocation tends to be rather costly; thus, location-specific constraints on firm operations may emerge over time.

Moreover, a large shock such as a natural disaster may alter the perception of firms. Even though incumbents may not be able to relocate quickly, new entrants may avoid areas hit by a natural disaster and instead choose another location. Hence, impacts of a natural disaster are reflected in changes in land prices, because land price is equivalent to the present value of future returns from land use when the market is efficient.

Based on these observations, we investigate the impacts of the 2011 Thailand floods on firm location choice and the reason some firms incurred heavy losses because of their initial location choice when others escaped from such losses. In order to investigate the impacts, we analyze a unique micro dataset of firms operating in central Thailand that was collected exclusively for this study. More specifically, this study examines the following three issues: First, determinants of firm location choice—in particular, each firm's awareness of the potential disaster risks at the time of its initial location choice; second, location-specific issues/problems affecting the operations of the firms; finally, impacts of the 2011 floods on real estate prices.

Among the main findings of our empirical analyses, we found that firms in the Chao

Phraya flood plains were mainly unaware of the flooding risk before the 2011 floods unlike firms in other areas. Nonetheless, the 2011 floods substantially affected awareness among firms, in particular, those incurring direct losses. Furthermore, the changes in land prices suggest that an increasing number of firms have been choosing locations outside the flood plains after the 2011 floods.

The remainder of the paper is organized as follows. In Section 2, we first investigate the determinants of firm location choice in central Thailand. Then, location-specific issues/problems (e.g., water shortages, blackouts, labor shortages, labor strikes, floods, and traffic congestion) that affect the operations of firms are identified from our micro data. Section 3 examines the impacts of the 2011 floods on real estate prices, which include not only land prices for industrial use but also land prices for residential and commercial use and prices of detached houses, townhouses, and condominiums. The final section provides concluding remarks and possible policy implications.

2 Location Choice

2.1 Data and Descriptive Statistics

In this study, we employ micro data of firms operating in Thailand collected using the "RIETI Survey of Industrial Estates/Parks and Firms in Thailand on Geographic and Flood Related Information" (the RIETI survey hereafter) conducted by the Research Institute of Economy, Trade and Industry (RIETI) from October 2013 until January 2014. Teikoku Data Bank (TDB) conducted a postal survey in Japan and delegated the survey in Thailand to Business Innovation Partners Co., Ltd., who conducted the survey in cooperation with the Industrial Estate Authority of Thailand (IEAT).

We designed the survey instrument, which comprises structured questionnaires. The postal questionnaire in Japan was sent to 842 firms selected from TDB's database. The selection criteria were firm size in terms of annual turnover (at least two billion yen), number of employees (at least 50), and presence in Thailand. The survey in Thailand was focused on tenant firms of 34 major IEs/parks in central Thailand (in Ayutthaya, Bangkok, Chachoengsao, Chonburi, Pathumthani, Prachinburi, Rayong, Samut Prakan, and Saraburi provinces) and the operators of these IEs/parks. The 34 IEs/parks are Saha Rattana Nakorn, Hi-Tech, Bangpa-in, Rojana-Ayutthaya, Factory Land (Wang-noi), Nava Nakorn-Pathumthani, Bangkadi, Bangchan, Lad Krabang, Bangpoo, Bang-plee, Gateway City, Wellgrow, 304 IP II, Amata Nakorn, Pinthong, Hemaraj Chonburi, 304 IP I, Kabinburi, Rojana-Prachinburi, Laem Chabang, Eastern Seaboard (Rayong), Hemaraj Eastern Seaboard, Siam Eastern, Amata City, Rojana-Rayong, Hemaraj Ray-ong Industrial Land, Rayong Industrial Park, Asia IE Mapta Phut, Hemaraj Eastern, Padaeng, Hemaraj Saraburi IL, Kaeng Khoi, and Nong Khae.

The resulting dataset comprises two parts: Firm-level module data and IE/park operator module data. The current study uses the former module, which consists of three sections. The first section focuses on basic attributes of the respondent's firm/plant, such as location, plant size, and operation history. The second section is devoted to flood-related information, such as direct/indirect losses from floods and/or inundation experience in the past and past and present risk perceptions toward floods. The third section concerns business-related questions, such as past and present main trading partners and past and present business sentiment. The final section concerns human resources and labor, for example, workforce size, wage and bonus payments, recruitment conditions, and labor disputes.

The number of respondents for the firm questionnaire was 314. In total, 129 responses were collected from a postal questionnaire sent to Japanese parent companies' headquarters in Japan. Furthermore, 185 responses were collected from a survey in Thailand, of which data on 102 firms were collected through face-to-face interviews, 38 using postal questionnaires, and 45 using telephone interviews.

Figure 1 exhibits the nine provinces covered in this study, which in turn are grouped into four regions—the Highlands region: Prachin Buri and Saraburi; the Eastern region: Chahoengsao, Chon Buri, and Rayong; the Bangkok Metropolitan region: Bangkok and Samut Prakan; and the Chao Phraya region: Ayutthaya and Pathum Thani. Firms' establishment years are shown in Figure 3. Although not directly shown in the figure, we can verify that all four regions have had at least one IE within its territory since the late 1980s.

Flood Damage

Figure 2 shows the spatial distribution of the flood damage, which is helpful in illustrating the geographical picture of the 2011 floods. The figure on the left shows the maximum depth of water immersion, and the figure on the right shows maximum inundation days. These figures show that Chao Phraya and Pathum Thani provinces in the Chao Phraya Region were disproportionately affected by the floods. In contrast, provinces in the Highlands (Prachin Buri and Saraburi) and Eastern regions (Chahoengsao, Chon Buri, and Rayong provinces) were affected by the floods to a much lesser extent.

Location Choice

In our analysis of firm location choice, we restrict our analysis to the firms that began operating in central Thailand after 1988. This is because 1988 is the first year when at least one IE was established in each of the four regions. Furthermore, we dropped plants/premises whose year of establishment is unknown to us from our analysis. Figure 3 illustrates the regional distributions of the resident firm's year of establishment. The firms in our data are divided into three groups according to their establishment year:

(1) 1988–1997 (i.e., before the Asian financial crisis); (2)1998–2011 (i.e., before the 2011 floods); and (3) 2012–2013 (i.e., after the 2011 floods). Figure 4 verifies that there are firm location patterns specific to each period. According to Figure 5, there is increasing awareness of natural disasters, because "low risk of natural disaster" has increasingly been chosen as one of the important factors for firm location choice.

2.2 Econometric Model and Results

Econometric Model

In order to formally investigate the determinants of the initial location choice by the firms, we employ the canonical multinomial model for location choice. Suppose that firm i maximizes its latent variable of indirect utility $V_i(r) = X_i\beta_r + \epsilon_{ir}$ by choosing the best region r_i^* out of the four regions:

$$V_i(r_i^*) = \max_r \{X_i\beta_r + \epsilon_{ir}\}, \tag{1}$$

where X_i includes factors that determine firm i's location choice as well as the industry category to control for unobserved industry-specific heterogeneity. In our survey, determinants of each firm's location choice are captured using the following question: "What were the determinants of your firm's location choice?" The respondents were asked to choose all applicable reasons from the following choices: (1) proximity to Bangkok (hereafter BKK); (2) proximity to the airport and port facilities; (3) inducement by business partner(s); (4) access to the labor market; (5) benefits from the Board of Investments (BOI); (6) low risk of natural disasters; (7) agglomeration of enterprises; (8) location availability; and (9) a result of merger and acquisition (M&A) activity. We use each firm's response to this question as a critical variable in the set of variables X_i.

Because each firm i chooses the best location from its perspective, the observed location choice of firm i, denoted by r_i^*, should satisfy the following:

$$r_i^* = \begin{cases} \text{Highlands} & \text{if } V_i(\text{Highlands}) \geq V_i(r) \text{ for all } r; \\ \text{Eastern} & \text{if } V_i(\text{Eastern}) \geq V_i(r) \text{ for all } r; \\ \text{Metropolitan} & \text{if } V_i(\text{Metropolitan}) \geq V_i(r) \text{ for all } r; \\ \text{Chao Phraya} & \text{if } V_i(\text{Chao Phraya}) \geq V_i(r) \text{ for all } r. \end{cases}$$

In the actual estimation, we employ a multinomial logit model by assuming that the error term ϵ_{ir} independently and identically follows an extreme value distribution $F(\epsilon) = \exp(-\exp(-\epsilon))$.[1]

Location Choice

[1] We also used a multinomial probit model by assuming a normal error term, but we could not achieve an overall convergence in the estimation of the model.

In the following, we use the Eastern region as the base default region. The estimated coefficient can then be interpreted as an odds ratio of choosing the particular region under investigation against the Eastern region. Table 1 reports the estimation results of the multinomial logit model previously explained. The standard errors shown in parentheses are clustered at the province level. The first three columns of the table exhibit the results for specification (1), which does not control for industry-specific heterogeneity. The latter three columns of the table report the results for specification (2), which controls for unobserved industry-specific heterogeneity by adding industry category dummies, that is, dummy variables for rubber and plastic products, electronic devices, machinery, motor vehicles and transport, and others. In both specifications, the variable *low risk of natural disasters* has a negative coefficient for the Chao Phraya region. This is consistent with the hypothesis that firms who are concerned with potential disaster risks are less likely to locate in the Chao Phraya region. In contrast, *low risk of natural disasters* has a positive coefficient for the Highlands region. These findings suggest that firms that were not concerned with natural disasters are likely to have chosen the Chao Phraya region, whereas firms that were wary of disasters chose the Highlands region. By comparing the results for specifications (1) and (2), we can see that most of the qualitative results are not really affected by the inclusion of a control for industry-specific heterogeneity. The only exception is the estimated coefficient of the "access to labor market" variable for the Chao Phraya region. This result suggests that labor market access may be industry specific.

Table 2 reports the results for an augmented version of the regression model. The model includes a dummy variable that identifies if the plant was established after the 2011 floods (the *after floods dummy*) as well as a set of interaction variables between this dummy variable and the location determinants. Two additional findings emerge from the augmented regression model. First, both *low risk of natural disasters* and its interaction variable with the *after flood dummy* are significantly negative for the Chao Phraya region. Thus, while the Chao Phraya region was less preferred before the 2011 floods among firms concerned with disasters, this location choice preference was strengthened even further after the 2011 floods. These firms were more likely to settle in the Eastern region. Second, firms who are sensitive to labor market conditions favored the Chao Phraya region, especially after the floods.

Location-Specific Problems for Firm Operations

Next we analyze the IE-specific issues/problems raised by the tenant firms. The respondents were asked the following item in the survey: "Please select all issues and problems applicable to the IE of your plant (v46)." The respondents were to choose all applicable issues from (1) water shortages; (2) blackouts; (3) labor shortages; (4) labor strikes; (5) floods; (6) traffic congestion; and (7) others. This question enables us to identify the

issues/problems each tenant firm faces. To examine the location-specific problems for firm operations, we adopt a simple linear probability model:

$$z_i = \alpha^z + W_i\beta^z + \epsilon_i^z, \tag{2}$$

where z_i is a dummy variable for each of the seven problems listed that identifies if the problem was raised by firm i, and W_i is a set of region or province dummy variables. Table 4 reports the results of estimation on a regional-level analysis.[2] Although the estimation results reported in Tables 1 and 2 indicate that firms that were less wary of natural disasters chose the Chao Phraya region, floods are considered a dominant problem in the Chao Phraya region. The estimation results at the provincial level reported in Table 5 also confirm that floods are a serious problem in the Chao Phraya region, especially in Ayutthaya province. These results suggest that firm location choice is irreversible to some extent; thus, firms who have become aware of the flooding risk only after the 2011 floods are unable to resolve the issue, at least in the short run.

In order to closely examine problems specific to each location, we allow for the coefficients in Equation (2) to vary across the following four periods depending on the firm's establishment year: (1) from 1962 to 1986 ("before the Plaza agreement"); (2) from 1986 to 1997 ("before the Asian financial crisis"); (3) from 1998 to 2011 ("before the 2011 floods"); and (4) since 2012 ("present"). Furthermore, we added a fifth category for the firms whose establishment year is unknown to us. Table 6 reports the estimation results. Even within the Chao Phraya region, there are differences in the degree of wariness of flood risk. While flooding is generally considered an issue in the Chao Phraya region, the concerns seem to be more severe among firms established in the region earlier than those established later. Intriguingly, floods in the Chao Phraya region are not considered a risk among new firms established in 2012 and 2013.

For issues other than floods, "labor shortages" is considered serious among new firms established in the Eastern region. According to the results for the IE regression model reported in Table 8, such a tendency is particularly true for IEs in the Chonburi and Rayong provinces. In contrast, labor shortage is not necessarily a significant problem for IEs in other provinces. These results are consistent with the widely held belief that the labor market is rather tight in the Eastern region as opposed to the Chao Phraya region, where labor is abundant. Furthermore, traffic congestion is considered a serious problem in Bangkok: Tables 3 and 5 indicate that all firms in Bangkok consider traffic jams/congestion an issue. Accordingly, traffic jams become significantly less of an issue for firms in other provinces when we set Bangkok as the base category in the regression analyses.

[2]The base for each table is as follows: Bangkok Metropolitan Region in Table 4; Bangkok Metropolitan Region for 2012 and 2013 in Table 6; Bangkok Province in Table 5; Bangkok Province from 1998–2011 in Table 7; and Lad Krabang IE in Table 8.

3 Impacts of the 2011 Floods on Land Prices

Thus far, we have investigated the determinants of firm location choice and the issues firms are currently facing—water shortages, blackouts, labor shortages, floods, and traffic congestion. A severe natural disaster may affect firm location choice substantially, which in turn may affect land prices significantly (because in principle, land price is the present value of future returns from land use). In this section, we attempt to quantify the impacts of the 2011 floods on real estate prices. We employ two datasets on real estate prices: Land prices of IEs collected by the Japan External Trade Organization (JETRO), land prices for residential, commercial, and industrial use, and prices of detached houses, townhouses, and condominiums compiled by the Agency for Real Estate Affairs (AREA) of Thailand. Both datasets cover periods before and after the 2011 floods.

More specifically, we use these two panel datasets to estimate the regression models based on a difference-in-difference (DID) framework: we consider the 2011 floods a natural experiment by using the 2011 flood-affected areas as the treatment group and the unaffected areas as the control group; then, we consider variations before and after the floods. We postulate the following two econometric models for our DID analysis:

- Fixed-effects model with time dummies

$$p_{it} = \alpha + \beta d_{it} + \sum_{m=2}^{T} \phi_m \mathbf{1}_{t=m} + \pi d_{it} \mathbf{1}_{t \geq t'} + \mu_i + \epsilon_{it}. \tag{3}$$

- Fixed-effects model with time dummies allowing for heterogeneity in treatment effect across time

$$p_{it} = \alpha + \beta d_{it} + \sum_{m=2}^{T} \phi_m \mathbf{1}_{t=m} + \sum_{m=t'}^{T} \pi_m d_{it} \mathbf{1}_{t=m} + \mu_i + \epsilon_{it}, \tag{4}$$

where T indicates the terminal round of the survey and $t = t', \ldots, T$ are the period after the flooding. The parameters of interest are π and π_m. The key identifying assumption here is that the *trend* in the land prices would be the same in flooded as well as non-flooded areas in the absence of the 2011 floods. Although the level of land prices in the flooded and non-flooded areas can differ, this gap should be captured by the IE fixed effects.

3.1 DID analysis using JETRO data

We use a dataset obtained from JETRO, who interviews approximately 40 IEs in Thailand and collects land price data several times a year, although not necessarily in a periodic manner. We restrict attention to the latest 10 rounds from the surveys conducted between

October 2008 and November 2012. Severe floods occurred in October 2011, and six survey rounds were conducted before and four rounds were conducted after the 2011 floods. Furthermore, we identified seven *flooded IEs* based on the reports by JETRO: Bangpa-In IE (Ayutthaya), Hi-Tech IE (Ayutthaya), Rojana Industrial Park (Ayutthaya), Saharattanakorn IE (Ayutthaya), Factory Land IE (Ayutthaya), Bangkadi Industrial Park (Pathum Thani), and Navanakorn IE (Pathum Thani).

For some IEs, we know only the upper and lower bounds of the land price. In the analysis, we treat the upper and lower bounds as different data points and use the *price category* dummies whose value is unity if a particular price data is adopted. Accordingly, we modify the econometric models slightly:

- Fixed-effect model with time dummies

$$p_{it} = \alpha + \beta d_{it} + \sum_{m=2}^{10} \phi_m \mathbf{1}_{t=m} + \sum_{n=1}^{2} \lambda_n c_{it}^n + \pi d_{it} \mathbf{1}_{t\geq 7} + \mu_i + \epsilon_{it}$$

- Fixed-effect model with time dummies allowing for heterogeneity in treatment effect across time

$$p_{it} = \alpha + \beta d_{it} + \sum_{m=2}^{10} \phi_m \mathbf{1}_{t=m} + \sum_{n=1}^{2} \lambda_n c_{it}^n + \sum_{m=t'}^{10} \pi_m d_{it} \mathbf{1}_{t=m} + \mu_i + \epsilon_{it}$$

- Fixed-effect model with time dummies allowing for heterogeneity in treatment effects across outcome category

$$\begin{aligned} p_{it} = \quad & \alpha + \beta d_{it} + \sum_{m=2}^{10} \phi_m \mathbf{1}_{t=m} + \sum_{n=1}^{2} \lambda_n c_{it}^n \\ & + \pi d_{it} \mathbf{1}_{t\geq 7} + \sum_{n=1}^{2} \pi_n (c_{it}^n d_{it} \mathbf{1}_{t\geq 7}) + \mu_i + \epsilon_{it} \end{aligned}$$

Figure 8 shows that the trend in the IE land prices is almost parallel between the flooded and non-flooded areas. After the 2011 floods, however, an increase in the land prices in the non-flooded area outpaced those in the flooded areas. Table 9 summarizes the trend in the land price of flooded and non-flooded areas. The DID analysis reported in Table 10 shows that the 2011 floods had a significantly negative impact on the land price in the flooded areas relative to the non-flooded ones. According to the point estimate of π_m, the magnitude of the negative impact is approximately 10% of the mean land price. Figure 8 indicates that the negative impact on the land price in the flooded areas relative to the non-flooded areas is generated by the increase in the land price of non-flooded areas. This suggests that stronger demand for land in the non-flooded areas after the

2011 floods has mainly been driven by new entrants, a finding which is consistent with the findings in the previous section.

3.2 DID analysis using AREA data

In order to test the sensitivity and robustness of the findings from the JETRO dataset, we employ a dataset obtained from the Agency for Real Estate Affairs (AREA), Thailand. The AREA dataset contains six price series: Raw land and real estate price data for industrial use, residential use, commercial use, detached houses, town houses, and condominiums. Prices are collected in 43 districts in various prefectures: 3 districts in Ayutthaya, 6 districts in Pathum Thani, 5 districts in Nonthaburi, 11 districts in Bangkok, 4 districts in Chachoengsao, 4 districts in Chon Buri, 3 districts in Prachin Buri, 4 districts in Samut Prakan, and 3 districts in Saraburi.

We treat all districts in Ayutthaya, Pathum Thani, and Nonthaburi as flooded areas and all districts in Chon Buri, Prachin Buri, Samut Prakan, and Saraburi as non-flooded areas. For some districts in Chachoengsao and Bangkok, prices for flooded and non-flooded areas are reported. We use both price series by treating them as separate data.

Figure 9 shows that the land price *levels* reported in the AREA dataset differ significantly from those reported in the JETRO dataset. This reflects the difference in the scope of the sampled areas: The JETRO dataset covers only IEs, whereas the AREA dataset includes prices both inside and outside the IEs.

Figure 9 shows that the 2011 floods had only limited impacts on the land and real estate prices except for the prices of land for industrial use. This can be formally confirmed using the DID estimation results for each land and real estate price based on Equations (3) and (4) in Table 12. Similar to the estimation results using the JETRO dataset, the 2011 floods negatively affected the prices of land for industrial use. Furthermore, we found a negative impact on prices of townhouses. Our estimation results, however, indicate that in the flooded as well as non-flooded areas, land prices have been following an upward trend. The land price of IEs and of townhouses in the flooded areas fell significantly relative to the corresponding prices in the non-flooded areas. In contrast, there is no statistically significant relative price effect in the case of lands for commercial and residential uses. The lack of an absolute decline in prices even in the flooded areas is somewhat similar to the finding by Wong (2008), who found that house prices in Hong Kong barely reacted to the 2003 Hong Kong Severe Acute Respiratory Syndrome (SARS) epidemic. In the case of the SARS epidemic in Hong Kong, the average house price declined by 1–3 percent if the estate was directly affected by SARS and by 1.6 percent for all estates as a result of the outbreak of the disease. These observations suggest that land and real estate prices may not react to a negative event, reflecting the relative lack of liquidity in the real estate market.

4 Conclusions

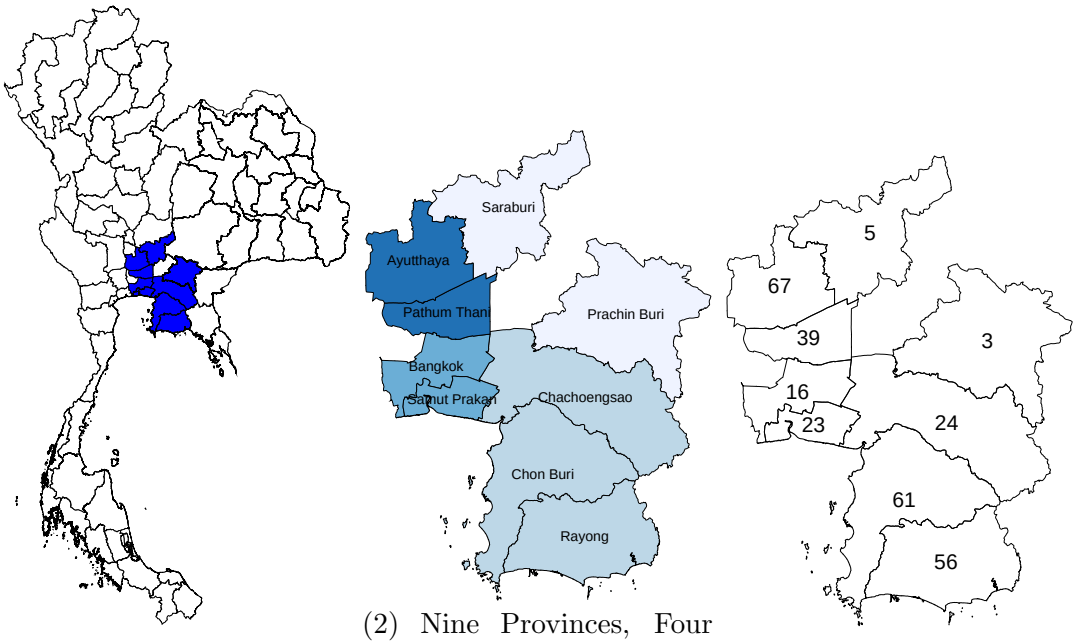
In this paper, we reviewed the determinants of firm location choice—in particular, the role of awareness of natural disasters among firms. Because relocation is rather costly, location choice is irreversible to an extent despite that the initially chosen location may suffer from problems that could emerge over time because of exogenous changes in the business environment. However, a large shock, including a natural disaster, may have significant impacts on firm location choice and alter the demand for real estate. Such an impact of a natural disaster is ultimately reflected in changes in land prices, because the land price is the present value of future returns from land use when the real estate market is efficient. The lack of liquidity in the real estate market, which is closely related to the costly nature of relocation, may still hinder the direct impacts of a natural disaster on real estate prices. In order to investigate such impacts, we collect a unique dataset of firms operating in central Thailand, including those that incurred losses during the 2011 Thailand floods.

The empirical evidence suggests that more firms located in the Chao Phraya flood plains had been unaware of the flooding risk before the 2011 floods than those located elsewhere. Moreover, the 2011 floods have had a substantial impact on the awareness of flooding risk among firms (in particular, those incurring direct losses), although new entrants in the flooded areas are not concerned with the flooding risk even after the 2011 floods. Nonetheless, more firms are choosing locations outside the Chao Phraya flood plains in the aftermath of the 2011 floods, and such a shift in the demand for land is reflected in the price hike in the non-flooded areas after the 2011 floods, whereas the land price movement in the flooded areas has been fairly flat. The latter finding is consistent with the findings of the existing works on the impacts of negative events on real estate prices, for instance, with the study by Wong (2008) on the SARS epidemic in Hong Kong. The stagnant price movement in the flooded areas may reflect the illiquid nature of the real estate market, which in turn is a reflection of the irreversibility of location choice because of the costly nature of relocation.

The finding that awareness of natural disasters has a significant impact on location choice suggests that some firms may make an erroneous initial location choice, which may cause regret once a severe natural disaster occurs. Furthermore, a firm's erroneous initial location choice may cause damage to other firms through disruptions in the supply chain network, as was widely reported during the 2011 Thailand floods. Thus, voluntary firm location may result in a socially sub-optimal use of land, that is, sub-optimal resource allocation. These findings indicate the importance of investment in ex ante flood control measures. More fundamentally, land use and/or development require thorough planning under full coordination between public and private sectors to prevent firms from making an erroneous initial location choice.

One important class of measures the current study has not examined is financial measures (e.g., catastrophe insurance), because it is impossible to control natural disasters completely so that no firms or people incur heavy losses. However, the 2011 Thailand floods caused major insurance companies to withdraw their coverage for floods in Thailand. Such a move prompted the Thai government to establish a state-backed insurance fund called the Natural Catastrophe Insurance Fund (NCIF), although its effectiveness remains to be seen. This turn of events for the insurance industry in Thailand illustrates the difficulty of developing a robust insurance mechanism against natural disasters. To design a well-functioning insurance mechanism, we must evaluate the robustness or sustainability of the mechanism. Furthermore, people's perceptions toward disasters are diverse and subject to large changes. In other words, setting a socially agreeable set of welfare criteria is difficult. Thus, it is beyond the scope of our paper to provide concrete policy recommendations, and it is imperative to accumulate further evidence to make such recommendations.

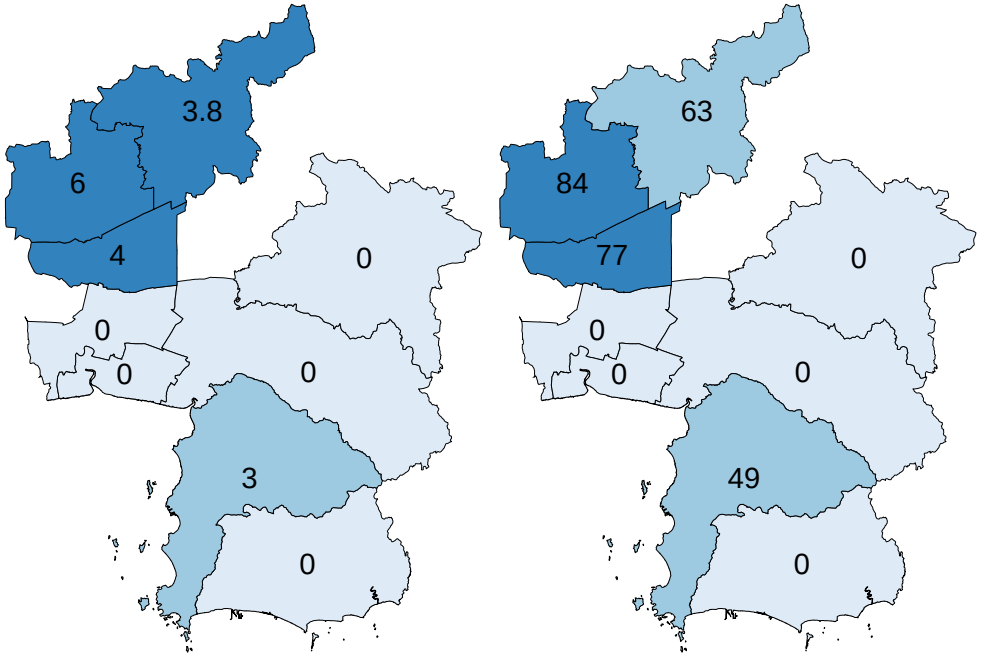
Figure 1: Thailand



(1) Provinces Covered (2) Nine Provinces, Four Regions (3) Number of Samples

Highlands: Prachin Buri, Saraburi
Eastern: Chahoengsao, Chon Buri, Rayong
Metropolitan: Bangkok, Samut Prakon
Chao Phraya: Ayutthaya, Pathum Thani

Figure 2: Flood Damage in 2011



(1) Maximum Depth of Water Immersion (m)

(2) Maximum Inundation Days

(1) v66: What was the depth of water immersion from the flood in 2011?
(2)v79-v84: In which day did water immersion start and end?

Figure 3: Established Year

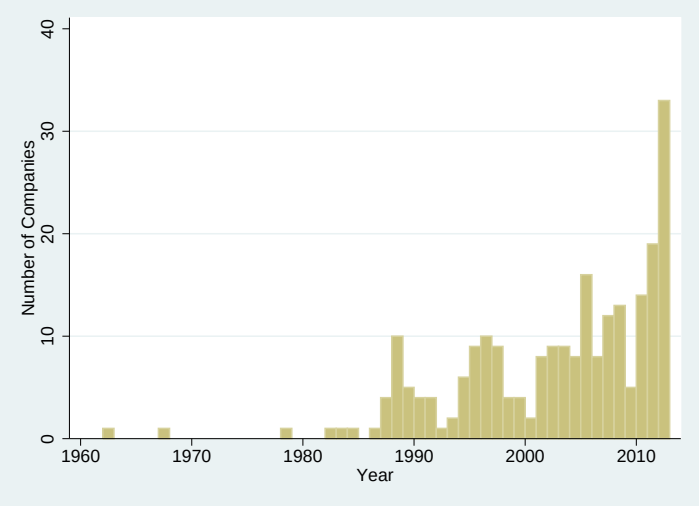
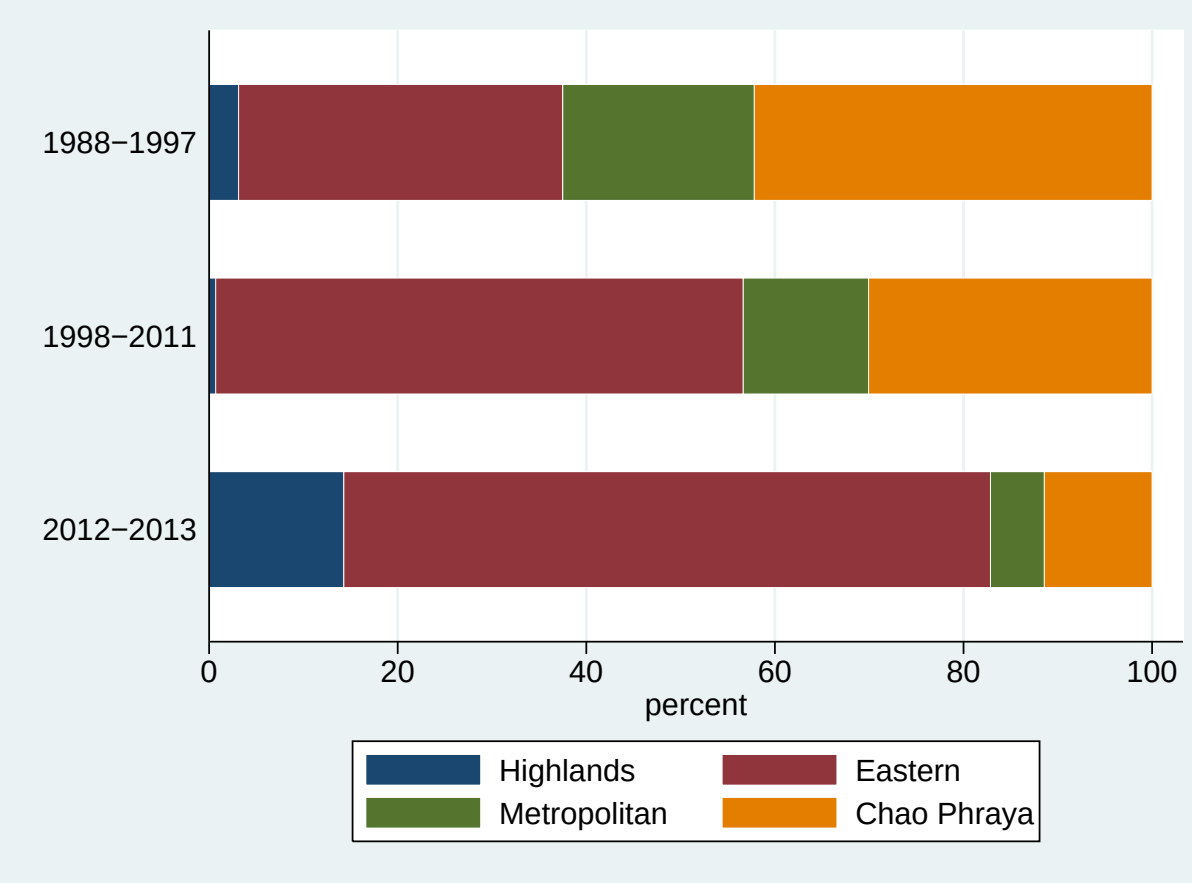
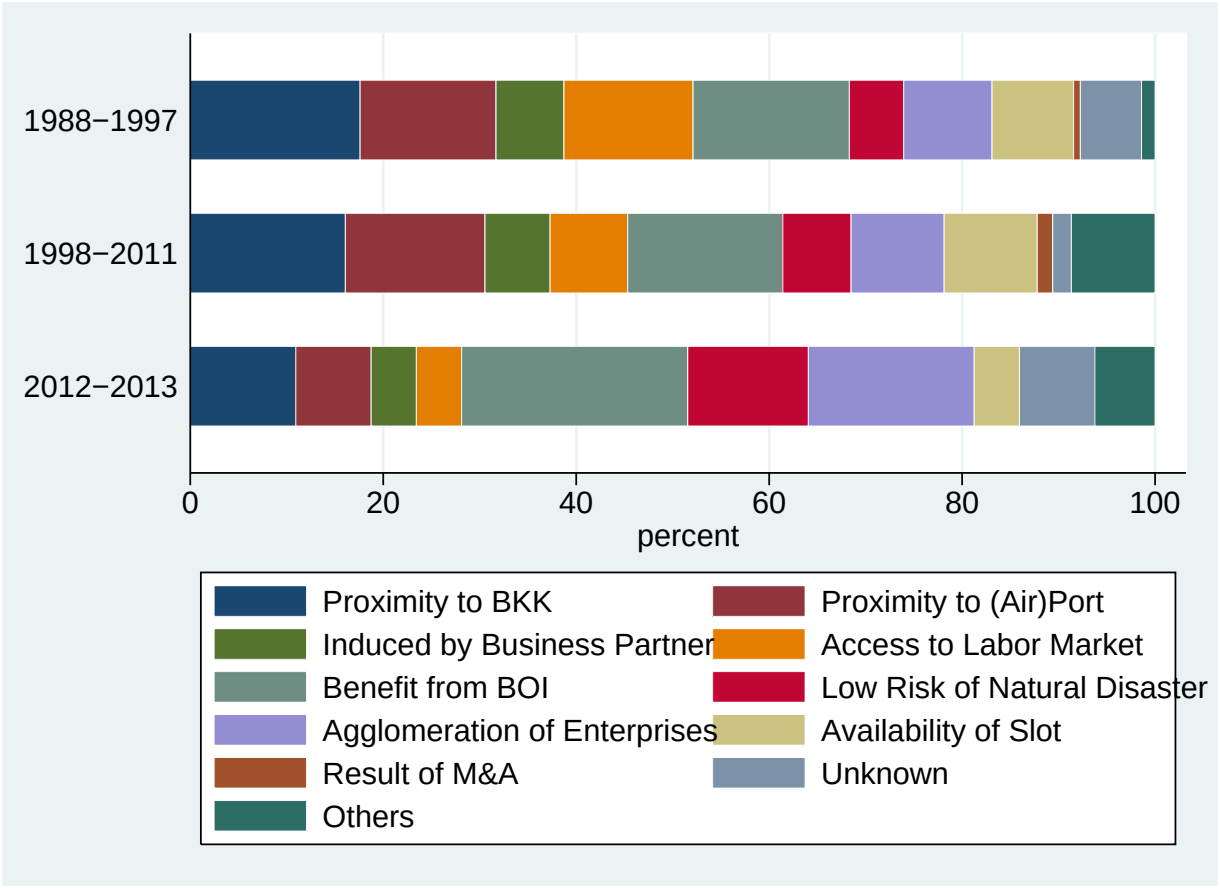


Figure 4: Location of Companies in Each Region



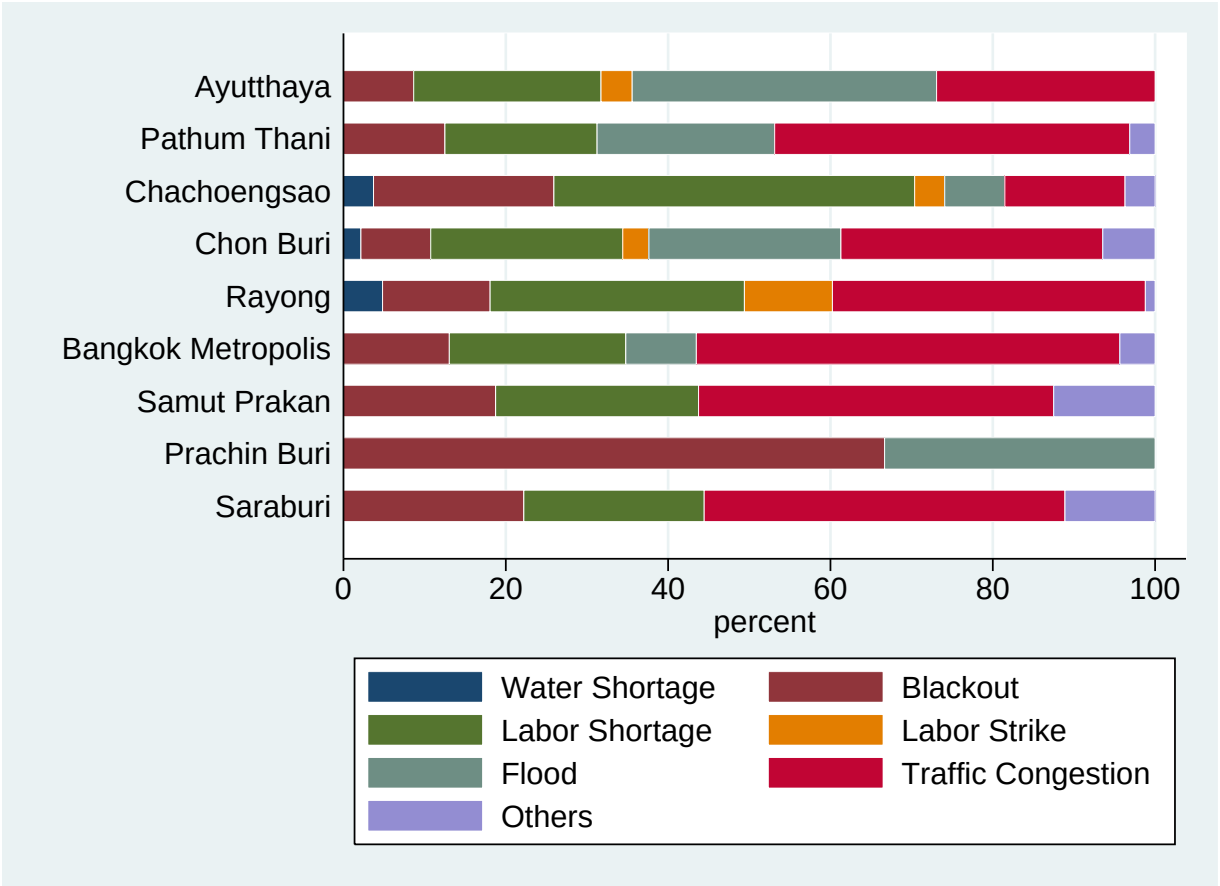
v46: In which province and IE is your company located?
Number of observations 1988–1997: 64 1998–2011: 143 2012–2013: 35

Figure 5: Determining Factors for Location Decision (Multiple Answers)



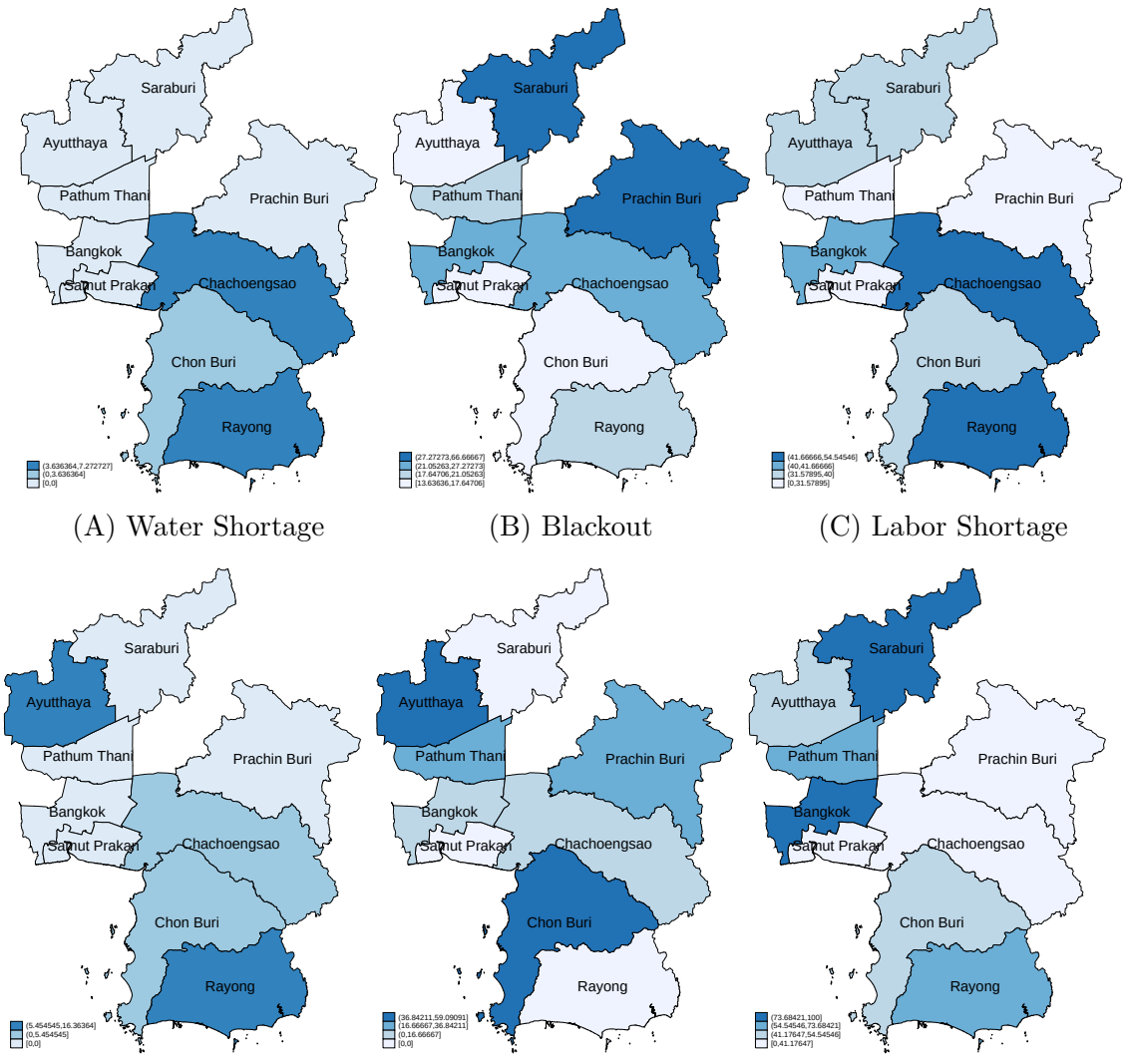
v25: What is the reason for choosing this location?
Number of observations 1988–1997: 64 1998–2011: 143 2012–2013: 35

Figure 6: IE Reported Problems



v46: What is problematic in your IE?

Figure 7: Percentage of Respondents listed the Issue

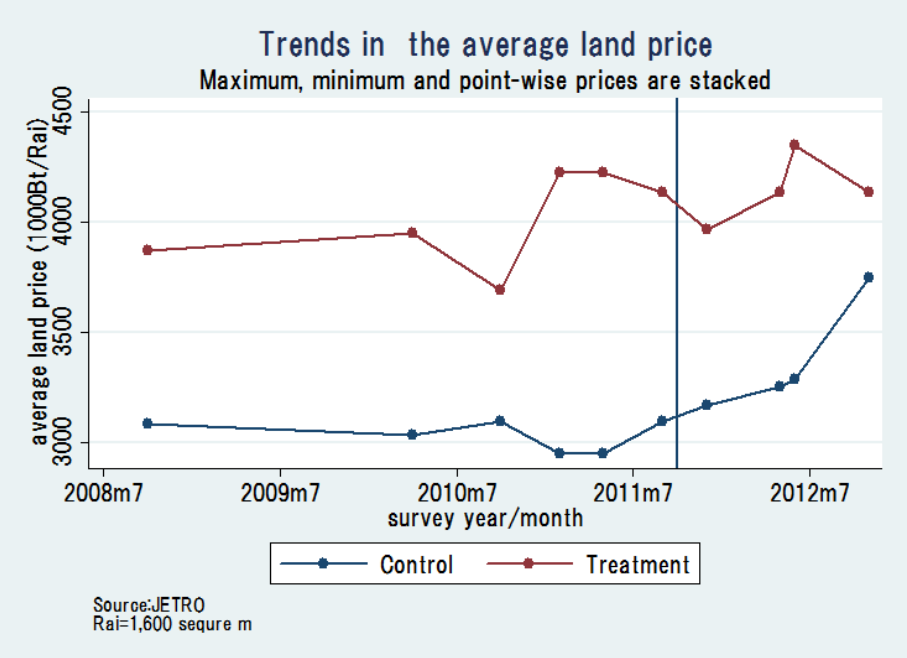


(A) Water Shortage (B) Blackout (C) Labor Shortage

(D) Labor Strike (E) Flood (F) Traffic Congestion

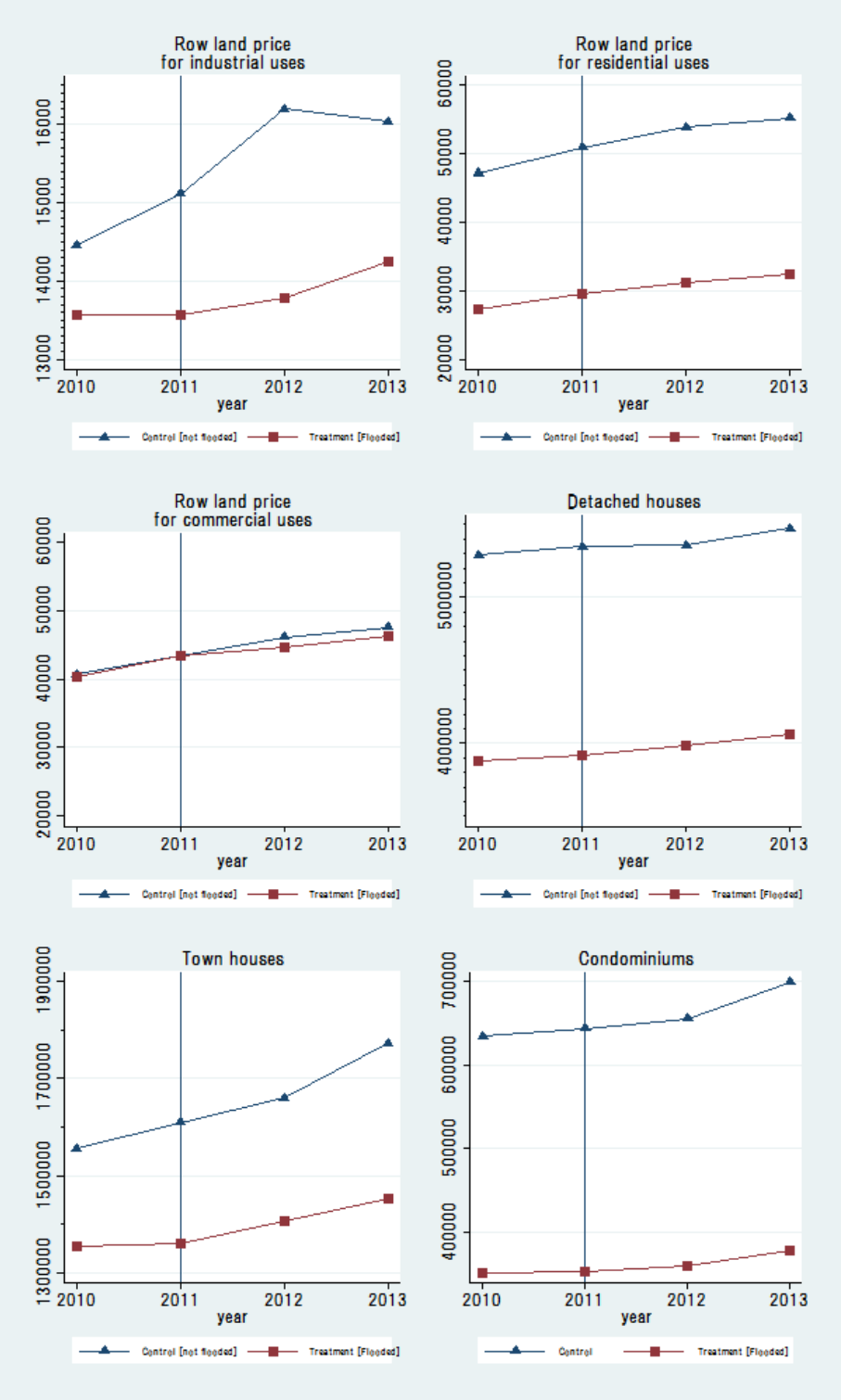
v46: What is problematic in your IE?
Quartile in darkest color.

Figure 8: Trend in Average Land and Housing Prices (JETRO data)



Data] from Japan External Trade Organization

Figure 9: Trend in Average Land and Housing Prices (AREA)



Data from Agency for Real Estate Affairs, Thailand

Table 1: Location Choice Determinants by Regions—Odds Ratio

	(1)			(2)		
	Highlands	Metropolitan	Chao Phraya	Highlands	Metropolitan	Chao Phraya
Proximity to BKK	1.144	1.406***	2.391***	0.695	1.847***	2.783***
	(0.773)	(0.199)	(0.321)	(0.835)	(0.401)	(0.446)
Proximity to Airport and Port	-19.50***	0.551	-1.990***	-18.47***	0.727	-1.987***
	(0.839)	(0.369)	(0.536)	(0.752)	(0.492)	(0.486)
Induced by Business Partner	-18.53***	-0.0372	-0.582***	-17.90***	-0.0304	-0.730***
	(1.512)	(0.427)	(0.179)	(1.229)	(0.564)	(0.276)
Access to Labor Market	1.244	0.853*	0.986**	1.033	0.826**	0.634
	(0.931)	(0.438)	(0.418)	(0.970)	(0.414)	(0.512)
Benefit from BOI	-0.442	-3.996***	-0.156	-0.445	-4.287***	-0.232
	(1.549)	(1.254)	(0.487)	(1.584)	(1.254)	(0.683)
Low Risk of Natural Disaster	2.901***	-0.217	-1.586**	3.208***	-0.506	-1.974***
	(0.916)	(0.384)	(0.717)	(1.103)	(0.398)	(0.628)
Agglomeration of Enterprises	-17.94***	-0.138	0.256*	-17.03***	-0.000821	0.528**
	(1.148)	(0.260)	(0.153)	(1.789)	(0.371)	(0.229)
Availability of Slot	-18.25***	0.556*	-0.459***	-17.61***	0.561**	-0.537***
	(1.205)	(0.297)	(0.146)	(1.266)	(0.244)	(0.206)
Result of M&A	-17.15***	2.695***	1.603	-15.81***	3.584***	2.575**
	(1.216)	(0.904)	(0.997)	(1.301)	(0.823)	(1.133)
Rubber and Plastic Products				1.342	0.711	-0.176
				(1.713)	(1.115)	(0.471)
Electronic Devices				1.696*	0.448	1.101*
				(0.943)	(0.831)	(0.626)
Machinery				-16.28***	-1.468*	-1.261**
				(1.917)	(0.760)	(0.576)
Motor Vehicles and Transport				-0.185	-2.324*	-2.374***
				(1.121)	(1.223)	(0.618)
Others				1.326	-0.835	-1.132*
				(0.928)	(1.034)	(0.589)
Constant	-2.726**	-1.538	-0.812	-3.598**	-0.868	0.0650
	(1.131)	(0.986)	(1.053)	(1.717)	(1.354)	(1.475)
Industry Control	No	No	No	Yes	Yes	Yes
Observations	242	242	242	242	242	242
Pseudo R-squared	0.263	0.350	0.263	0.350	0.263	0.350

Province clustered standard errors in parentheses * $p < .10$, ** $p < .05$, *** $p < .01$

Survey: v25 Which factor did you consider for choosing the current location of your company?

Base: Eastern

Table 2: Location Choice Determinants by Regions Before and After the 2011 Floods—Odds Ratio

	(1)			(2)		
	Highlands	Metropolitan	Chao Phraya	Highlands	Metropolitan	Chao Phraya
Proximity to BKK	0.981	1.417***	2.362***	-14.66***	1.824***	2.664***
	(0.778)	(0.223)	-0.329	(1.185)	(0.453)	-0.47
Proximity to Airport and Port	-17.38***	0.445	-2.159***	-17.42***	0.679	-2.029***
	(0.822)	(0.312)	-0.505	(0.826)	(0.462)	-0.471
Induced by Business Partner	-17.11***	-0.0852	-0.648***	-16.98***	-0.0634	-0.776***
	(1.217)	(0.412)	-0.178	(1.846)	(0.574)	-0.256
Access to Labor Market	-14.82***	0.654*	0.713**	-15.46***	0.651**	0.382
	(1.437)	(0.337)	-0.323	(1.226)	(0.293)	-0.428
Benefit from BOI	-0.735	-3.939***	-0.0214	-0.0843	-4.235***	-0.0982
	(1.843)	(1.201)	-0.423	(1.358)	(1.184)	-0.575
Low Risk of Natural Disaster	2.313	-0.0541	-1.365*	2.112	-0.430	-1.978***
	(1.876)	(0.563)	-0.762	(1.679)	(0.553)	-0.587
Agglomeration of Enterprises	-16.76***	-0.104	0.315**	-17.44***	0.0444	0.606***
	(0.921)	(0.280)	-0.145	(1.019)	(0.251)	-0.232
Availability of Slot	-17.13***	0.489*	-0.497***	-17.05***	0.516**	-0.500**
	(1.206)	(0.272)	-0.129	(1.478)	(0.210)	-0.201
Result of M&A	-16.29***	2.566***	1.398	-16.78***	3.424***	2.292*
	(1.365)	(0.985)	-1.054	(1.698)	(0.953)	-1.221
After	0.667	-0.609	-1.583*	1.256	-0.446	-1.319
	(1.861)	(1.106)	-0.845	(2.137)	(1.215)	-0.842
Interaction Natural Disaster	-0.716	-24.99***	-24.55***	29.45***	-23.65***	-36.24***
	(2.348)	(1.764)	-1.448	(2.554)	(2.390)	-1.544
Interaction Labor Market	54.36***	3.004	40.07***	82.79***	23.09***	57.00***
	(1.472)	(2.208)	-1.375	(3.058)	(2.684)	-2.117
Rubber and Plastic Products				-13.21***	0.476	-0.436
				(1.050)	(1.040)	-0.605
Electronic Devices				-12.52***	0.256	0.881
				(2.259)	(0.716)	-0.629
Machinery				-60.90***	-1.576**	-1.495**
				(2.988)	(0.690)	-0.654
Motor Vehicles and Transport				-59.95***	-2.443**	-2.459***
				(3.061)	(1.182)	-0.67
Others				-13.61***	-1.058	-1.438**
				(1.815)	(0.850)	-0.709
Constant	-2.581**	-1.402	-0.606	11.38***	-0.576	0.488
	(1.247)	(1.023)	-1.066	(2.694)	(1.241)	-1.583
Industry Control	No	No	No	Yes	Yes	Yes
Observations	242	242	242	242	242	242
Pseudo R-squared	0.288	0.378	0.288	0.378	0.288	0.378

Province clustered standard errors in parentheses * $p < .10$, ** $p < .05$, *** $p < .01$

Survey: v25 Which factor did you consider for choosing the current location of your company?

Base: Eastern

Table 3: Location-Specific Issues (Multiple Answers)

%	Water Shortages	Blackouts	Labor Shortages	Labor Strikes	Floods	Traffic Congestion	Total Number of Companies
Ayutthaya	0	13.6	36.4	6.1	59.1	42.4	66
Pathum Thani	0	21.1	31.6	0	36.8	73.7	38
Chachoengsao	4.5	27.3	54.5	4.5	9.1	18.2	22
Chon Buri	3.6	14.5	40.0	5.5	40.0	54.5	55
Rayong	7.3	20.0	47.3	16.4	0	58.2	55
Bangkok Metropolis	0	25.0	41.7	0	16.7	100.0	12
Samut Prakan	0	17.6	23.5	0	0	41.2	17
Prachin Buri	0	66.7	0	0	33.3	0	3
Saraburi	0	40.0	40.0	0	0	80.0	5
Total	2.6	19.0	39.2	6.2	29.3	53.1	273

Note: The numbers are the percentages of firms that raised the issue as a problem they are facing.

Survey: v46: What is problematic in your IE?

Figure7 geographically shows the result of Table3.

Table 4: Issues of Industrial Estate by Region

	(1) Water Shortage	(2) Blackout	(3) Labor Shortage	(4) Labor Strike	(5) Flood	(6) Traffic Congestion	(7) Others
Chao Phraya	1.79 10 $^{-16}$	-0.0434	0.0358	0.0385	0.441***	-0.117	-0.0842*
	(0.0330)	(0.0822)	(0.102)	(0.0505)	(0.0890)	(0.105)	(0.0462)
Eastern	0.0530	-0.0175	0.144	0.0985**	0.113	-0.155	-0.0428
	(0.0322)	(0.0803)	(0.100)	(0.0493)	(0.0870)	(0.103)	(0.0452)
Metropolitan (BASE)							
Highland	1.28 10 $^{-16}$	0.293*	-0.0603	3.32 10 $^{-16}$	0.0560	-0.155	0.0216
	(0.0627)	(0.156)	(0.195)	(0.0961)	(0.169)	(0.200)	(0.0879)
Constant	-1.66 10 $^{-16}$	0.207***	0.310***	-3.14 10 $^{-16}$	0.0690	0.655***	0.103**
	(0.0292)	(0.0727)	(0.0906)	(0.0447)	(0.0787)	(0.0929)	(0.0409)
Observations	273	273	273	273	273	273	273
Adjusted R^2	0.017	0.009	0.006	0.013	0.135	-0.002	0.007

Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

v46: What is problematic in your IE?

Table 5: Issues of Industrial Estate by Province

	(1) Water Shortage	(2) Blackout	(3) Labor Shortage	(4) Labor Strike	(5) Flood	(6) Traffic Congestion	(7) Others
Ayutthaya	-3.09 10^{-16}	-0.114	-0.0530	0.0606	0.424***	-0.576***	-0.0833
	(0.0463)	(0.123)	(0.153)	(0.0755)	(0.126)	(0.148)	(0.0683)
PathumThani	-5.98 10^{-16}	-0.0395	-0.101	-9.18 10^{-16}	0.202	-0.263*	-0.0307
	(0.0488)	(0.130)	(0.162)	(0.0797)	(0.133)	(0.156)	(0.0721)
Chachoengsao	0.0455	0.0227	0.129	0.0455	-0.0758	-0.818***	-0.0379
	(0.0529)	(0.141)	(0.175)	(0.0863)	(0.144)	(0.169)	(0.0781)
Chonburi	0.0351	-0.110	0.00439	0.0702	0.219*	-0.439***	0.0395
	(0.0468)	(0.125)	(0.155)	(0.0764)	(0.128)	(0.150)	(0.0691)
Rayong	0.0566	-0.0425	0.0550	0.151*	-0.167	-0.434***	-0.0833
	(0.0471)	(0.126)	(0.156)	(0.0769)	(0.128)	(0.151)	(0.0696)
BKK (BASE)							
SamutPrakan	-3.88 10^{-16}	-0.0625	-0.229	-1.00 10^{-15}	-0.167	-0.625***	0.0417
	(0.0563)	(0.150)	(0.186)	(0.0919)	(0.153)	(0.180)	(0.0831)
Prachinburi	-4.78 10^{-16}	0.417	-0.417	-4.49 10^{-16}	0.167	-1.000***	-0.0833
	(0.0951)	(0.254)	(0.315)	(0.155)	(0.259)	(0.304)	(0.140)
Saraburi	-3.98 10^{-16}	0.150	-0.0167	-3.23 10^{-16}	-0.167	-0.200	0.117
	(0.0785)	(0.209)	(0.260)	(0.128)	(0.214)	(0.251)	(0.116)
Constant	3.68 10^{-16}	0.250**	0.417***	8.74 10^{-16}	0.167	1.000***	0.0833
	(0.0426)	(0.113)	(0.141)	(0.0695)	(0.116)	(0.136)	(0.0628)
Observations	272	272	272	272	272	272	272
Adjusted R^2	-0.004	0.005	0.006	0.016	0.225	0.112	0.033

Standard errors in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

v46: What is problematic in your IE?

Table 6: Issues of Industrial Estate by Region with Different Establishment Year Group

	(1) Water Shortage	(2) Blackout	(3) Labor Shortage	(4) Labor Strike	(5) Flood	(6) Traffic Congestion	(7) Others
Chao Phraya 1962 1985	-4.59 10^{-16}	-0.214	0.357	7.20 10^{-16}	0.929***	-0.0714	-2.49 10^{-16}
	(0.0826)	(0.225)	(0.274)	(0.137)	(0.237)	(0.281)	(0.121)
Chao Phraya 1986 1997	-3.63 10^{-16}	-0.0530	0.212	6.98 10^{-16}	0.509***	-0.0230	-9.14 10^{-17}
	(0.0469)	(0.128)	(0.156)	(0.0777)	(0.135)	(0.159)	(0.0686)
Chao Phraya 1998 2011	-1.85 10^{-16}	-0.0192	0.272*	0.0976	0.441***	-0.0836	0.0488
	(0.0451)	(0.123)	(0.150)	(0.0747)	(0.129)	(0.153)	(0.0659)
Chao Phraya 2012 2013	-4.14 10^{-16}	0.0357	0.107	7.29 10^{-16}	-0.0714	-0.0714	-1.64 10^{-16}
	(0.0826)	(0.225)	(0.274)	(0.137)	(0.237)	(0.281)	(0.121)
Chao Phraya unknown	-2.83 10^{-16}	-0.0893	0.0655	6.86 10^{-16}	0.345**	0.0536	1.36 10^{-16}
	(0.0490)	(0.133)	(0.162)	(0.0811)	(0.141)	(0.166)	(0.0716)
Eastern 1962 1985	1.000***	-0.214	-0.143	7.22 10^{-16}	-0.0714	0.429	-1.45 10^{-16}
	(0.151)	(0.411)	(0.500)	(0.250)	(0.433)	(0.512)	(0.220)
Eastern 1986 1997	0.0500	0.0357	0.157	0.0500	0.279*	0.0786	0.150**
	(0.0508)	(0.138)	(0.168)	(0.0841)	(0.146)	(0.172)	(0.0742)
Eastern 1998 2011	0.0133	-0.0143	0.270*	0.147**	0.102	-0.0114	0.0267
	(0.0424)	(0.116)	(0.141)	(0.0702)	(0.122)	(0.144)	(0.0620)
Eastern 2012 2013	0.0833*	-0.0476	0.524***	0.0417	-0.0298	-0.280*	0.0833
	(0.0490)	(0.133)	(0.162)	(0.0811)	(0.141)	(0.166)	(0.0716)
Eastern unknown	0.167***	-0.131	0.440**	6.85 10^{-16}	0.179	-0.321*	0.0833
	(0.0573)	(0.156)	(0.190)	(0.0949)	(0.165)	(0.195)	(0.0838)
Metropolitan 1962 1985	-4.90 10^{-16}	-0.214	0.857*	7.26 10^{-16}	-0.0714	0.429	1.000***
	(0.151)	(0.411)	(0.500)	(0.250)	(0.433)	(0.512)	(0.220)
Metropolitan 1986 1997	-3.10 10^{-16}	0.0357	0.274	6.86 10^{-16}	0.0119	0.0952	0.167**
	(0.0573)	(0.156)	(0.190)	(0.0949)	(0.165)	(0.195)	(0.0838)
Metropolitan 1998 2011 (BASE)							
Metropolitan unknown	-4.72 10^{-16}	-0.214	0.357	7.26 10^{-16}	-0.0714	0.429	-2.70 10^{-16}
	(0.110)	(0.300)	(0.365)	(0.182)	(0.316)	(0.374)	(0.161)
Highland 1986 1997	-4.20 10^{-16}	0.286	-0.143	7.23 10^{-16}	-0.0714	-0.571	-1.17 10^{-16}
	(0.110)	(0.300)	(0.365)	(0.182)	(0.316)	(0.374)	(0.161)
Highland 1998 2011	-4.13 10^{-16}	0.786*	-0.143	7.24 10^{-16}	-0.0714	-0.571	-1.87 10^{-16}
	(0.151)	(0.411)	(0.500)	(0.250)	(0.433)	(0.512)	(0.220)
Highland 2012 2013	-3.60 10^{-16}	0.186	0.257	6.51 10^{-16}	0.129	0.229	0.200*
	(0.0759)	(0.207)	(0.252)	(0.126)	(0.218)	(0.258)	(0.111)
Constant	3.16 10^{-16}	0.214**	0.143	-6.63 10^{-16}	0.0714	0.571***	-6.94e-18
	(0.0389)	(0.106)	(0.129)	(0.0645)	(0.112)	(0.132)	(0.0569)
Observations	273	273	273	273	273	273	273
Adjusted R^2	0.153	-0.018	0.025	0.007	0.159	0.020	0.071

Standard error in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

v46: What is problematic in your IE?

Table 7: Issues of Industrial Estate by Province with Different Establishment Year Group

	(1) Water Shortage	(2) Blackout	(3) Labor Shortage	(4) Labor Strike	(5) Flood	(6) Traffic Congestion	(7) Others
Ayutthaya 1962 1985	-3.71 10^{-15}	-0.400	0.800	-4.06 10^{-15}	0.800*	-1.000*	-8.53 10^{-15}
	(0.134)	(0.435)	(0.526)	(0.270)	(0.428)	(0.521)	(0.229)
Ayutthaya 1986 1997	-3.48 10^{-15}	-0.344*	0.133	-3.72 10^{-15}	0.411**	-0.611**	-8.09 10^{-15}
	(0.0621)	(0.201)	(0.243)	(0.125)	(0.198)	(0.241)	(0.106)
Ayutthaya 1998 2011	-3.53 10^{-15}	-0.239	0.219	0.129	0.381**	-0.581**	-8.18 10^{-15}
	(0.0592)	(0.192)	(0.232)	(0.119)	(0.188)	(0.229)	(0.101)
Ayutthaya 2012 2013	-3.66 10^{-15}	0.100	0.300	-4.07 10^{-15}	-0.200	-0.500	-8.33 10^{-15}
	(0.103)	(0.332)	(0.402)	(0.206)	(0.327)	(0.398)	(0.175)
Ayutthaya unknown	-3.65 10^{-15}	-0.257	0.0143	-4.33 10^{-15}	0.443**	-0.500**	-7.83 10^{-15}
	(0.0640)	(0.207)	(0.250)	(0.128)	(0.204)	(0.248)	(0.109)
PathumThani 1962 1985	-3.49 10^{-15}	-0.400	0.133	-2.94 10^{-15}	0.800***	-0.333	-7.94 10^{-15}
	(0.0897)	(0.290)	(0.351)	(0.180)	(0.286)	(0.348)	(0.152)
PathumThani 1986 1997	-3.40 10^{-15}	-0.0923	0.185	-4.30 10^{-15}	0.338	-0.231	-7.90 10^{-15}
	(0.0646)	(0.209)	(0.253)	(0.130)	(0.206)	(0.250)	(0.110)
PathumThani 1998 2011	-3.44 10^{-15}	-0.1000	0.200	-3.56 10^{-15}	0.1000	-0.300	0.200*
	(0.0672)	(0.218)	(0.263)	(0.135)	(0.214)	(0.261)	(0.114)
PathumThani 2012 2013	-3.60 10^{-15}	-0.400	-0.200	-3.94 10^{-15}	-0.200	-0.500	-8.17 10^{-15}
	(0.103)	(0.332)	(0.402)	(0.206)	(0.327)	(0.398)	(0.175)
PathumThani unknown	-3.43 10^{-15}	-0.300	-6.07 10^{-15}	-3.55 10^{-15}	-0.100	-0.200	-7.91 10^{-15}
	(0.0672)	(0.218)	(0.263)	(0.135)	(0.214)	(0.261)	(0.114)
Chachoengsao 1986 1997	-3.59 10^{-15}	0.100	-0.200	-3.93 10^{-15}	0.300	-0.500	-8.14 10^{-15}
	(0.103)	(0.332)	(0.402)	(0.206)	(0.327)	(0.398)	(0.175)
Chachoengsao 1998 2011	-3.59 10^{-15}	-0.150	0.425	0.125	-0.0750	-0.625**	-8.12 10^{-15}
	(0.0700)	(0.227)	(0.274)	(0.140)	(0.223)	(0.271)	(0.119)
Chachoengsao 2012 2013	0.167**	-0.0667	0.133	-3.09 10^{-15}	-0.200	-1.000***	0.167
	(0.0743)	(0.241)	(0.291)	(0.149)	(0.237)	(0.288)	(0.126)
Chachoengsao unknown	-3.53 10^{-15}	-0.233	0.633**	-3.11 10^{-15}	-0.200	-1.000***	-7.76 10^{-15}
	(0.0743)	(0.241)	(0.291)	(0.149)	(0.237)	(0.288)	(0.126)
Chonburi 1986 1997	0.0769	-0.246	0.185	0.0769	0.262	-0.385	0.231**
	(0.0646)	(0.209)	(0.253)	(0.130)	(0.206)	(0.250)	(0.110)
Chonburi 1998 2011	-3.58 10^{-15}	-0.244	0.206	0.0937	0.175	-0.406*	0.0625
	(0.0590)	(0.191)	(0.231)	(0.118)	(0.188)	(0.229)	(0.100)
Chonburi 2012 2013	0.125*	-0.275	0.550**	-3.74 10^{-15}	-0.0750	-0.500*	0.125
	(0.0700)	(0.227)	(0.274)	(0.140)	(0.223)	(0.271)	(0.119)
Chonburi unknown	-3.57 10^{-15}	-0.400	-0.200	-3.72 10^{-15}	0.550**	-0.750**	0.250*
	(0.0824)	(0.267)	(0.322)	(0.165)	(0.262)	(0.319)	(0.140)
Rayong 1986 1997	-3.56 10^{-15}	-0.0667	0.133	-3.14 10^{-15}	-0.200	-0.167	-7.76 10^{-15}
	(0.0743)	(0.241)	(0.291)	(0.149)	(0.237)	(0.288)	(0.126)
Rayong 1998 2011	0.0286	-0.171	0.171	0.200*	-0.200	-0.429*	-7.83 10^{-15}
	(0.0587)	(0.190)	(0.230)	(0.118)	(0.187)	(0.228)	(0.0998)
Rayong 2012 2013	-3.48 10^{-15}	-0.300	0.600**	0.1000	-0.200	-0.700***	-7.71 10^{-15}
	(0.0672)	(0.218)	(0.263)	(0.135)	(0.214)	(0.261)	(0.114)
Rayong unknown	1.000***	-0.400	0.800**	-3.81 10^{-15}	-0.200	4.03 10^{-14}	-7.97 10^{-15}
	(0.103)	(0.332)	(0.402)	(0.206)	(0.327)	(0.398)	(0.175)
Constant	3.51 10^{-15}	0.400**	0.200	3.70 10^{-15}	0.200	1.000***	7.66 10^{-15}
	(0.0549)	(0.178)	(0.215)	(0.110)	(0.175)	(0.213)	(0.0934)
Observations	272	272	272	272	272	272	272
Adjusted R^2	0.304	-0.018	0.036	-0.032	0.266	0.094	0.110

Standard error in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

v46: What is problematic in your IE?

Table 7: Issues of Industrial Estate by Province with Different Establishment Year Group (Compared to BKK 1998–2011) Cont.

	(1) Water Shortage	(2) Blackout	(3) Labor Shortage	(4) Labor Strike	(5) Flood	(6) Traffic Congestion	(7) Others
BKK 1962 1985	-3.64 10^{-15}	-0.400	0.800	-4.02 10^{-15}	-0.200	4.00 10^{-14}	1.000***
	(0.134)	(0.435)	(0.526)	(0.270)	(0.428)	(0.521)	(0.229)
BKK 1986 1997	-3.64 10^{-15}	-0.150	0.300	-4.01 10^{-15}	0.0500	4.00 10^{-14}	-8.29 10^{-15}
	(0.0824)	(0.267)	(0.322)	(0.165)	(0.262)	(0.319)	(0.140)
BKK 1998-2011 (BASE)							
BKK unknown	-3.62 10^{-15}	-0.400	0.300	-4.00 10^{-15}	-0.200	4.01 10^{-14}	-8.25 10^{-15}
	(0.103)	(0.332)	(0.402)	(0.206)	(0.327)	(0.398)	(0.175)
SamutPrakan 1986 1997	-3.55 10^{-15}	-0.114	0.0857	-3.77 10^{-15}	-0.200	-0.571**	0.286**
	(0.0719)	(0.233)	(0.281)	(0.144)	(0.229)	(0.279)	(0.122)
SamutPrakan 1998 2011	-3.52 10^{-15}	-0.289	-0.0889	-3.63 10^{-15}	-0.200	-0.667**	-7.71 10^{-15}
	(0.0685)	(0.222)	(0.268)	(0.137)	(0.218)	(0.265)	(0.116)
Prachinburi 1986 1997	-3.60 10^{-15}	0.600	-0.200	-3.94 10^{-15}	-0.200	-1.000*	-8.15 10^{-15}
	(0.134)	(0.435)	(0.526)	(0.270)	(0.428)	(0.521)	(0.229)
Prachinburi 1998 2011	-3.60 10^{-15}	0.600	-0.200	-3.93 10^{-15}	-0.200	-1.000*	-8.15 10^{-15}
	(0.134)	(0.435)	(0.526)	(0.270)	(0.428)	(0.521)	(0.229)
Prachinburi 2012 2013	-3.60 10^{-15}	-0.400	-0.200	-3.94 10^{-15}	0.800*	-1.000*	-8.15 10^{-15}
	(0.134)	(0.435)	(0.526)	(0.270)	(0.428)	(0.521)	(0.229)
Saraburi 1986 1997	-3.68 10^{-15}	-0.400	-0.200	-4.10 10^{-15}	-0.200	-1.000*	-8.54 10^{-15}
	(0.134)	(0.435)	(0.526)	(0.270)	(0.428)	(0.521)	(0.229)
Saraburi 2012 2013	-3.69 10^{-15}	0.100	0.300	-4.09 10^{-15}	-0.200	3.98 10^{-14}	0.250*
	(0.0824)	(0.267)	(0.322)	(0.165)	(0.262)	(0.319)	(0.140)
Constant	3.51 10^{-15}	0.400**	0.200	3.70 10^{-15}	0.200	1.000***	7.66 10^{-15}
	(0.0549)	(0.178)	(0.215)	(0.110)	(0.175)	(0.213)	(0.0934)
Observations	272	272	272	272	272	272	272
Adjusted R^2	0.304	-0.018	0.036	-0.032	0.266	0.094	0.110

Standard error in parentheses, * * $p < .10$, ** $p < .05$, *** $p < .01$

v46: What is problematic in your IE?

Table 8: Issues of Industrial Estate by Industrial Estate (Compared to Lad Krabang)

	(1) Water Shortage	(2) Blackout	(3) Labor Shortage	(4) Labor Strike	(5) Flood	(6) Traffic Congestion	(7) Others
Saha Rattana Nakorn	-1.09 10^{-15}	-0.182	0.636*	5.96 10^{-15}	0.318	-1.000***	-0.0909
	(0.0929)	(0.294)	(0.376)	(0.181)	(0.301)	(0.352)	(0.172)
Hi- Tech	-8.54 10^{-16}	-0.0949	-0.146	7.38 10^{-15}	0.383***	-0.522***	-0.0909
	(0.0443)	(0.140)	(0.179)	(0.0864)	(0.144)	(0.168)	(0.0821)
Bangpa-in	-7.63 10^{-16}	-0.182	-0.0636	6.70 10^{-15}	0.618***	-0.800***	-0.0909
	(0.0528)	(0.167)	(0.214)	(0.103)	(0.171)	(0.200)	(0.0978)
Rojana- Ayutthaya	-8.64 10^{-16}	0.0440	0.0880	0.129	0.367***	-0.516***	-0.0909
	(0.0424)	(0.134)	(0.172)	(0.0827)	(0.138)	(0.161)	(0.0786)
Nava Nakorn- Pathumthani	-6.53 10^{-16}	0.0182	-0.0303	6.06 10^{-15}	0.252*	-0.233	-0.0576
	(0.0426)	(0.135)	(0.172)	(0.0831)	(0.138)	(0.162)	(0.0789)
Bangkadi	-9.36 10^{-16}	0.0682	-0.114	6.22 10^{-15}	-0.0568	-0.375*	0.0341
	(0.0562)	(0.178)	(0.227)	(0.110)	(0.182)	(0.213)	(0.104)
Gateway City	0.0625	0.131	0.136	6.28 10^{-15}	-0.182	-1.000***	-0.0284
	(0.0473)	(0.150)	(0.192)	(0.0923)	(0.154)	(0.179)	(0.0877)
Wellgrow	-7.90 10^{-16}	-0.0152	0.303	0.167	0.152	-0.333	-0.0909
	(0.0613)	(0.194)	(0.248)	(0.120)	(0.199)	(0.233)	(0.114)
Amata Nakorn	0.0256	-0.0793	-0.00466	0.0256	0.357***	-0.410***	0.0117
	(0.0413)	(0.131)	(0.167)	(0.0805)	(0.134)	(0.156)	(0.0764)
Pinthong	-7.47 10^{-16}	-0.0280	0.175	0.0769	-0.182	-0.615***	-0.0140
	(0.0495)	(0.157)	(0.200)	(0.0966)	(0.161)	(0.188)	(0.0917)
Laem Chabang	0.333***	0.485*	-0.0303	0.333**	0.152	-0.333	0.242*
	(0.0787)	(0.249)	(0.318)	(0.154)	(0.255)	(0.298)	(0.146)
Eastern Seaboard (Rayong)	-7.69 10^{-16}	-0.00940	0.0846	0.241***	-0.182	-0.379**	-0.0909
	(0.0428)	(0.136)	(0.173)	(0.0835)	(0.139)	(0.162)	(0.0793)
Hemaraj Eastern Seaboard	-8.35 10^{-16}	0.104	0.208	0.286**	-0.182	-0.286	0.0519
	(0.0584)	(0.185)	(0.236)	(0.114)	(0.190)	(0.222)	(0.108)
Siam Eastern	-9.05 10^{-16}	-0.182	0.136	6.30 10^{-15}	-0.182	4.92 10^{-15}	-0.0909
	(0.0929)	(0.294)	(0.376)	(0.181)	(0.301)	(0.352)	(0.172)
Amata City	-8.22 10^{-16}	-0.182	0.351	6.44 10^{-15}	-0.182	-0.714***	-0.0909
	(0.0584)	(0.185)	(0.236)	(0.114)	(0.190)	(0.222)	(0.108)
Rojana- Rayong	-9.26 10^{-16}	-0.182	0.636	6.31 10^{-15}	-0.182	-1.000**	-0.0909
	(0.126)	(0.400)	(0.511)	(0.246)	(0.410)	(0.479)	(0.234)
Hemaraj Rayong Industrial Land	-9.13 10^{-16}	0.818**	-0.364	6.33 10^{-15}	-0.182	-1.000**	-0.0909
	(0.126)	(0.400)	(0.511)	(0.246)	(0.410)	(0.479)	(0.234)
Rayong Industrial Park	-9.25 10^{-16}	-0.182	-0.364	6.32 10^{-15}	-0.182	-1.000**	-0.0909
	(0.126)	(0.400)	(0.511)	(0.246)	(0.410)	(0.479)	(0.234)
Asia IE Mapta Phut	0.500***	0.0682	0.136	6.40 10^{-15}	-0.182	4.79 10^{-15}	-0.0909
	(0.0706)	(0.224)	(0.286)	(0.138)	(0.229)	(0.268)	(0.131)
Hemaraj Eastern	1.000***	0.818**	-0.364	6.35 10^{-15}	-0.182	-1.000**	-0.0909
	(0.126)	(0.400)	(0.511)	(0.246)	(0.410)	(0.479)	(0.234)
Padaeng	-9.29 10^{-16}	0.818**	-0.364	6.28 10^{-15}	-0.182	-1.000**	-0.0909
	(0.126)	(0.400)	(0.511)	(0.246)	(0.410)	(0.479)	(0.234)
Bangchan	-9.95 10^{-16}	0.818**	0.636	6.10 10^{-15}	-0.182	4.95 10^{-15}	-0.0909
	(0.126)	(0.400)	(0.511)	(0.246)	(0.410)	(0.479)	(0.234)
Lad Krabang (BASE)							
Bangpoo	-7.74 10^{-16}	-0.0818	-0.0636	6.53 10^{-15}	-0.182	-0.600***	0.00909
	(0.0528)	(0.167)	(0.214)	(0.103)	(0.171)	(0.200)	(0.0978)
Bangplee	-7.98 10^{-16}	0.104	-0.221	6.46 10^{-15}	-0.182	-0.571**	0.0519
	(0.0584)	(0.185)	(0.236)	(0.114)	(0.190)	(0.222)	(0.108)
304 IP I	-7.70 10^{-16}	0.485*	-0.364	7.23 10^{-15}	0.152	-1.000***	-0.0909
	(0.0787)	(0.249)	(0.318)	(0.154)	(0.255)	(0.298)	(0.146)
Hemaraj Saraburi IL	-7.62 10^{-16}	0.218	0.0364	6.76 10^{-15}	-0.182	-0.200	0.109
	(0.0652)	(0.207)	(0.264)	(0.127)	(0.211)	(0.247)	(0.121)
Constant	7.70 10^{-16}	0.182	0.364**	-6.55 10^{-15}	0.182	1.000***	0.0909
	(0.0364)	(0.115)	(0.147)	(0.0711)	(0.118)	(0.138)	(0.0675)
Observations	272	272	272	272	272	272	272
Adjusted R^2	0.325	0.056	0.002	0.055	0.262	0.160	-0.023

Standard error in parentheses, * $p < .10$, ** $p < .05$, *** $p < .01$

v46: What is problematic in your IE?

Table 9: Descriptive Statistics (JETRO data)

		Flooded area					Non flooded area				
	round	mean	sd	min	max	Observations	mean	sd	min	max	Observations
Land price Bt./Rai [1]	1	3433.33	750.56	2700	4200	3	3177.86	1985.45	950	7500	14
	2	4216.67	800.52	3400	5000	3	3258.18	2258.17	950	7500	11
	3	3837.5	1001.15	2700	5000	4	3258.18	2258.17	950	7500	11
	4	3450	70.71	3400	3500	2	3454.17	2144.07	1450	7500	12
	5	3450	70.71	3400	3500	2	3454.17	2144.07	1450	7500	12
	6	4133.33	1628.91	3000	6000	3	3404.55	1889.24	1550	7500	11
	7	3966.67	1342.88	3000	5500	3	3834.62	2033.82	1550	8000	13
	8	4133.33	1628.91	3000	6000	3	4183.33	2183.76	1600	8000	12
	9	3200	282.84	3000	3400	2	4026.92	2169.74	1550	8000	13
	10	4133.33	1628.91	3000	6000	3	3821.43	1927.9	1750	7000	14
Land price (upper bound) Bt./Rai [1]	1	4500	1414.21	3500	5500	2	3275	2206.62	1500	6500	4
	2	4150	919.24	3500	4800	2	3210	1928.99	1500	7000	10
	3	3500		3500	3500	1	3354.55	1891.75	1500	7000	11
	4	5500		5500	5500	1	2664.29	1185.58	1450	5000	7
	5	5500		5500	5500	1	2664.29	1185.58	1450	5000	7
	6					0	3071.11	1910.76	1440	7000	9
	7					0	2815.56	1838.39	1440	7500	9
	8					0	2855.56	1490.9	1500	6500	9
	9	6000		6000	6000	1	2881.25	1607.11	1500	6600	8
	10					0	4111.11	4122.03	1500	14000	9
Land price (Lower bound) Bt./Rai [1]	1	3900	848.53	3300	4500	2	2575	1384.14	1200	4500	4
	2	3350	70.71	3300	3400	2	2600	1383.23	1200	5500	10
	3	3300		3300	3300	1	2672.73	1334.23	1200	5500	11
	4	4500		4500	4500	1	2364.29	1085.78	1200	4500	7
	5	4500		4500	4500	1	2364.29	1085.78	1200	4500	7
	6					0	2738.89	1812.42	1150	6500	9
	7					0	2557.78	1735.96	1220	7000	9
	8					0	2410	1391.46	1300	5900	9
	9	5000		5000	5000	1	2487.5	1458.41	1300	5900	8
	10					0	3277.78	2521.3	1300	8000	9
Land price (stacked) Bt./Rai [1]	1	3740	865.64	2700	5500	10	3121.67	1883.96	950	7500	36
	2	4030	713.05	3300	5000	10	3090	1949.75	950	7500	42
	3	3750	839.31	2700	5000	10	3135.91	1921.67	950	7500	44
	4	3966.67	861.78	3400	5500	6	3107.89	1836.33	1200	7500	38
	5	3966.67	861.78	3400	5500	6	3107.89	1836.33	1200	7500	38
	6	4133.33	1456.94	3000	6000	6	3179.75	1824.61	1150	7500	40
	7	3966.67	1201.11	3000	5500	6	3365	1957.31	1220	8000	44
	8	4133.33	1456.94	3000	6000	6	3518.81	1998.82	1300	8000	42
	9	3966.67	1242.04	3000	6000	6	3515.48	2002.6	1300	8000	42
	10	4133.33	1456.94	3000	6000	6	3771.74	2524.21	1300	14000	46

Data from Japan External Trade Organization

[1] 1 square wah = 4 m^2, 1 Rai = 400 square wah = 1600 m^2

Table 10: DID analysis using JETRO data

	(1)	(2)	(3)
After flooded	-337.9*		-328.1*
	(182.7)		(195.7)
After flooded [round 7]		-190.6	
		(145.7)	
After flooded [round 8]		-227.9	
		(237.7)	
After flooded [round 9]		-472.7***	
		(123.7)	
After flooded [round 10]		-461.5	
		(279.2)	
After flooded * upper price			-30.72
			(194.3)
After flooded * lower price			-193.6
			(140.4)
Upper price	587.8**	593.7**	589.0**
	(268.0)	(268.0)	(272.8)
Lower price	-171.8	-165.9	-166.6
	(152.3)	(150.6)	(152.5)
Round 2	162.6	161.5	162.0
	(116.4)	(116.5)	(116.4)
Round 3	173.1	172.2	172.7
	(111.6)	(111.7)	(111.6)
Round 4	283.2**	282.7**	283.1**
	(108.1)	(108.6)	(108.4)
Round 5	283.2**	282.7**	283.1**
	(108.1)	(108.6)	(108.4)
Round 6	407.8***	407.2***	407.6***
	(118.9)	(119.3)	(119.1)
Round 7	501.8***	483.6***	500.4***
	(137.3)	(137.2)	(137.6)
Round 8	700.8***	687.6***	699.4***
	(142.0)	(141.8)	(142.1)
Round 9	677.0***	694.5***	680.3***
	(138.7)	(139.8)	(139.3)
Round 10	905.2***	921.2***	903.8***
	(203.1)	(213.4)	(203.1)
Constant	2925.2***	2923.1***	2924.2***
	(127.1)	(127.7)	(127.9)
Observations	484	484	484
Adjusted R^2	0.283	0.282	0.280

Data from Japan External Trade Organization
Standard errors in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 11: Descriptive Statistics (AREA)

		Flooded areas					Non-flooded areas				
category	year	mean	sd	min	max	# of observation	mean	sd	min	max	# observations
Raw land price -Residential uses Bt./square wah [1]	2010	27360	29597.15	4000	110000	15	47211.61	96481.3	375	500000	28
	2011	29506.67	33757.68	4000	125000	15	50925	106163.2	400	550000	28
	2012	31140	35454.73	4500	130000	15	53853.57	115207.8	400	600000	28
	2013	32426.67	36997.19	4800	135000	15	55269.64	117164.7	400	610000	28
Raw land price - commercial uses Bt./square wah [1]	2010	40420	33623.86	7200	110000	10	40740	40064.17	2500	90000	5
	2011	43350	38055.55	7500	125000	10	43500	43604.76	2500	100000	5
	2012	44750	39770.35	7500	130000	10	46160	47282.16	2500	110000	5
	2013	46360	41553.8	7800	135000	10	47580	48993.49	2700	115000	5
Raw land price - industrial uses Bt./square wah [1]	2010	13571.43	3493.191	10000	17500	7	14458.33	9585.639	3000	32000	12
	2011	13571.43	3493.191	10000	17500	7	15116.67	10256.78	3200	35000	12
	2012	13785.71	3238.533	10500	17500	7	16200	10484.19	3200	35000	12
	2013	14257.14	3182.691	10800	17500	7	16033.33	10428.31	3200	3.53×10^4	12
Detached houses	2010	3879167	1637273	2400000	8100000	12	5292106	4546191	1500000	1.60×10^7	19
	2011	3916667	1620372	2450000	8100000	12	5350000	4542577	1500000	1.60×10^7	19
	2012	3979167	1610118	2500000	8100000	12	5357369	4540305	1500000	1.60×10^7	19
	2013	4059167	1688057	2550000	8500000	12	5472106	4616376	1520000	1.60×10^7	19
Townhouses	2010	1353846	981593.4	700000	4200000	13	1555790	1054432	500000	4900000	19
	2011	1361539	977273.8	750000	4200000	13	1609474	1059158	730000	5000000	19
	2012	1407692	1021609	750000	4400000	13	1659211	1046946	735000	5000000	19
	2013	1452308	1030681	790000	4450000	13	1773053	1136377	745000	5500000	19
Condominiums	2010	351250	177799	150000	600000	8	634545.4	512510.8	80000	1500000	11
	2011	352500	176453.2	150000	600000	8	643636.4	513308.3	90000	1500000	11
	2012	360000	177522.6	170000	600000	8	655454.6	516282.2	100000	1500000	11
	2013	377250	189221.5	180000	640000	8	699090.9	539800.1	190000	1650000	11

Data from Agency for Real Estate Affairs, Thailand

[1] 1 square wah = 4 m^2, 1 Rai = 400 square wah = 1600 m^2

Table 12: Effect of Flooding on Land and Housing Prices

	(1) Industrial uses	(2) Industrial uses	(3) Residential uses	(4) Residential uses	(5) Commercial uses	(6) Commercial uses
After flooded	-1025*		-2473.4		-606.7	
	(507.1)		(4070.1)		(4617.5)	
After flooded [2011]		-658.3*		-1566.7		170.0
		(330.4)		(2561.7)		(2909.5)
After flooded [2012]		-1527.4***		-2862.0		-1090.0
		(526.2)		(4602.0)		(5057.4)
After flooded [2013]		-889.3		-2991.4		-900.0
		(851.0)		(5192.2)		(6289.0)
year 2011	793.4**	658.3*	4029.7	3713.4*	3277.8	2760.0
	(364.5)	(330.4)	(2711.0)	(2206.7)	(3257.7)	(2119.0)
year 2012	1556.6***	1741.7***	6506.4	6642.0	5097.8	5420.0
	(503.7)	(513.2)	(4025.7)	(4247.5)	(3918.9)	(4266.3)
year 2013	1625**	1575.0*	7877.3*	8058.0*	6644.4	6840.0
	(685.5)	(815.8)	(4312.0)	(4685.0)	(4278.4)	(5293.0)
Constant	14131.6***	14131.6***	40286.6***	40286.6***	40526.7***	40526.7***
	(237.0)	(241.6)	(1852.8)	(1867.8)	(1621.1)	(1662.2)
Observations	76	76	172	172	60	60
Adjusted R^2	0.309	0.317	0.114	0.105	0.280	0.256

	(7) Detached houses	(8) Detached houses	(9) Town houses	(10) Town houses	(11) Condominiums	(12) Condominiums
After flooded	4780.7		-71456.1**		-19515.2	
	(46502.8)		(34282.3)		(13548.0)	
After flooded [2011]		-20394.7		-45991.9**		-7840.9
		(27953.8)		(20155.4)		(5613.5)
After flooded [2012]		34736.8		-49574.9		-12159.1
		(57571.2)		(33400.3)		(16548.6)
After flooded [2013]		-2.81e-11		-118801.6		-38545.5
		(84587.5)		(78109.5)		(23845.3)
year 2011	48149.4*	57894.7**	64029.1***	53684.2***	14006.4	9090.9
	(25455.9)	(21696.0)	(21964.0)	(19229.5)	(8579.7)	(5421.2)
year 2012	76859.1***	65263.2**	112310.3***	103421.1***	24006.4	20909.1
	(25887.9)	(25018.9)	(26720.2)	(27403.0)	(14038.5)	(15731.5)
year 2013	178149.4***	180000***	198029.1***	217263.2***	56532.7***	64545.5***
	(49375.8)	(63436.6)	(56287.6)	(75118.7)	(17928.1)	(22143.9)
Constant	4745161.3***	4745161.3***	1473750***	1473750***	515263.2***	515263.2***
	(16970.0)	(17163.9)	(14650.7)	(14812.6)	(5730.6)	(5841.9)
Observations	124	124	128	128	76	76
Adjusted R^2	0.304	0.299	0.293	0.297	0.412	0.439

Data; Agency for Real Estate Affairs, Thailand
Standard errors in parentheses
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

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Appendix

A.1 Industry

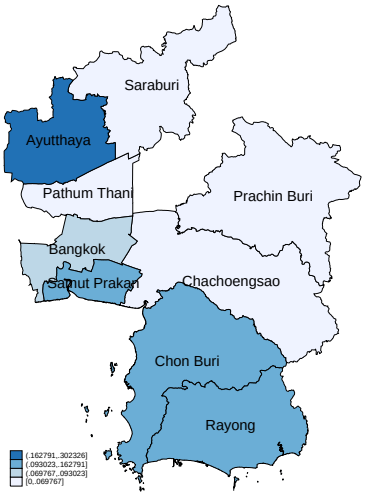
TableA.1 in the Appendix shows the number of establishments of each industry by province[3]. These 5 industry groups comprise 24 industries categories used in "International Standard Industrial Classification on All Economic Activities (ISIC), Rev.4." The geographic maps of the proportion of companies in each industry group and classification are shown in the Appendix in Figures A.1 and A.2, respectively.

Table A.1: Number of Companies in Each Industry Group (Multiple Answers)

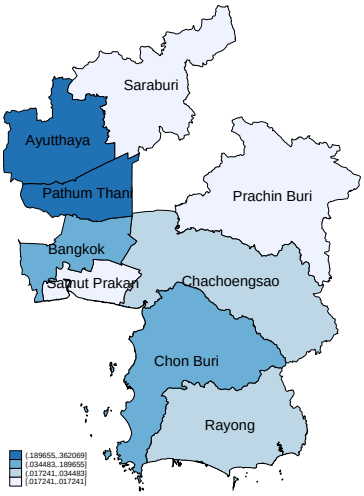
	Rubber and Plastic Products	Electronic Devices	Machinery	Motor Vehicles and Transport	All Other	Total Number of Companies
Saraburi	0	1	0	1	3	5
Ayutthaya	12	20	5	6	25	66
Bangkok Metropol	2	4	1	2	3	12
Pathum Thani	2	13	4	5	16	38
Prachin Buri	1	1	0	1	1	3
Chachoengsao	2	2	1	11	6	22
Rayong	6	1	1	17	30	55
Chon Buri	5	10	10	15	22	55
Samut Prakan	7	1	0	2	7	17
Total	37	53	22	60	113	273

[3]Because we asked multiple-answer questions, the sum of the answers exceeds the total number of companies.

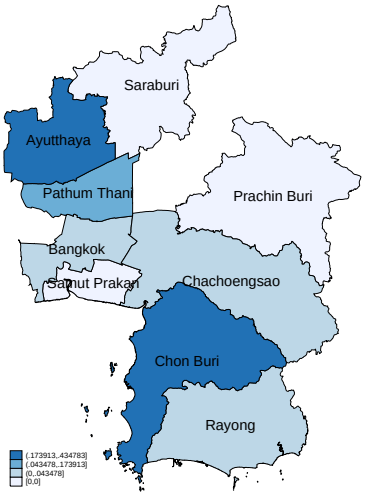
Figure A.1: Proportion of Companies in Each Industry Group



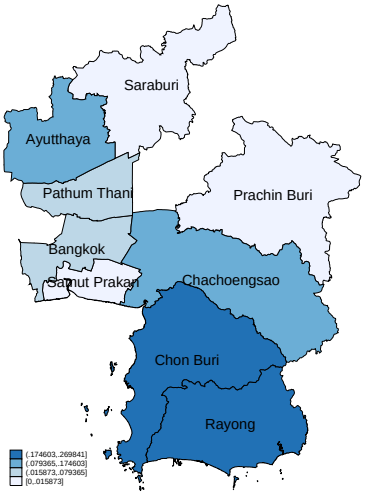
(A) Rubber and Plastic Products



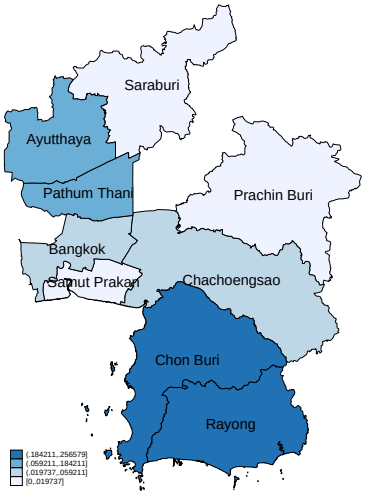
(B) Electronic Devices



(C) Machinery



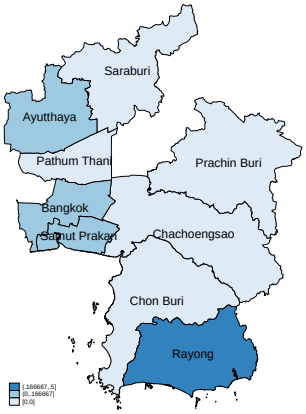
(D) Motor Vehicles and Transport



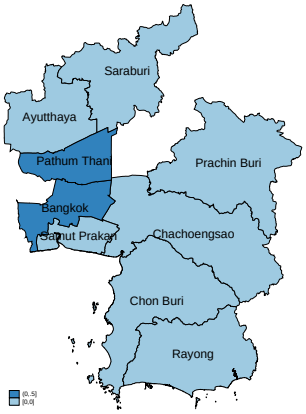
(E) Others

v11: Which industry does your company belong to?
Quartile in darkest color.
A: Rubber and plastic products
B: (1) Computers, electronics, and optical products (2) Electrical equipment
C: Machinery and equipment n.e.c.
D: (1) Motor vehicles, trailers, and semi-trailers (2) Other transport equipment
E: All other

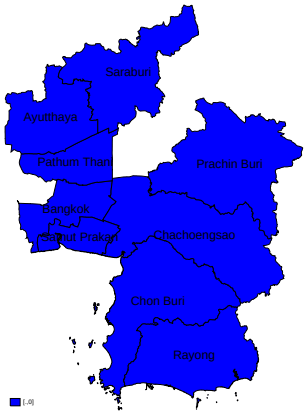
Figure A.2: Proportion of Companies in Each Industry



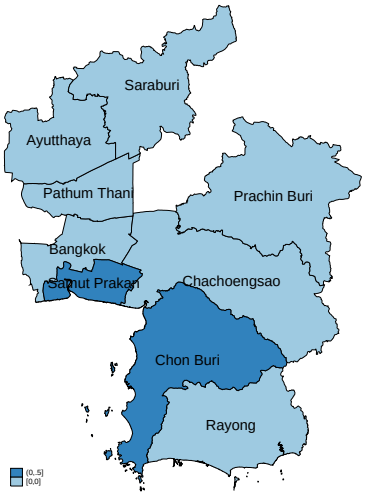
(1) Food Products 6



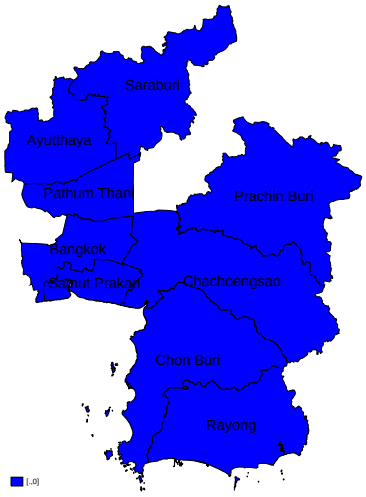
(2) Beverages 2



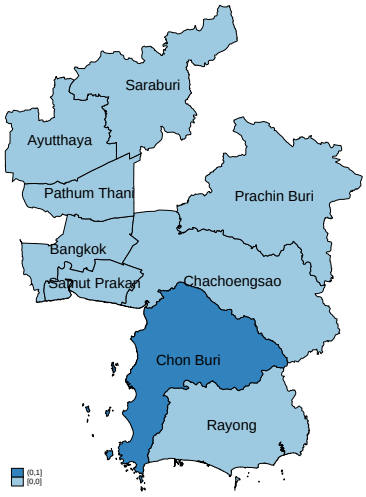
(3) Tobacco Products 0



(4) Textiles 2

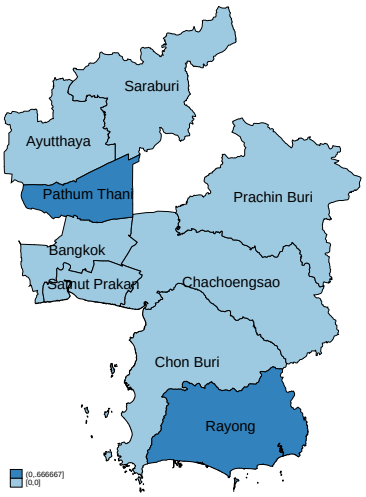


(5) Wearing Apparel 0

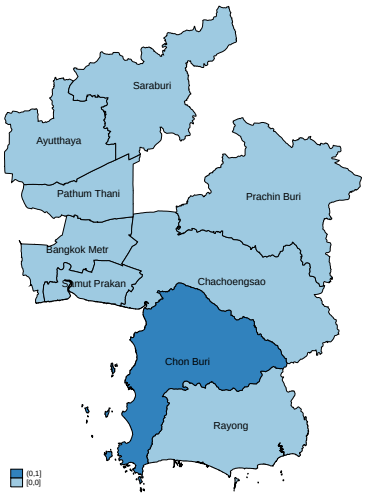


(6) Wood and Wood and Cork Products, Except Furniture 1

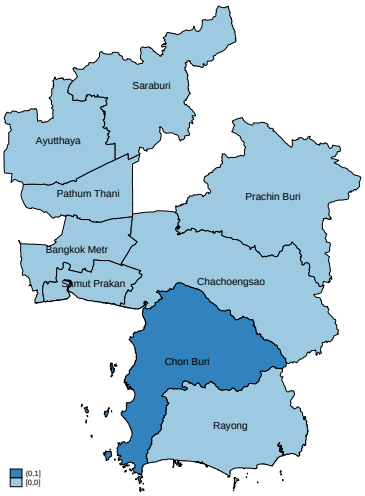
v11: Which industry does your company belong to?
Quartile in darkest color.
The number after the industry name shows the total number of sampled companies in the industry.



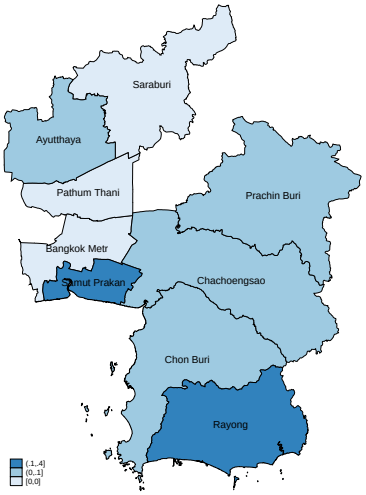
(7) Paper and Paper products 3



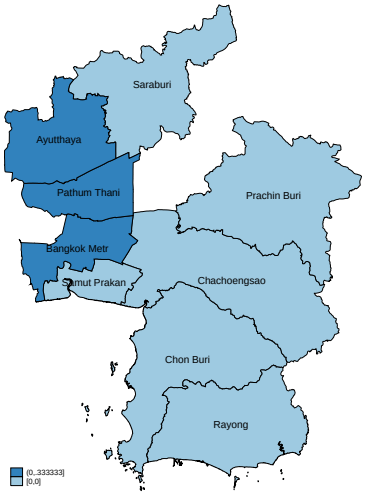
(8) Printing and Reproduction of Recorded Media 1



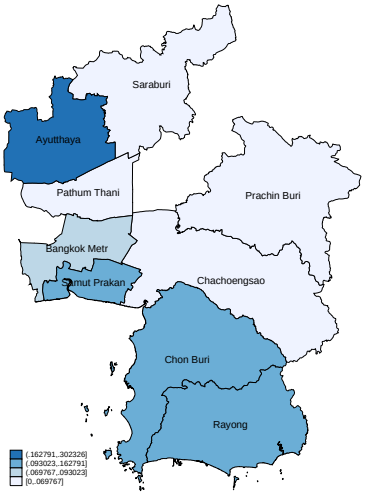
(9) Coke and Refined Petroleum Products 1



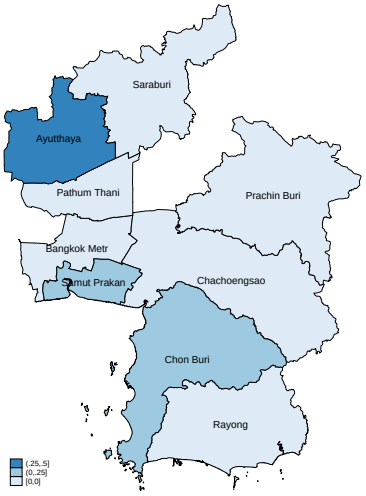
(10) Chemicals and Chemical Products 10



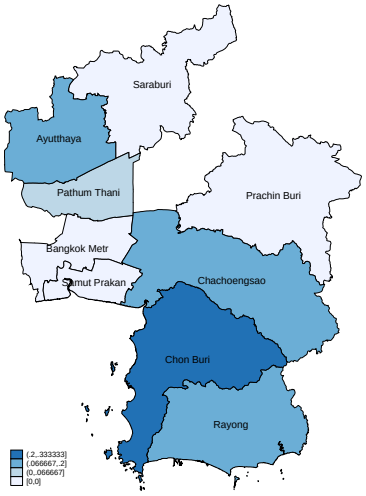
(11) Pharmaceuticals, Medicinal Chemicals, and Botanical Products 3



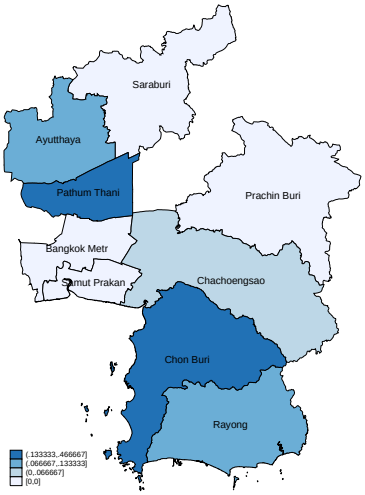
(12) Rubber and Plastics Products 43



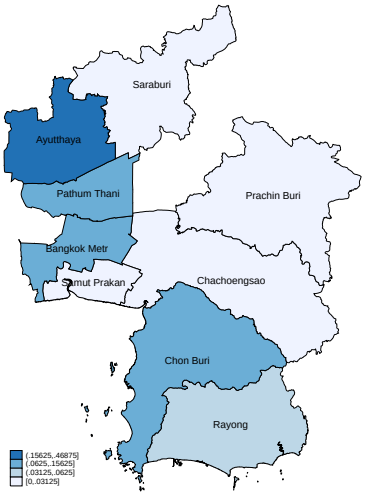
(13) Other Non-metallic Mineral Products 4



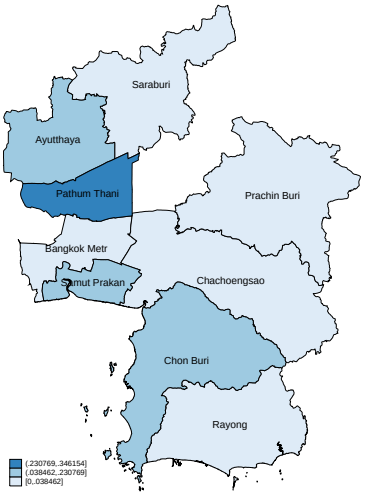
(14) Basic Metals 15



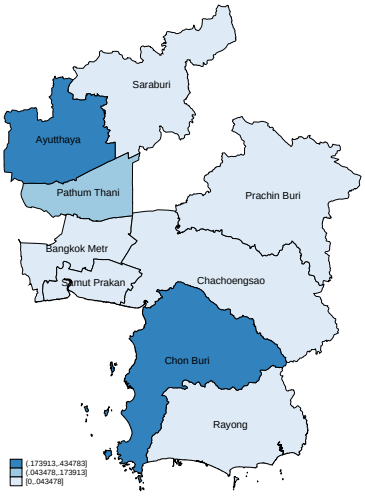
(15) Fabricated Metal Products, except Machinery and Equipment 15



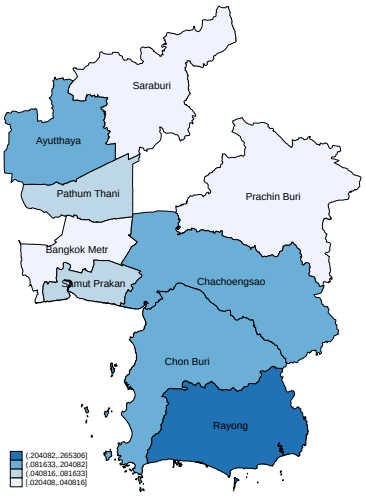
(1) Computers, Electronics, and Optical Products 32



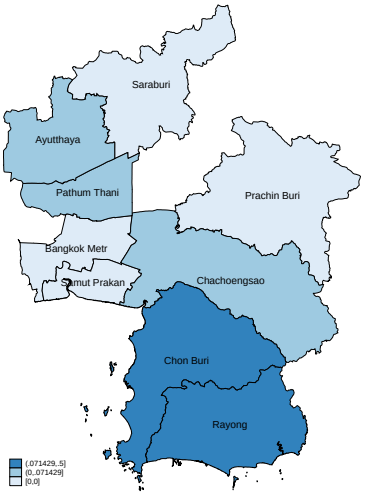
(2) Electrical Equipment 26



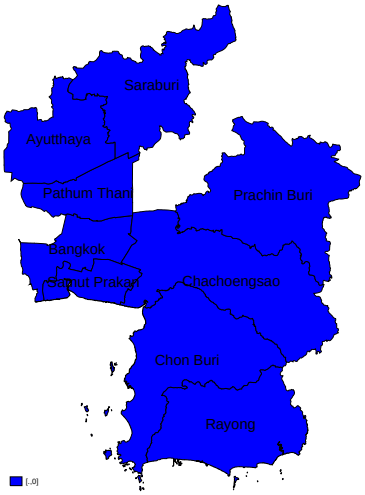
(3) Machinery and Equipment n.e.c. 23



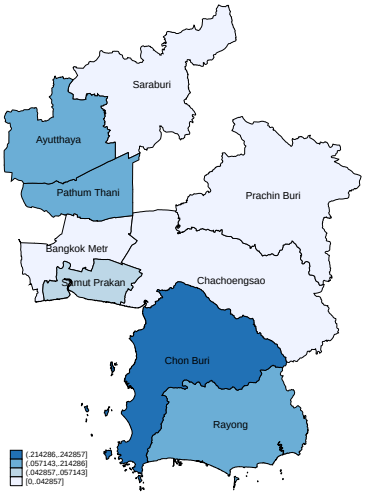
(4) Motor Vehicles, Trailers, and Semi-trailers 49



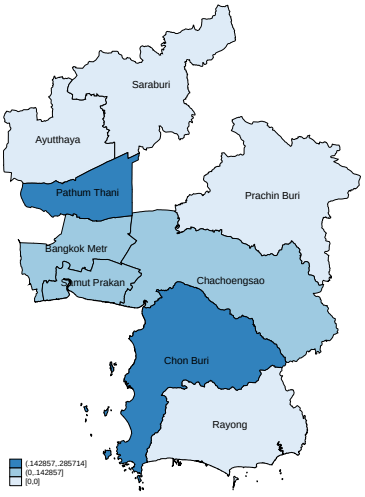
(5) Other Transport Equipment 14



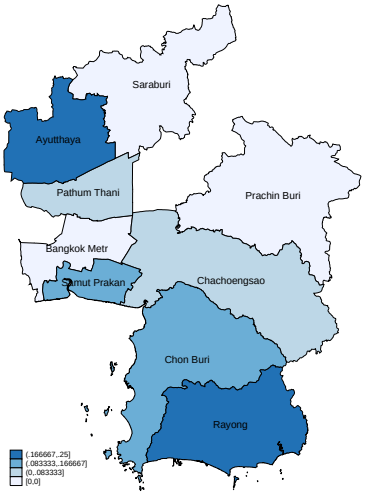
(6) Furniture 0



(7) Other Manufacturing 70



(8) Repair and Installation of Machinery and Equipment 7



(9) Industry Sector not Listed Above 12