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Abstract

We examine the existence of adverse selection and moral hazard in the corporate insurance market empirically. While natural disasters hit households and firms alike, corporate insurance against disasters have been under-investigated in the literature. To bridge this gap, we employ a unique firm dataset on the 2011 Thailand floods exclusively collected for this study. We aim to uncover how insurance subscription is geographically diversified before and after the floods and how insurance subscription and payment are associated with firms' production and employment levels after the floods. We find that the property insurance subscription before the floods was systematically higher amongst firms located in the areas directly affected by the floods than amongst others, indicating adverse selection, while the market is missing after the floods. Also, both insurance subscription and payment of business interruption insurance are negatively associated with firms' production and employment after the floods, suggesting the existence of moral hazard.

Keywords**:** Adverse selection, Business interruption insurance, Disaster insurance, Moral hazard, Property insurance.

JEL classifications**:** D82, G22, H84.

[1] This study is conducted as a part of the Project, "An Empirical Study on Economic Resilience and Maintenance of Economic Strength Against Disasters," undertaken at Research Institute of Economy, Trade and Industry(RIETI). This study utilizes the micro data collected for 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 Yutaro Izumi, Akito Kamei and Yoko Okuyama for their excellent research assistantship. The author is grateful for helpful comments and suggestions by Masahisa Fujita, Masayuki Morikawa, and Yoko Konishi, and other Discussion Paper seminar participants at RIETI.

1 Introduction

Numerous natural and man-made disasters (i.e., technological disasters, economic crises, and violence-related disasters such as wars and conflicts) have been hitting different areas in the world, and increasingly so recently (Sawada, 2007; Hoyois and Guha-Sapir, 2015; IFRC, 2015). Damages caused by earthquakes, floods, storms, economic crises and terrorist attacks can be substantial enough to force firms to collapse. Also, such negative consequences of disasters can undermine the recovery process because businesses are at the very core of market economies, and their termination as going concerns would be harmful for the local economy's recovery. Thus, we expect formal insurance and reinsurance markets play an important role in mitigating shocks arising from disasters. To the best of our knowledge, however, there is no research on the extent and effectiveness of formal disaster insurance of firms' assets and activities. This lack of research may be attributed, at least partially, to the lack of overall insurance schemes available to firms.

This paper aims to bridge this gap in the literature by investigating the case of 2011 Thailand floods. In October 2011, the lower Chao Phraya basin was hit by severe floods. These were caused by heavy monsoon rains in all regions along the Chao Phraya River - the upstream and the lower basin itself. The floods were indeed the worst in the past five decades: The estimated total damages amounted to THB 1,425 billion or 45.7 billion USD, with the manufacturing sector most severely hit at total damages of THB 1,007 billion or 32 billion USD (World Bank, 2011). The floods showed us that unexpected, severe, and adverse events could occur in an otherwise steadily growing middle income country like Thailand. This may manifest itself the importance of formal insurance schemes for an emerging economy to achieve stable and sustainable growth.

In this paper we employ a unique dataset that surveyed firms in central Thailand to address the nature and consequences of two types of formal insurance of firms, property and business interruption (BI) insurance. The main findings are as follows. First, by a double-difference analysis of insurance subscription status, we show that firms located in severely inundated/directly affected area had been more likely to subscribe to property insurance before the floods. We interpret this finding as an indication of an adverse selection problem in the property insurance market. Second, BI insurance payment appears to slow the recovery speed even after controlling for the level of damages. We interpret this finding as evidence of moral hazard in the BI insurance market.

Among related studies Hoyt and Khang (2000) and Aunon-Nerin and Ehling (2008) focused on corporate property insurance and self-insurance. These studies however do not consider catastrophe insurance and BI insurance, and are also silent about the recovery process after disasters. Michel-Kerjan et al. (2011) is the only paper that studied corporate catastrophe insurance in the literature, they nevertheless do not analyze post disaster recoveries. Another important contribution of our study is in the uniqueness of the dataset: Through this dataset we can observe not only insured firms, but also uninsured firms unlike in studies that use data from insurance companies such as Michel-Kerjan et al. (2011).

2 Data and Econometric Strategy

2.1 Data

In this paper we employ micro data of firms operating in central Thailand from 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 (Wangnoi), Nava Nakorn-Pathumthani, Bangkadi, Bangchan, Lad Krabang, Bangpoo, Bangplee, 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 Rayong 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.

We drop the firms which answered some questions inconsistently or that they changed its location after the Thailand flood, to make the interpretation of result clear.[1] This procedure leaves us with 294 firms in the main analysis.

Figure 1 shows the provinces in the Central Thailand area, in which the RIETI survey studies. Figure 2 shows the sample size for each province. Figures 3 and 4 show the maximum number of inundation days and depth of inundation. Notice that the RIETI survey studies the heavily damaged area relatively intensively, which makes statistically meaningful the comparison between the area suffered from damage and the area with little damage.

2.2 Econometric Strategy

It is widely argued that adverse selection and moral hazard problems arise when there is asymmetric information. In insurance markets, insurance subscribers typically have private information about their riskiness (i.e. hidden types) and about their behavior (i.e. hidden actions) that insurance companies do not possess. The high-risk type insurance subscribers would seek wider insurance coverage than the low-risk type, i.e. adverse selection (Rothschild and Stiglitz, 1976). Also, insurance subscribers with wider coverage will exert fewer efforts, increasing riskiness, leading to moral hazard (Arnott

[1] Although there is risk of selection on the basis of location choice, such concern is of second order importance, given that the number of firms which chose to change the location after the flood is as small as 14.

and Stiglitz, 1988). In both cases, we should observe a positive correlation between risk and insurance coverage/ subscription (Chiappori and Salanie, 2013). Accordingly, we test the following two hypotheses:

- *Property and/or BI insurance suffers from adverse selection.*

- *Property and/or BI insurance suffers from moral hazard.*

We expect that adverse selection is severer for property insurance, and likewise, moral hazard for BI insurance. In what follows, we explain how we are going to test these two hypotheses.

2.2.1 Adverse selection

To test adverse selection, we examine the pattern of insurance subscription by paying particular attention to the location of the firms as well as the (risk) perception of the firms about the vulnerability against flooding. We first estimate the following regression model separately for property insurance and for BI insurance and also separately for before the 2011 floods ($t = 0$) and for after the 2011 floods ($t = 1$) — so there will be four separate results): For every firm i,

$$Sub_{i,t} = \alpha_t + \beta_t AP_i + \varepsilon_{i,t}, \tag{1}$$

where $Sub_{i,t}$ is the insurance subscription status dummy in period t, AP_i is the Ayutthaya-Pathumthani dummy, and $\varepsilon_{i,t}$ is the error term. If β is positive statistically significantly before the 2011 floods, then the result is consistent with adverse selection. Also, if β becomes statistically insignificant after the 2011 floods, that may be reflecting the missing insurance market, i.e. insurance companies withdrew from the market and stopped offering insurance.

Furthermore, using the whole samples, we estimate the following regression model: For every firm i and every period t,

$$Sub_{i,t} = \alpha + \beta AP_i + \gamma T_t + \delta AP_i \cdot T_t + \varepsilon_{i,t}, \tag{2}$$

where T_t is the after-2011-floods dummy (i.e. $T_1 = 1$, and $T_t = 0$ for all $t \leq 0$). As in equation (1), if β is positive statistically significantly, then the result is consistent with adverse selection. Also, if $\delta < 0$, then the insurance market may have become missing for firms located in Ayutthaya and Pathumthani. This is consistent with the prediction of Rothschild and Stiglitz (1976) in the sense that no equilibrium may exist when adverse selection is present.

In addition to the regression analyses, we also directly examine if risk perception about vulnerability against floods or subscription status was different prior to the 2011 floods between (i) firms located in Ayutthaya/Pathumthani and others, (ii) firms incurred direct damage/loss and others, and (iii) firms whose sites were inundated and others. Namely, we test if the differences between each pair of groups are statistically significant by comparing the sample means.

2.2.2 Moral hazard

Turning our attention to moral hazard, we study the impacts of insurance subscription status on the recovery efforts made by the firms after the floods. To be more specific, firms who had subscribed to insurance (BI insurance in particular) would have weaker incentives to make recovery efforts if the insurance payment is quickly made. To measure the impacts, we pick up changes in the following variables: the production level, the number of workers employed, the number of engineers employed, and the number of line managers employed. By letting $Y_{i,t}$ denote the variable of interest and ΔY_i the change in Y_i, we estimate the following regression model, separately for property and BI insurance:

$$\Delta Y_i = \alpha + \beta_1 Paid_i + \beta_2 Wait_i + Damage_i + \varepsilon_i, \tag{3}$$

where $Paid_i$ is the insurance payment status dummy ($Paid_i = 1$ if firm i had received insurance payment by the time of the RIETI survey), $Wait_i$ is the number of months from October 2011 until the insurance payment (for firms with $Paid_i = 0$, we set $Wait_i = 0$), and $Damage_i$ is log(1 + the monetary value of damage firm i incurred). If there is no endogeneity, we can interpret β_1 as the effect of insurance payment and β_2 as the marginal effect of delayed payment for firms paid at some time. To see this, we rewrite equation (3) as follows:

$$\begin{aligned}\Delta Y_i &= \alpha + \beta_1 Paid_i + \beta_2 Wait_i + Damage_i + \varepsilon_i \\ &= \alpha + \beta_1 Paid_i + \beta_2 Wait_i \cdot Paid_i + Damage_i + \varepsilon_i \\ &= \alpha + Paid_i \cdot (\beta_1 + \beta_2 Wait_i) + Damage_i + \varepsilon_i.\end{aligned}$$

Furthermore, we measure moral hazard by the length of time took to resume production. To this end, we define an orderd variable RT_i as follows:

$$RT_i = \begin{cases} 1 & \text{if production resumed in December 2011;} \\ 2 & \text{if production resumed in January 2012;} \\ 3 & \text{if production resumed in February 2012;} \\ 4 & \text{if production resumed in March 2012;} \\ 5 & \text{if production resumed in April or May 2012;} \\ 6 & \text{if production resumed after June 2012.} \end{cases}$$

We then estimate the following regression model as an ordered probit model, separately for property and BI insurance:

$$RT_i^* = \alpha + \beta_1 Paid_i + \beta_2 Wait_i + Damage_i + \varepsilon_i, \tag{4}$$

where RT_i^* is the exact time took until the resumption of production which is treated as a latent variable, and we use RT_i in an ordered probit model.

We also estimate the impacts of insurance subscription status before and after the 2011 floods on the recover efforts made by the firms after the floods. To this end, we postulate the following difference-in-difference model:

$$\begin{aligned} Y_{i,t} &= \alpha + \beta_0 AP_i + \beta_1 T_t + \beta_2 Sub_{i,t-1} + \gamma_1 AP_i \cdot T_t + \gamma_2 T_t \cdot Sub_{i,t-1} \\ &+ \gamma_3 AP_i \cdot Sub_{i,t-1} + \delta AP_i \cdot T_t \cdot Sub_{i,t-1} + \varepsilon_{i,t}. \end{aligned}$$

where ε_t is an error term. By taking the difference between $t = 1$ and $t = 0$ of this model when we assume that $Sub_{i,0} = Sub_{i,-1}$, where $t = -1$ is one period before $t = 0$, we obtain the following estimable model, again separately for property and BI insurance:

$$\Delta Y_i = \beta_1 + \gamma_1 AP_i + \gamma_2 Sub_{i,0} + \delta AP_i \cdot Sub_{i,0} + \Delta\varepsilon_i, \tag{5}$$

where $\Delta\varepsilon_i = \varepsilon_{i,1} - \varepsilon_{i,0}$. Note that the assumption that $Sub_{i,0} = Sub_{i,-1}$ asserts that firms do not change their insurance subscriptions or contracts frequently.

3 Estimation Results

In this section, we report the estimation results of the regression models and the results of the statistical tests to examine if the two hypotheses are rejected or not. We first report the results on adverse selection, followed by those on moral hazard.

3.1 Adverse Selection

In what follows, we examine if there was an adverse selection problem for the corporate insurance market that indemnifies losses caused by natural disasters. Table 2 reports the estimation results of models (1) and (2). It is clear from Table 2 that the Ayutthaya/Pathumthani dummy AP_i is statistically insignificant in cases for BI insurance; thus, adverse selection is absent as far as BI insurance is concerned

In contrast, for property insurance AP_i is statistically significant at the 5% level for (1) before the 2011 floods and for (2). These indicates that we cannot reject the hypothesis that adverse selection was an issue before the 2011 floods. In contrast, AP_i is insignificant for (1) after the 2011 floods, suggesting that the adverse selection is no longer evident. This may well be because of the change in the behavior of the insurance companies—they restricted the supply of property insurance in Ayutthaya and Pathumthani. In model (2), the interaction term of AP_i and the after-2011-floods dummy T_t, i.e. $AP_i \cdot T_t$, is insignificant, yet the point estimate is negative; thus, the estimate does not contradict with the hypothesis of missing property insurance market in Ayutthaya and Pathumthani after the 2011 floods, although it does not provide a strong support for it either.

Table 3 reports comparisons of three different pairs - location-wise (AP_i), damage-wise, and inundation-wise - on the likelihood of the awareness of vulnerability against floods (i.e. $RP_{i,0}$) and on the likelihood of property insurance subscription (i.e. $Sub_{i,0}$) before the 2011 floods. It is clear that firms locating in Ayutthaya and Pathumthani were more likely to be aware of the vulnerability against flooding and were also more likely to be subscribing to property insurance before the floods, suggesting adverse selection. Also, firms that incurred damage were also more likely to be aware of the vulnerability against flooding, and that, they were also more likely to be subscribing to property insurance before the floods, suggesting adverse selection. The same applies to firms that suffered from inundation. Hence, the results reported in Table 3 strongly suggests the existence of adverse selection in the property insurance market before the 2011 floods.

3.2 Moral Hazard

Next, we examine moral hazard. Tables 4—7 report the estimation results of model (3): Table 4 on the change in production level, Table 5 on the change in the number of workers, Table 6 on the change in the number of engineers, and Table 7 on the change in the number of line managers. The definitions of ΔY_i are as follows:

(i) For production level,

$$\Delta Y_i = \begin{cases} 1 & \text{if production has increased since the 2011 floods;} \\ 0 & \text{if production remains the same since the 2011 floods;} \\ -1 & \text{if production has decreased since the 2011 floods;} \\ -2 & \text{if the firm has stopped producing after the 2011 floods.} \end{cases}$$

(ii) For the number of workers, engineers, and line managers,

$$\Delta Y_i = \begin{cases} 1 & \text{if the number has increased since June 2011;} \\ 0 & \text{if the number remains the same since June 2011;} \\ -1 & \text{if the number has decreased since June 2011.} \end{cases}$$

It is evident that moral hazard is absent for property insurance, since the insurance payment status dummy $Paid_i$ is insignificant in all of its regression model specifications. In contrast, $Paid_i$ is statistically significant for BI insurance on the changes in production level and in the number of workers. This suggests that firms who received insurance payment for property damage tend to reduce the production level or the number of workers. However, $Paid_i$ is insignificant for the change in the number of engineers or in the number of line managers. This may be reflecting that the reduction in the production level is considered as temporary because it is likely that firing and recruiting engineers or line managers may well be more difficult than firing and hiring workers. Meanwhile the timing of the insurance payment $Wait_i$ is insignificant in all specifications.

Figure 7 reports the histograms of the length of the suspension of production, or the time took for the firm to resume production - for firms outside Ayutthaya and Pathumthani on the left and for those in Ayutthaya or Pathumthani on the right. It is clear from the histograms that most firms outside Ayutthaya and Pathumthani did not suffer from suspension, while the length of suspension varies greatly in Ayutthaya and Pathumthani. To investigate if this dispersion is the result of possible moral hazard due to insurance payment, BI insurance in particular, we report the estimation results of model (4) in Table 8. Again, $Paid_i$ is insignificant for property insurance, while it is significant for BI insurance, suggesting the existence of moral hazard for the latter. If we control for the monetary value of damage or losses, $Wait_i$ becomes statistically significant, and its point estimate is negative. Thus, when the insurance payment takes more time, firms tend to resume production earlier, or conversely, firms who received quicker insurance payments tend to postpone the resumption of their productions. This suggests that a quick BI insurance payment provides a perverse incentive to the firms, offering more breathing space so that they delay the recovery, i.e. yet another sign of moral hazard.

Table 9 shows another evidence of moral hazard of BI. As a preliminary result, the first column shows the result of the regression on the firm geographic variable. This indicates that firms located in Ayutthaya and Pathumthani experienced more severe decline in production after the flood. To see how this impact differs across whether the firm subscripted each type of insurance, the right two columns show the results of the regression model (5), with production level change as an outcome variable. Observing the left column, the difference in impact across being insured by property insurance is small and statistically insignificant. In contrast, the right column shows that the difference by BI is large and statistically significant. Using the change in labor management as another outcome variable, Table 10 shows the results of similar models. For the workers and engineer variable, the results are similar: Property insurance did not change the impact of the flood in a statistically significant manner, whereas BI did. We did not find such evidence on the line manager variables, although its point estimate is negative. This pattern of significance is consistent with our interpretation of moral hazard: If hiring and firing workers or engineers is easier for firms than doing line managers, then the difference in effort to recover quickly after the flood should be reflected in the number of workers and engineers stronger than that of line managers.

4 Conclusion

In this paper, we empirically investigated corporate insurance against disasters, which is an area in the existing literature that is under-investigated. In particular, we tested the existence of adverse selection and moral hazard in the corporate insurance market empirically with a unique dataset on the 2011 Thailand floods that is exclusively collected.

Two empirical results emerge: first, property insurance subscription before the 2011 floods was systematically higher amongst firms located in areas that were directly affected by the floods than amongst others, indicating adverse selection. It appears that firms in the lower Chao Phraya basin, where the floods hit most severely, were aware of the flooding risk, and they were more likely to subscribe to property insurance before the floods. However, the discrepancy across regions in terms of property insurance subscription has become statistically insignificant, possibly because of the missing market for firms in the lower Chao Phraya basin, which may well be caused by the withdrawal of insurance companies from the property insurance market in the region.

Second, both insurance subscription and payment of BI insurance are negatively associated with the firm's levels of production and employment — the number of workers in particular for the latter, after the floods, suggesting the existence of moral hazard. While BI insurance is frequently promoted to help smooth the cash flow of the insured firm when they face disruptions or suspensions of production, the very fact that the ease of smoothing the cash flow is providing a perverse incentive to the firms to reduce the recovery effort.

Figure 1: Provinces studied

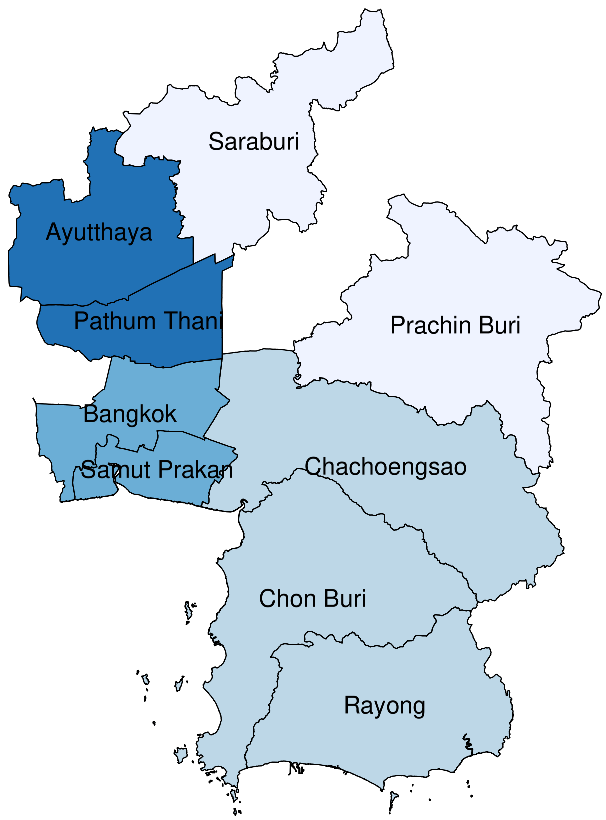


Figure 2: Sample size for each province

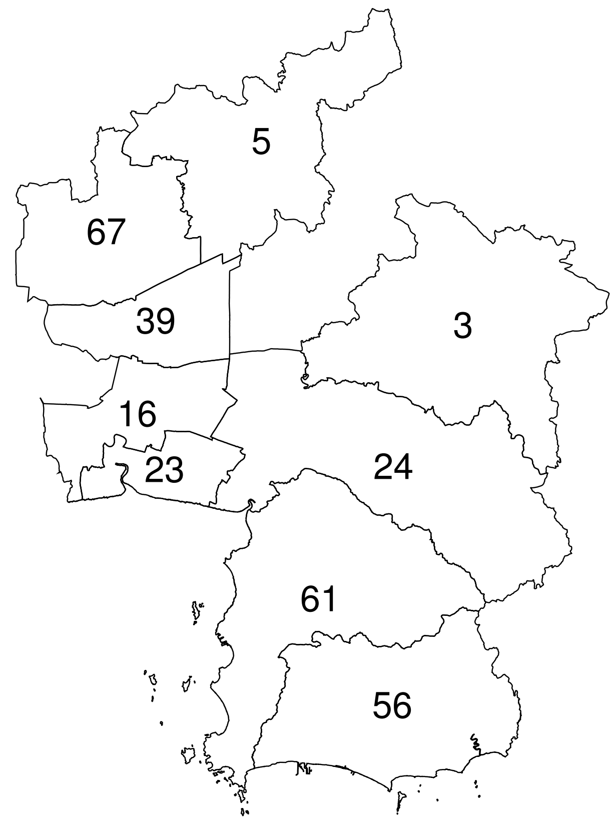


Figure 3: Maximum number of days of inundation

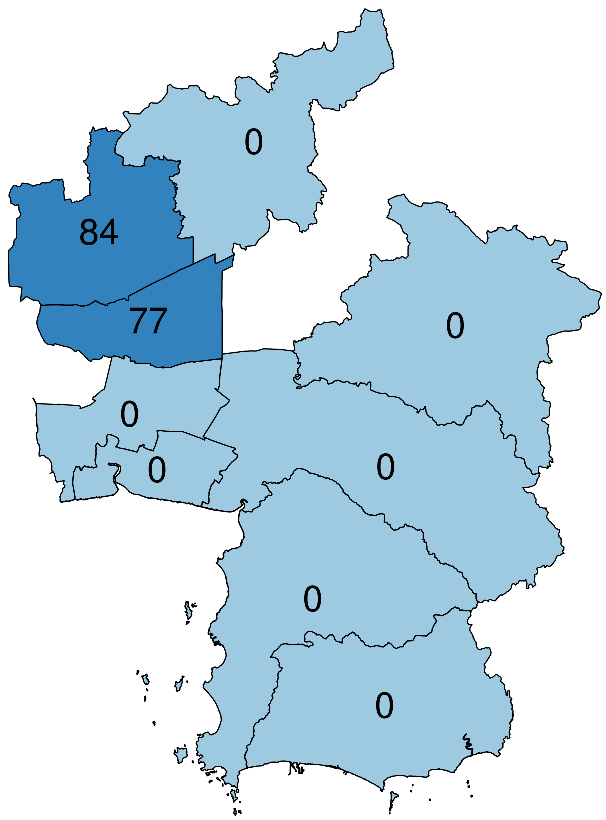


Figure 4: Maximal depth of inundation (meters)

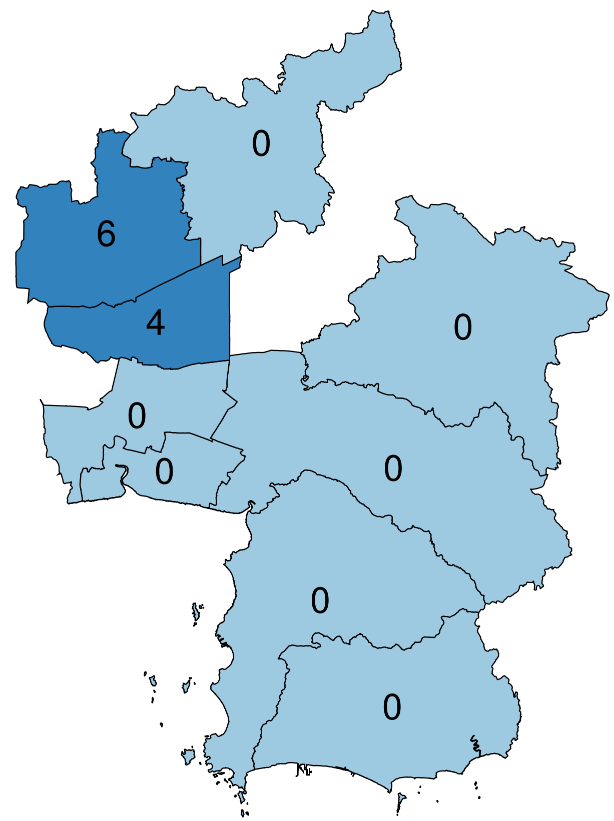


Table 1: Distribution of surveyed firms across Industrial Estates/Parks

Name	Frequency	%
N/A	24	8.39
Saha Rattana Nakorn	2	0.70
Hi- Tech	23	8.04
Bangpa-in	10	3.50
Rojana- Ayutthaya	30	10.49
Nava Nakorn- Pathumthani	29	10.14
Bangkadi	8	2.80
Bangchan	1	0.35
Lad Krabang	11	3.85
Bangpoo	10	3.50
Bangplee	7	2.45
Gateway City	16	5.59
Wellgrow	6	2.10
Amata Nakorn	35	12.24
Pinthong	11	3.85
304 IP I	3	1.05
Laem Chabang	3	1.05
Eastern Seaboard (Rayong)	29	10.14
Hemaraj Eastern Seaboard	7	2.45
Siam Eastern	2	0.70
Amata City	7	2.45
Rojana- Rayong	1	0.35
Hemaraj Rayong Industrial Land	1	0.35
Rayong Industrial Park	1	0.35
Asia IE Mapta Phut	5	1.75
Hemaraj Eastern	1	0.35
Padaeng	1	0.35
Hemaraj Saraburi IL	2	0.70
Total	286	100.00

Table 2: Adverse Selection - Regressions of insurance subscription ($Sub_{i,t}$)

	Property Insurance			BI Insurance		
	(1): $t = 0$	(1): $t = 1$	Model (2)	(1): $t = 0$	(1): $t = 1$	Model (2)
AP_i	0.222**	0.057	0.222**	0.095	0.020	0.095
	(0.093)	(0.075)	(0.093)	(0.076)	(0.082)	(0.076)
T_t			-0.145			0.022
			(0.120)			(0.043)
$AP_i \cdot T_t$			-0.164			-0.075
			(0.132)			(0.056)
R^2	0.07	0.00	0.09	0.01	0.00	0.01

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

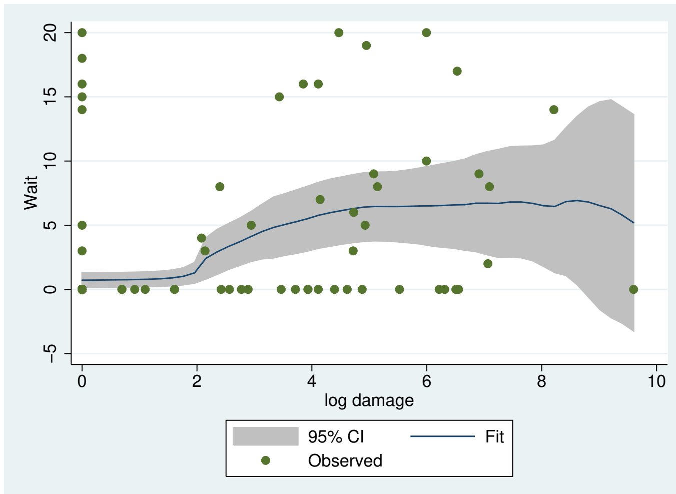
Note 1: AP_i is the Ayutthaya/Pathumthani dummy and T_t is the after-2011-floods dummy.
Note 2: Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in Table 1.
Note 3: $t = 0$ indicates before the 2011 floods and $t = 1$ after the floods.

Table 3: Adverse selection: Comparisons of means

	Location		
	(a) $AP_i = 0$	(b) $AP_i = 1$	(b) − (a) Difference
$\Pr\{RP_{i,0} = 1\}$	0.165	0.390	0.225***
	(0.03)	(0.05)	(0.05)
$\Pr\{Sub_{i,0} = 1\}$	0.667	0.873	0.206***
	(0.07)	(0.04)	(0.08)
	Damage		
	(a) No	(b) Yes	(b) − (a) Difference
$\Pr\{RP_{i,0} = 1\}$	0.196	0.353	0.157**
	(0.05)	(0.07)	(0.08)
$\Pr\{Sub_{i,0} = 1\}$	0.643	0.857	0.214**
	(0.13)	(0.05)	(0.12)
	Inundation		
	(a) No	(b) Yes	(b) − (a) Difference
$\Pr\{RP_{i,0} = 1\}$	0.178	0.408	0.230***
	(0.03)	(0.06)	(0.06)
$\Pr\{Sub_{i,0} = 1\}$	0.628	0.902	0.274***
	(0.07)	(0.04)	(0.08)

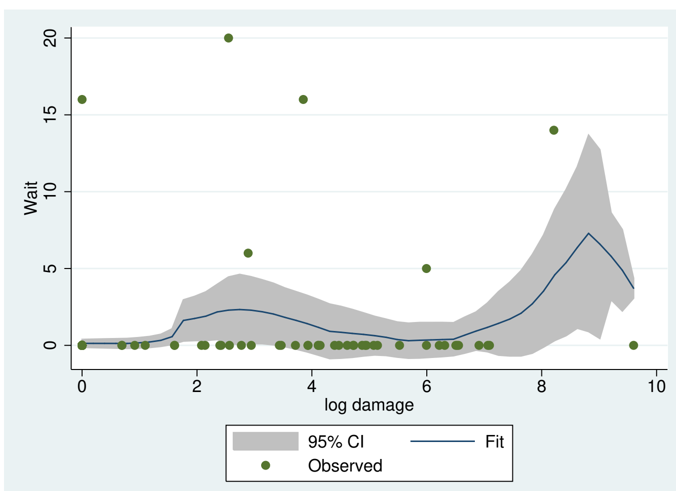
Note 1: $RP_{i,0}$ is the risk perception dummy at $t = 0$ (i.e. before the 2011 floods), which indicates that the firm was aware of the vulnerability against flooding.
Note 2: $Sub_{i,0}$ is the subscription status dummy at $t = 0$.
Note 3: AP_i is the Ayutthaya/Pathumthani dummy.
Note 4: The column 'Difference' is reporting the difference between the two groups reported in the two columns immediately to its left. Moreover, the results of the one-sided test H_0 : Difference $= 0$ vs H_1 : Difference > 0 are reported.
Note 5: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Figure 5: Plot of PI waiting periods and log damage



Note: The fitted line is given by the local polynomial model. A rule-of-thumb bandwidth estimator, Epanechinikov kernel, and local-mean smoothing are used.

Figure 6: Plot of BI waiting periods and log damage



Note: The fitted line is given by the local polynomial model. A rule-of-thumb bandwidth estimator, Epanechinikov kernel, and local-mean smoothing are used.

Table 4: Moral Hazard: Regressions of changes in production level

	Property	Property	BI	BI
$Paid_i$	-0.615	-0.252	-1.064^{***}	-0.658^{**}
	(0.520)	(0.562)	(0.250)	(0.300)
$Wait_i$	0.023	0.020	0.053	0.038
	(0.041)	(0.045)	(0.054)	(0.070)
$Damage_i$		-0.049		-0.031
		(0.085)		(0.078)
R^2	0.04	0.08	0.02	0.06
N	159	159	156	156

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: Damage is controlled by log (monetary value of damage +1), whether the amount of damage was positive, and whether it was missing. The point estimates of log (monetary value of damage +1) is reported above, in the regression with controlling damage.
Note 2: Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in Table 1.

Table 5: Moral Hazard: Regressions of changes in the number of workers

	Property	Property	BI	BI
$Paid_i$	-0.298	0.065	-1.094***	-0.933***
	(0.424)	(0.590)	(0.233)	(0.300)
$Wait_i$	0.016	0.010	0.053	0.042
	(0.028)	(0.035)	(0.054)	(0.053)
$Damage_i$		0.013		0.059
		(0.047)		(0.048)
R^2	0.01	0.06	0.04	0.07
N	156	156	154	154

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: Damage is controlled by log (monetary value of damage +1), whether the amount of damage was positive, and whether it was missing. The point estimates of log (monetary value of damage +1) is reported above, in the regression with controlling damage.
Note 2: Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in Table 1.

Table 6: Moral Hazard: Regressions of changes in the number of engineers

	Property	Property	BI	BI
$Paid_i$	-0.466	-0.169	-0.302	-0.121
	(0.318)	(0.445)	(0.487)	(0.445)
$Wait_i$	0.032	0.030	0.038	0.035
	(0.021)	(0.023)	(0.041)	(0.050)
$Damage_i$		-0.064		-0.037
		(0.058)		(0.079)
R^2	0.02	0.06	0.02	0.04
N	154	154	152	152

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: Damage is controlled by log (monetary value of damage +1), whether the amount of damage was positive, and whether it was missing. The point estimates of log (monetary value of damage +1) is reported above, in the regression with controlling damage.
Note 2: Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in Table 1.

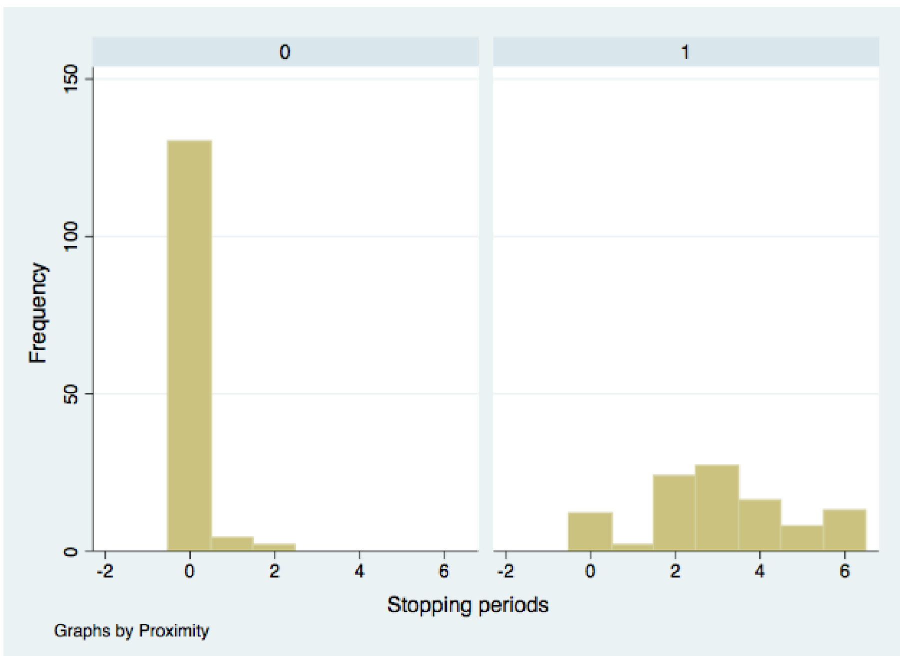
Table 7: Moral Hazard: Regressions of changes in the number of line managers

	Property	Property	BI	BI
$Paid_i$	-0.076	0.094	-0.054	0.038
	(0.391)	(0.481)	(0.466)	(0.409)
$Wait_i$	-0.003	0.005	-0.038	-0.030
	(0.025)	(0.021)	(0.032)	(0.044)
$Damage_i$		-0.135*		-0.103
		(0.078)		(0.072)
R^2	0.01	0.07	0.02	0.06
N	153	153	151	151

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: Damage is controlled by log (monetary value of damage +1), whether the amount of damage was positive, and whether it was missing. The point estimates of log (monetary value of damage +1) is reported above, in the regression with controlling damage.
Note 2: Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in Table 1.

Figure 7: Length of suspension - Ayutthaya/Pathumthani (Right) and other provinces (Left)



Note: The histogram on the right is for Ayutthaya and Pathumthani (i.e. $AP_i = 1$) and the one on the left is for all other provinces (i.e. $AP_i = 0$). The horizontal axis measures the length of suspension (in months).

Table 8: Moral Hazard: Regressions of length of suspension (RT_i)

	Property	Property	BI	BI
$Paid_i$	0.239	0.155	0.727**	0.881*
	(0.532)	(0.604)	(0.335)	(0.455)
$Wait_i$	−0.038	−0.042	−0.056	−0.072***
	(0.049)	(0.048)	(0.041)	(0.022)
$Damage_i$		0.049		0.012
		(0.096)		(0.076)
N	90	90	88	88

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: Numbers shows the coefficient estimates of the ordered probit model.
Note 2: Damage is controlled by log (monetary value of damage +1), whether the amount of damage was positive, and whether it was missing. The point estimates of log (monetary value of damage +1) is reported above, in the regression with controlling damage.
Note 3: Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in Table 1.

Table 9: Moral hazard: Regressions of production changes

	2x Diff	3x Diff	
		Property	BI
AP	-0.375	-0.303	-0.353
	(0.085)***	(0.286)	(0.152)**
diffimpact		-0.285	-0.630
		(0.347)	(0.236)**
R^2	0.04	0.08	0.08
N	262	262	262

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: AP indicates the location of the firm ($AP = 1$ if in Ayutthaya or Pathumthani, and $AP = 0$ otherwise).
Note 2: Variable "diffimpact" indicates our preferred triple difference estimates in the model (5). Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in table 1.

Table 10: Moral hazard: Regressions of labor management changes

	Worker			Engineer			Line manager		
	D2	PI, D3	BI, D3	D2	PI, D3	BI, D3	D2	PI, D3	BI, D3
AP	-0.435	-0.592	-0.173	-0.362	-0.020	-0.181	-0.299	-0.255	-0.105
	(0.103)***	(0.276)**	(0.184)	(0.109)***	(0.388)	(0.113)	(0.109)**	(0.361)	(0.161)
diffimpact		0.373	-0.721		-0.384	-0.360		0.076	-0.322
		(0.389)	(0.396)*		(0.460)	(0.208)*		(0.348)	(0.360)
R^2	0.07	0.16	0.19	0.06	0.16	0.17	0.05	0.08	0.17
N	232	232	232	227	227	227	227	227	227

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note 1: AP indicates the location of the firm ($AP = 1$ if in Ayutthaya or Pathumthani, and $AP = 0$ otherwise).

Note 2: Variable $diffimpact$ indicates our preferred triple difference estimates in the model (5). Standard errors are heteroskedasticity-robust and clustered at the industrial estates shown in table 1.

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