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IZUMI, Yutaro
GRIPS

NAKATA, Hiroyuki
RIETI

SAWADA, Yasuyuki
University of Tokyo

SEKIGUCHI, Kunio
RIETI

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Perception Gaps and Proactive Strategy in Japanese SME Disaster Recovery[1]

Yutaro IZUMI (GRIPS), Hiroyuki NAKATA (University of Tokyo), Yasuyuki SAWADA (University of Tokyo), Kunio SEKIGUCHI (Cabinet Office)
Research Institute of Economy, Trade and Industry

Abstract

This paper examines the post-disaster effectiveness of countermeasures available to Japanese SMEs. Based on a unique survey of over 3,500 SMEs, we document a stark disconnect: subjective evaluations of property insurance are lowest for earthquakes but highest for storms—a ranking that reverses for public relief and loans, likely reflecting differences in the predictability of disaster classes. These perceptions, however, correlate weakly with objective accounting measures. Crucially, despite these perceptual mismatches and the inherent noise in SME accounting data, proactive strategic changes yield robust, positive financial results. Furthermore, Business Continuity Plans (BCPs) generally function effectively in reducing the likelihood of business interruption. Ultimately, while policy interventions must be tailored to specific disaster types, our findings highlight proactive strategic adaptation as the critical driver of SME recovery.

Keywords: Business Continuity Plan (BCP), insurance, public relief, predictability, uncertainty
JEL classification : D81, G22, H84, M10, Q54

[1]This study is conducted as a part of the project “SME Resilience to Disasters: An empirical investigation” undertaken at the Research Institute of Economy, Trade and Industry (RIETI).
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1 Introduction

Japan has suffered damages from various natural disasters, including earthquakes, volcanic eruptions, typhoons, and heavy rains. Although the number of natural disasters causing mass casualties has decreased compared to the past, disasters resulting in an extremely large number of casualties and extensive damage, such as the 2011 Great East Japan Earthquake, have still occurred even since the turn of this century.

It is clear that suppressing human and economic damages from various disasters through structural disaster prevention—such as making buildings earthquake-resistant, flood control, and constructing seawalls—is critical. However, it is impossible to make everything completely damage-proof; thus, making non-structural measures is also essential. These include financial countermeasures such as insurance, commercial bank and public loans, public subsidies, and the formulation of Business Continuity Plans (BCPs). This applies equally to households, firms, and the public sector.

Conventional insurance products targeting firms to compensate for disaster-related damages include fire insurance, car insurance, and marine insurance. Direct damage to buildings and other properties caused by wind storms, such as typhoons, is covered by standard fire insurance policies. By contrast, direct damage caused by earthquakes, volcanic eruptions, or water damage such as floods is not covered by standard fire insurance policies (similar to fire insurance for households) but is covered through special opt-in riders. In recent years, in addition to conventional insurance products such as fire insurance, various lines of casualty insurance have been marketed to firms. These include liability insurance, comprehensive business activity insurance (which covers business interruption), comprehensive movable property insurance, and cyber insurance.

While there is a substantial body of empirical literature on household demand for disaster insurance, of which earlier works include Kunreuther et al. (1978) on flood and earthquake insurance in the United States, existing studies report that when subscription is voluntary rather than mandatory, (a) insurance penetration rates remain low, (b) they spike immediately after a major disaster, but (c) they gradually decline over time (Browne and Hoyt, 2000; Kriesel and Landry, 2004; Michel-Kerjan et al., 2012; Gallagher, 2014; Mol et al., 2020). By contrast, empirical research on corporate demand for disaster insurance remains limited due to data constraints. Even among the few existing empirical studies, such as Zou et al. (2003), Adams et al. (2011), Michel-Kerjan et al. (2015) and Asai (2019), the underlying factors behind the sluggish disaster insurance subscription rates have not been directly examined.

Meanwhile, the terms "risk" and "uncertainty" are used broadly and generally. However, they have precise definitions in economics and decision theory. "Risk" refers to a situation where objective or subjective probabilities can be identified. "Ambiguity" refers to a situation where it is known what outcomes or states could occur, but a single probability—including a subjective one—cannot be identified. "Unforeseen contingencies" (or "unawareness") refers

to a situation where the possible outcomes or states cannot even be described. While coin tosses and dice rolls represent situations where objective probabilities are known, in practice, objective probabilities are unknown in most real-world scenarios, which are considered to fall under subjective probability, ambiguity, or unforeseen contingencies. The difficulty of prediction increases in the order of risk, ambiguity, and unforeseen contingencies.

For example, comparing the difficulty of predicting damages from earthquakes and floods, predicting damages from earthquakes is considered extremely difficult because it is highly challenging to forecast when, where, and at what scale an earthquake will occur. By contrast, in the case of floods, even if forecasting precipitation is difficult, identifying where flooding is likely to occur is considered relatively easy, making damage prediction easier compared to earthquakes.

In economics, individuals and households are generally assumed to be averse to risk and uncertainty. Being "risk-averse" means that given the same expected value, a lottery with a smaller variance in the distribution of prize amounts is preferred, while being "ambiguity-averse" means that when comparing a situation that can be captured as risk with a situation that can only be captured as ambiguity—that is, a situation where probabilities are known versus one where they are unknown—the situation captured as risk is preferred.

Regarding the demand for insurance, it is theoretically known that for a risk-averse individual or household, if the insurance premium equals the expected value of the insurance payout, they will purchase insurance until all losses are fully covered under any circumstances. In other words, individuals and households are considered to have a motivation to transfer risk to others through insurance. While the relationship between risk aversion and insurance demand is clear in this manner, the relationship between ambiguity aversion and insurance demand is not as clear. This is because, on one hand, if purchasing insurance can eliminate ambiguity, it can serve as a motivation to buy insurance; on the other hand, if the insurance contract itself introduces ambiguity, it can lead to forgoing insurance. Therefore, whether ambiguity aversion motivates insurance purchases depends on the specific contents of the insurance contract.

By contrast, for corporations—especially listed firms where ownership and management are separated—it is difficult to conceive of insurance purchases motivated by risk diversification, as it is far less costly for investors to diversify risk through capital markets (Mayers and Smith, 1982; Hoyt and Khang, 20000301). However, since many SMEs are unlisted and family-owned, where ownership and management are rarely separated, it is plausible that they, like individuals and households, are motivated to purchase insurance for risk diversification purposes.

Meanwhile, one of the benefits of formulating a BCP is that by clearly anticipating possible scenarios, a firm can organise the uncertainties it faces. Because it is impossible to completely and comprehensively anticipate all possible scenarios, BCP formulation cannot elevate the situation to the level of "risk" in the strict economics and decision-theoretic sense; however, at the very least, an effect of reducing unforeseen contingencies and the degree of ambiguity can be expected.

Despite these theoretical underpinnings, empirical evidence on how firms actually evaluate

and utilize countermeasures across varying degrees of uncertainty remains scarce. Our primary contribution is bridging decision theory with empirical corporate finance to explain this behavior. While ambiguity aversion and unforeseen contingencies are increasingly recognized in household finance and theoretical models, our study is, to our knowledge, the first to empirically apply the continuum of risk, ambiguity, and unforeseen contingencies to corporate disaster countermeasures. By framing SME behavior through this lens—and specifically positioning BCPs as a mechanism to actively reduce unforeseen contingencies—we provide a novel theoretical framework to explain the demand for, and effectiveness of, post-disaster financial strategies. To bridge the empirical gap and test these theoretical predictions, we address the following questions:

(a) *How does the effectiveness of financial and strategic countermeasures vary across different types and scales of disasters?*

(b) *Do these subjective perceptions of disaster countermeasures translate into objective financial recovery?*

(c) *Is actual effectiveness affected by the firm's proactive attitude?*

To address these questions, our study combines a unique dataset—obtained from a 2025 survey of over 3,500 SMEs, detailing business strategy changes, BCP formulation, disaster experiences, and subjective perceptions—with firm-level accounting data provided by Tokyo Shoko Research (TSR).

Our analysis yields three main findings. Regarding the first question, we document a significant perceptual gap driven by disaster predictability: while property insurance is highly valued for relatively predictable events like wind and water damage, its subjective effectiveness drops significantly for highly unpredictable and ambiguous events, such as earthquakes. In these scenarios of severe uncertainty, firms rely more heavily on commercial bank loans and public subsidies. Regarding the second question, we find only a weak association between a firm's subjective rating of these financial tools and its subsequent objective financial performance. Finally, in response to the third question, our findings underscore the paramount importance of proactive strategic adaptation. Firms that leverage post-disaster resources not merely to return to the status quo, but to implement proactive strategic changes—coupled with the decisive execution of BCPs—demonstrate robust financial resilience. Consequently, this paper highlights that while securing liquidity through insurance or loans is a necessary prerequisite, it is the firm's proactive operational agility that ultimately dictates long-term survival.

2 Data and Empirical Strategy

2.1 Data

This paper conducts an analysis using firm-level data collected through the "Survey on Small and Medium-Sized Enterprises' Disaster Countermeasures" (the RIETI survey hereafter) conducted by the Research Institute of Economy, Trade and Industry (RIETI) from January until March 2025 in conjunction with the Tokyo Shoko Research (TSR) dataset from 2007 until 2024. The RIETI survey targeted 15,000 SMEs nationwide. In the sampling process, we restricted the target to the prefectures that had designated severe disaster areas (including localized disasters), accounted for the distribution at the municipal level, limited the scope to industries with a large number of BCP-certified firms, and deliberately focused on firms located near the thresholds of the industry-specific definitions of SMEs (specifically, around the upper and lower limits of medium-sized enterprises).[1] The survey questionnaires were sent by mail, and responses were collected via mail, a dedicated website, and email. Three weeks after the initial mailing, reminders were issued via mail and telephone. Ultimately, 3,510 valid responses were obtained, yielding a response rate of 23.4%.

Table 1. Disaster Experience by Disaster Type

	Primary Establishment						Secondary Establishment					
Disaster Type	1st	2nd	3rd	4th	5th	Total	1st	2nd	3rd	4th	5th	Total
Earthquake	553	43	13	4	0	613	41	4	1	0	0	46
Typhoon, Strong Wind, and Tornado	351	100	31	12	4	498	21	7	2	2	1	33
Heavy Rain and Flood	184	55	17	3	0	259	18	3	0	0	0	21
Lightning Strike	77	33	8	7	2	127	8	1	1	0	0	10
Heavy Snowfall	89	19	7	2	5	122	5	2	0	0	0	7
Abnormal Tidal Disaster	4	1	0	0	0	5	0	0	0	0	0	0
Tsunami	9	0	0	0	0	9	2	0	0	0	0	2
Volcanic Eruption	1	1	0	0	0	2	0	0	0	0	0	0
Landslide	12	2	0	0	0	14	0	0	0	0	0	0
Drought	1	1	2	0	0	4	0	0	0	0	0	0
Others	59	26	10	6	3	104	5	2	0	1	1	9
Total	1340	281	88	34	14	1757	100	19	4	3	2	128

Note: '1st–5th' indicate the k-th time a firm experienced *any* disaster (not necessarily the same type).

[1] In Japan, a "severe disaster" ("Gekijin saigai") is a specific administrative classification determined by the Cabinet under the Act on Special Financial Support to Deal with the Designated Disaster of Extreme Severity. Currently, there are two distinct types of designations: a nationwide designation ("Hon-geki"), which is applied when total damage across the country exceeds statutory thresholds, and a localized designation ("Kyoku-geki"), which is applied to specific municipalities that suffer exceptionally severe damage even if the national criteria are not met. Once a disaster or municipality receives this designation, the central government enacts special financial measures, including enhanced subsidy rates for local government recovery projects and special disaster-recovery credit guarantees and loans specifically targeting affected SMEs.

The survey questions were designed to capture SMEs' disaster responses comprehensively from multiple perspectives. These include *past disaster experiences*, *financial countermeasures through insurance and loans*, *the presence or absence of changes in business strategy and scale*, *the implementation status and timing of disaster countermeasures*, and *the anticipated disasters and motivations for formulating Business Continuity Plans (BCPs)*. Regarding past disaster experiences, respondents could answer for up to five disaster experiences over the past 15 years, and we asked about experiences not only at their main establishment but also at secondary establishments. As shown in Table 1, the total number of disasters experienced across primary establishments was 1,757 and that across secondary establishments was 128. Of these, earthquakes accounted for about 34%, wind damage (such as typhoons, windstorms, and tornadoes) for about 28%, water damage and floods (such as heavy rain) for about 15%, and other disasters for about 22%. Table 2 shows the disaster experiences categorized by scale (severe disasters vs. non-severe disasters), with severe disasters accounting for 42.8% of the total.

Table 2. Annual Distribution of Disaster Experiences by Disaster Scale

Year of Occurrence	Disaster Scale		Total
	Non-Severe	Severe	
Before 2011	35	4	39
2011	37	364	401
2012	10		10
2013	31		31
2014	36		36
2015	41		41
2016	33	37	70
2017	35		35
2018	65	266	331
2019	150		150
2020	74	26	100
2021	95		95
2022	123		123
2023	116		116
2024	133	69	202
2025	10		10
Total	1,024 (57.2%)	766 (42.8%)	1,790

Table 3 reports the frequencies and proportions of business suspension across both primary and secondary establishments, disaggregated by the cumulative number of disaster experiences. A clear and highly consistent pattern emerges from the data: establishments with greater disaster experience demonstrate a significantly higher capacity to avoid operational suspension.

Table 3. Business Suspension

	Primary Establishment			Secondary Establishment		
Disaster Experience	Not Suspended	Suspended	Total	Not Suspended	Suspended	Total
1st	1025	440	1465	97	33	130
	(70.0%)	(30.0%)	(100%)	(74.6%)	(25.4%)	(100%)
2nd	248	71	319	31	5	36
	(77.7%)	(22.3%)	(100%)	(86.1%)	(13.9%)	(100%)
3rd	105	22	127	20	0	20
	(82.7%)	(17.3%)	(100%)	(100%)	(0%)	(100%)
4th	60	8	68	16	0	16
	(88.2%)	(11.8%)	(100%)	(100%)	(0%)	(100%)
5th	46	3	49	17	1	18
	(93.9%)	(6.1%)	(100%)	(94.4%)	(5.6%)	(100%)
Total	1484	544	2028	181	39	220
	(73.2%)	(26.8%)	(100%)	(82.3%)	(17.7%)	(100%)

Note: '1st–5th' indicate the k-th time a firm experienced *any* disaster (not necessarily the same type).

For primary establishments, the proportion of suspended operations declines monotonically with each subsequent disaster event, dropping from 30.0% during the first disaster to merely 6.1% by the fifth. A highly comparable downward trajectory is observed among secondary establishments, where the suspension rate falls from 25.4% during the first experience to 0.0% by the third and fourth events, before checking in at a negligible 5.6% for the small sample of fifth-time affected establishments.

This negative relationship between disaster recurrence and business interruption strongly points toward an organizational learning effect, or a process of "learning-by-doing" in crisis management. Having navigated prior shocks, firms likely refine their emergency protocols, fortify non-structural defenses, and enhance their operational agility, rendering them progressively more resilient to subsequent hazards. Alternatively, this pattern may partially reflect a selection mechanism or survivorship bias; less resilient or structurally vulnerable firms may permanently exit the market after an initial or secondary shock, meaning that the pool of enterprises experiencing higher-order disasters is systematically skewed towards inherently robust survivors. Regardless of the relative weight of these two mechanisms, the empirical evidence clearly demonstrates that repeated exposure is strongly coupled with an enhanced capacity to maintain business continuity.

In addition to the data from the RIETI survey, we use the following variables from the TSR dataset: Sales, Total Sales, Number of Employees, (Total) Assets, Fixed Assets, and Labor Productivity.[2] Table [TSR] reports the descriptive statistics of these variables. The descriptive

[2]"Sales" refers to the sale of finished goods, merchandise, etc., whereas "Total Sales" represents the sum of sales, revenue from completed construction contracts, and operating revenue, less sales returns and allowances. Construction companies and civil engineering companies generate the vast majority of their top-line income from revenue from completed construction contracts; thus, for these companies, "Total Sales" is the appropriate

statistics of these variables alongside variables from the RIETI survey are reported in Table 7 in the appendix.

2.2 Measures of Effectiveness and Impact

For each disaster experience, the survey asked about various impacts—such as the amount of direct damage (damage to stock, such as buildings and equipment), the amount of indirect damage (losses due to business interruption/suspension), the presence of tangible asset damage, and the occurrence of business interruption/suspension—in addition to the month and year of occurrence and the type of disaster. Furthermore, for each disaster experience, respondents were asked to evaluate the use and subjective effectiveness of financial countermeasures—namely, property insurance, business interruption insurance, commercial bank loans, public loans, and public subsidies—on a 10-point scale.

Using data from all disaster experiences, we first analyze how firms subjectively evaluate the effectiveness of each countermeasure by comparing the empirical cumulative distributions of the 10-point subjective evaluations across different disaster types and scales. Next, we analyze the impact of each countermeasure on post-disaster business interruption by comparing the probability of business interruption based on the presence or absence of these measures.

We analyze how closely subjective evaluations align with objective business performance. To this end, we first compare the empirical cumulative distributions of pre- and post-disaster changes (three- to five-year windows each) in financial and operational measures between two cohorts: companies that gave a high evaluation score (6 or higher) and those that gave a low score (5 or lower) to a given countermeasure across each disaster type. In addition, we regress these performance changes on the evaluation scores and a vector of control variables: For every firm i,

$$\Delta Y_i = \beta_0 + \beta_1 S_i + \mathbf{X}_i \gamma + \varepsilon_i, \tag{1}$$

where ΔY_i is firm i's pre- and post-disaster change in a given financial or operational measure, S_i is firm i's evaluation score of the countermeasure for the type of disaster firm i experienced, $\mathbf{X}_i$ is the vector of control variables, and ε_i is the error term.

2.3 BCPs and Proactive Strategies

While advance preparation is considered effective for responding when a disaster strikes, what specific preparations should be made is not always self-evident. In the case of companies, business continuity is important, and attempts have been made to systematize what kind of preparations can enable a business to continue. BCP is defined in the latest international standard ISO22301:2019 as "documented procedures that guide an organization to respond to interruptions and disruptions of business operations, restore and resume operations, and recover

measure.

them to a predetermined level." Regarding the maintenance of a BCP after its formulation, it is considered effective to introduce BCM (Business Continuity Management), which is an activity to continuously maintain and improve an organization's business continuity capability, and BCMS (Business Continuity Management System), which is a system to operate BCM effectively, efficiently, and continuously.

Furthermore, the Japanese government is working to promote the formulation of BCPs. The Cabinet Office formulated the "Business Continuity Guidelines" in 2005, which have been successively revised since then. Additionally, the Small and Medium Enterprise Agency introduced the "Business Continuity Enhancement Plan Certification System" ("Jigyokei") in 2019, promoting the formulation of business continuity enhancement plans——which can be considered a simplified version of a BCP——specifically for small and medium-sized enterprises.

3 Results

3.1 Subjective Evaluations

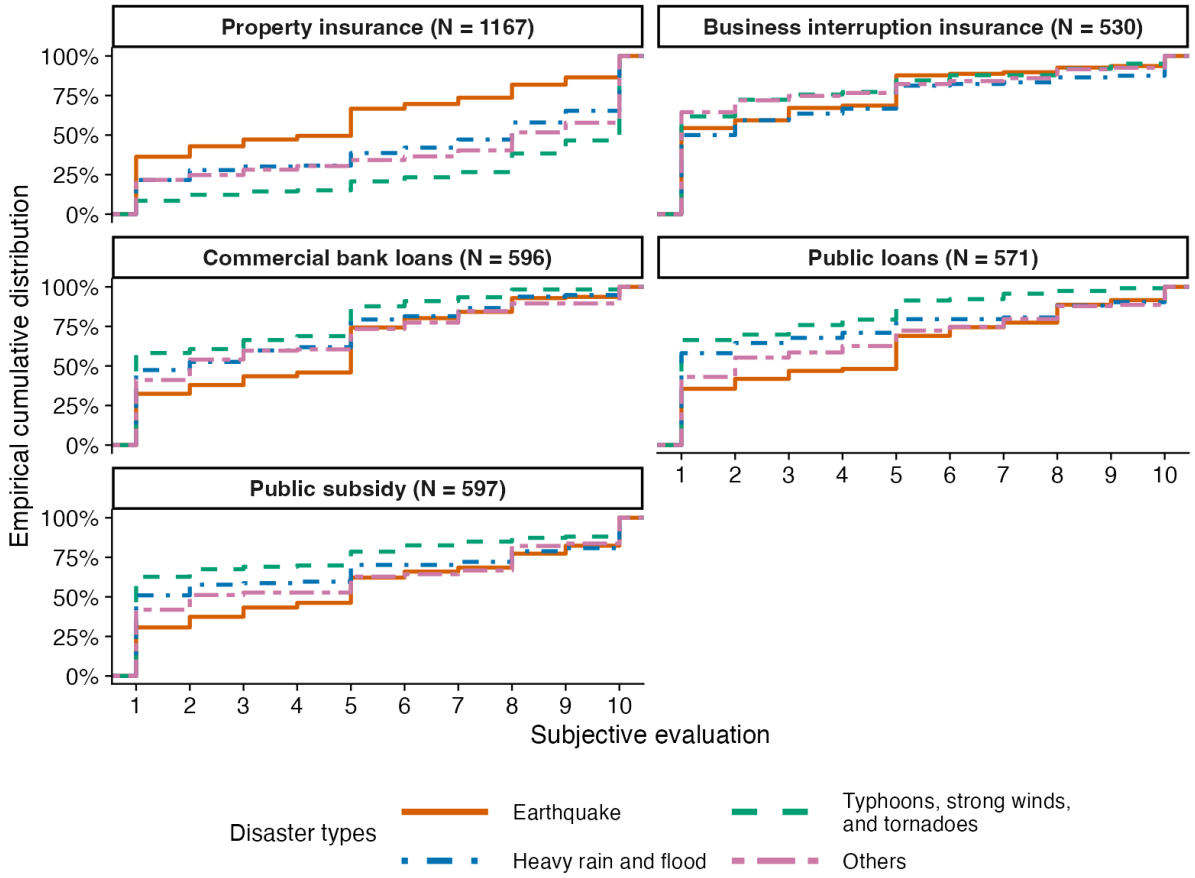
Here, we analyze each firm's subjective effectiveness evaluation for each countermeasure. First, we examine whether there are differences in the subjective effectiveness evaluations across four types of disasters: earthquakes, wind damage (such as typhoons, wind storms, and tornadoes), water damage and floods (such as heavy rain), and other disasters.

Figure 1 shows the empirical cumulative distribution functions by disaster type for the subjective effectiveness evaluations (where 1 is the lowest evaluation and 10 is the highest) of property insurance, business interruption insurance, commercial bank loans, public loans, and public subsidies. This expresses the empirical distribution of the subjective effectiveness of each countermeasure for the experienced disasters in the form of cumulative probability. For example, the proportion of responses evaluating the effectiveness of property insurance against earthquakes as 2 or lower is slightly over 40%, whereas the proportion evaluating its effectiveness against wind damage, such as typhoons, as 2 or lower is slightly over 10%. Therefore, it can be said that a distribution function positioned lower (or further to the right) overall indicates a tendency towards higher evaluations. For instance, regarding property insurance, its evaluation as a countermeasure against wind damage (e.g., typhoons) is the highest, while its evaluation as a countermeasure against earthquakes is the lowest.

Although differences in subjective effectiveness **evaluations by disaster type** are observed for all countermeasures, the main points are as follows:

- **Property insurance:** While its evaluation as a countermeasure against wind damage (e.g., typhoons) is very high, its evaluation against earthquakes is low. It also receives relatively high evaluations as a countermeasure against water damage and other disasters.
- **Business interruption insurance:** The evaluation is generally low for almost all dis-

Figure 1: Empirical distributions of subjective evaluations by disaster type



Notes: This figure shows empirical cumulative distribution functions of subjective evaluations for five financial recovery measures: property insurance, business interruption insurance, commercial bank loans, public loans, and public subsidies. Subjective evaluations are measured on an integer scale from 1 to 10. The plotted distributions are based on evaluations from firms that used each measure. Disaster types are classified into four categories: earthquakes, typhoons/strong winds/tornadoes, heavy rain/floods, and other disasters. Each panel reports the total number of non-missing observations used for the corresponding recovery measure.

asters.

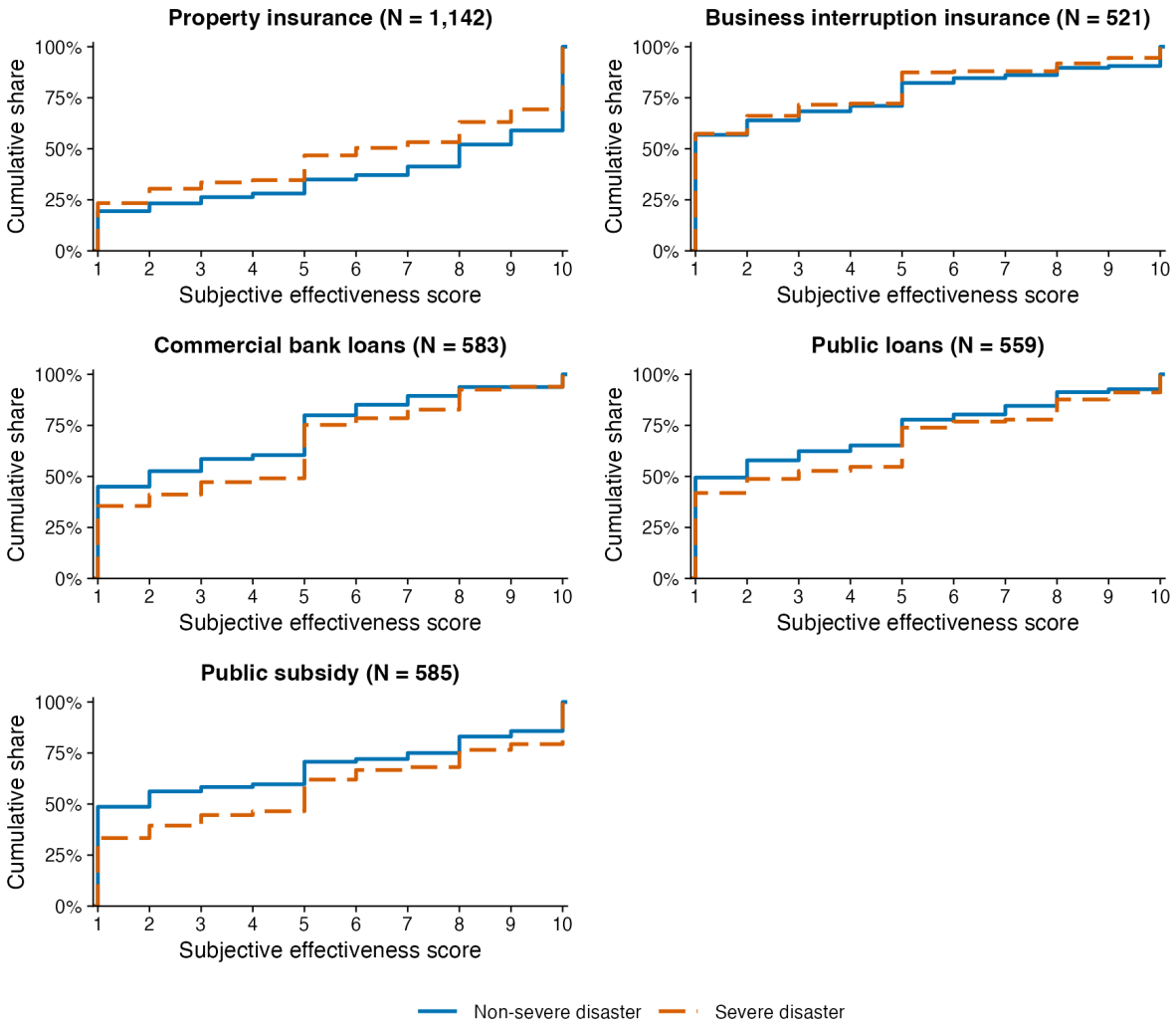
- **Commercial bank and public loans:** These show a very similar trend. Their evaluation as a countermeasure against wind damage (e.g., typhoons) is the lowest, their evaluation against earthquakes is relatively high, and their evaluations as a countermeasure against water damage and other disasters are not particularly favorable.
- **Public subsidies:** These also show a trend similar to commercial bank loans and public loans; however, across all disasters, the proportion of responses giving the highest evaluation is around 20%.

We analyze the effectiveness of each countermeasure by disaster scale. As mentioned earlier, while the definition of disaster scale is not uniquely determined, here we classify disasters into two categories: designated severe disasters and other non-severe disasters. Figure 2, similar to Figure 1, plots the empirical cumulative distribution functions of the subjective effectiveness evaluations (1 being the lowest, 10 being the highest) for property insurance, business interruption insurance, commercial bank loans, public loans, and public subsidies, categorized not by disaster type but by whether they are severe disasters or not. Although differences in the distribution of effectiveness evaluations **between severe and non-severe disasters** are observed for all countermeasures, the main points are as follows:

- **Property insurance:** While relatively high evaluations as a countermeasure against severe disasters account for half of the responses, its evaluations as a countermeasure against non-severe disasters are even higher.
- **Business interruption insurance:** The evaluation remains low regardless of whether it is a severe disaster or not.
- **Commercial bank and public loans:** None of these receive particularly high evaluations overall; however, their evaluations as countermeasures against severe disasters exceed those against non-severe disasters.
- **Public subsidies:** For both severe and non-severe disasters, about 20% of the responses give the highest evaluation.

So far, we have observed the distributions of subjective effectiveness evaluations for each countermeasure by disaster type (earthquakes, wind damage, water damage, and others) and scale (severe disasters vs. non-severe disasters). The evaluation of business interruption insurance consistently remains at a low level, possibly reflecting the low subscription rate. By contrast, the evaluation of property insurance varies considerably depending on the type and scale of the disaster. On one hand, the low evaluation as a countermeasure against earthquakes is consistent with the fact that standard fire insurance policies do not cover earthquakes and a special rider, which has a low subscription rate, is needed. On the other hand, its extremely

Figure 2: Cumulative probability distributions of evaluation scores for severe vs. non-severe disasters



high evaluation as a countermeasure against wind damage, such as typhoons, likely reflects that such damage is covered by standard fire insurance policies. Furthermore, its intermediate evaluation as a countermeasure against water damage, such as floods, suggests that this is also influenced by the fact that water damage requires coverage through an optional rider. Therefore, the decision to attach a special rider to a fire insurance policy is crucial, and predictability may have a significant impact on the decision. In other words, for hard-to-predict disasters like earthquakes, many firms forgo attaching the special rider, whereas for relatively predictable disasters like water damage, a comparatively larger number of firms choose to attach it.

Conversely, because many firms do not attach an earthquake rider to their fire insurance for hard-to-predict disasters like earthquakes, the effectiveness evaluation for commercial bank loans against earthquakes is higher. This may reflect situations in which firms rely on loans from their relationship banks and/or utilize new public loans and public subsidies after a disaster. Namely, unlike insurance, commercial bank loans, public loans, and public subsidies are not structured as contracts with finely detailed pre-disaster conditions for funding, but rather take the form of looser incomplete contracts, which are designed to be utilized when insurance coverage is absent.

Additionally, predicting large-scale severe disasters is considered more difficult than predicting other disasters. Therefore, it is possible that the effectiveness of property insurance is higher for more predictable non-severe disasters and lower for less predictable severe disasters. For commercial bank loans, public loans, and public subsidies, conversely, their effectiveness is higher for less predictable severe disasters and lower for more predictable non-severe disasters.

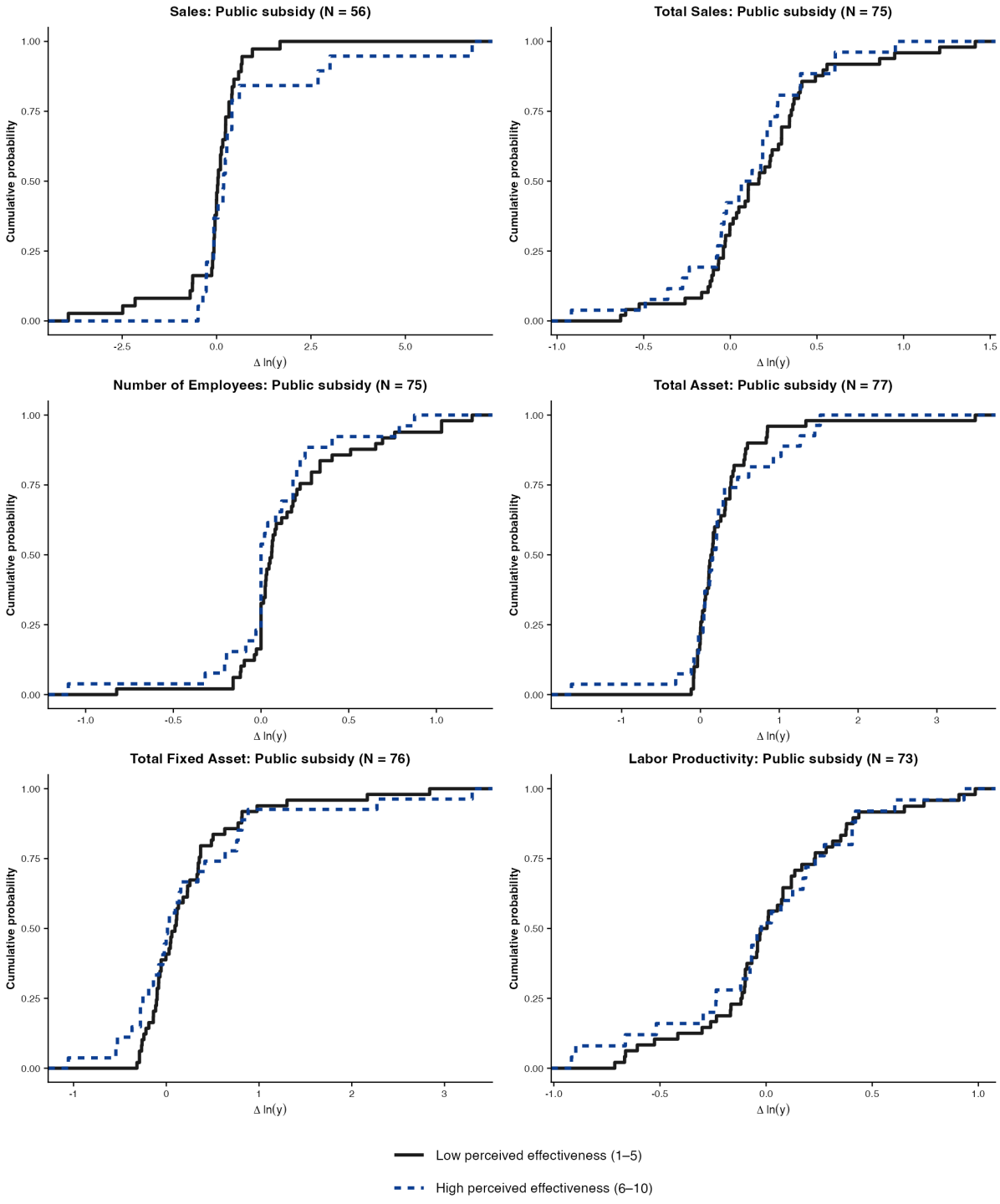
3.2 Weak Association between Subjective Evaluations and Accounting Measures

To evaluate whether the subjective effectiveness of disaster countermeasures translates into objective financial recovery, we merge the survey responses with firm-level accounting data from TSR. Interestingly, the empirical analysis reveals only a weak association between a firm's subjective rating of a financial tool (such as commercial bank loans or property insurance) and its subsequent objective financial performance. This can be confirmed by Figure 3, which reports the empirical cumulative distributions of *Sales*, *Total Sales*, *Number of Employees*, *Total Asset*, *Total Fixed Asset*, and *Labor Productivity* by perceived effectiveness of public subsidies—the solid lines are for firms with lower evaluation scores (i.e., between 1 and 5) and the dashed lines are for firms with higher evaluation scores (i.e., between 6 and 10).

In addition, Table 4 reports the estimation results of equation (1) for the logarithmic change in the outcome from one year before the disaster to three years after the disaster. The subjective evaluation score for public subsidies has no association with any of the outcome variables.

Several factors may explain this disconnect. First, SME accounting data inherently contains substantial noise, which can obscure short-term recovery signals. Second, subjective evaluations

Figure 3: Weak association of post-disaster recovery with subjective evaluation of public subsidies



Notes: This figure plots empirical cumulative distribution functions of objective recovery across six firm outcomes. Objective recovery is defined as the log change in the outcome from one year before the disaster to three years after the disaster, $\log(y_{i,t+3}) - \log(y_{i,t-1})$. The sample is restricted to firms that used public subsidies after experiencing a disaster. Firms are divided into two groups based on their perceived effectiveness score for public subsidies: low perceived effectiveness, defined as scores from 1 to 5, and high perceived effectiveness, defined as scores from 6 to 10. A rightward shift of the CDF indicates a stronger recovery distribution.

Table 4. Public Subsidies Evaluation Score and 3-Year Recovery

Outcome:	(1) Sales	(2) Total sales	(3) Employee	(4) Asset	(5) Fixed asset	(6) Labor prod.
Evaluation Score	−0.004	−0.005	−0.027	−0.009	−0.005	0.007
	(0.043)	(0.013)	(0.019)	(0.030)	(0.041)	(0.016)
Direct Damage	0.154**	−0.017	0.010	−0.013	−0.084*	−0.022
	(0.067)	(0.015)	(0.024)	(0.036)	(0.047)	(0.017)
Indirect Damage	−0.074	0.006	−0.012	−0.033	−0.004	0.011
	(0.055)	(0.013)	(0.016)	(0.025)	(0.040)	(0.016)
Respondent Type	−0.036	0.004	−0.070	0.073	−0.262	0.029
	(0.370)	(0.119)	(0.127)	(0.151)	(0.242)	(0.121)
Observations	35	49	49	51	50	47
FE	✓	✓	✓	✓	✓	✓

Notes: Standard errors clustered at the firm level are in parentheses. The dependent variable is the log change in the outcome from one year before the disaster to three years after the disaster. 'Evaluation Score' is the firm's subjective evaluation score for public subsidies, measured from 1 to 10, with higher values indicating that the firm perceived public subsidies as more effective. 'Direct Damage' and 'Indirect Damage' are the log-transformed reported amounts of direct and indirect disaster damage, respectively, defined as log(1+damage). 'Respondent Type' is an indicator equal to one if the questionnaire respondent is the firm representative or a member of management, and zero otherwise. The sample is restricted to firms that used public subsidies and reported a positive evaluation score. Disaster-type fixed effects and disaster-year fixed effects are included in all specifications. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

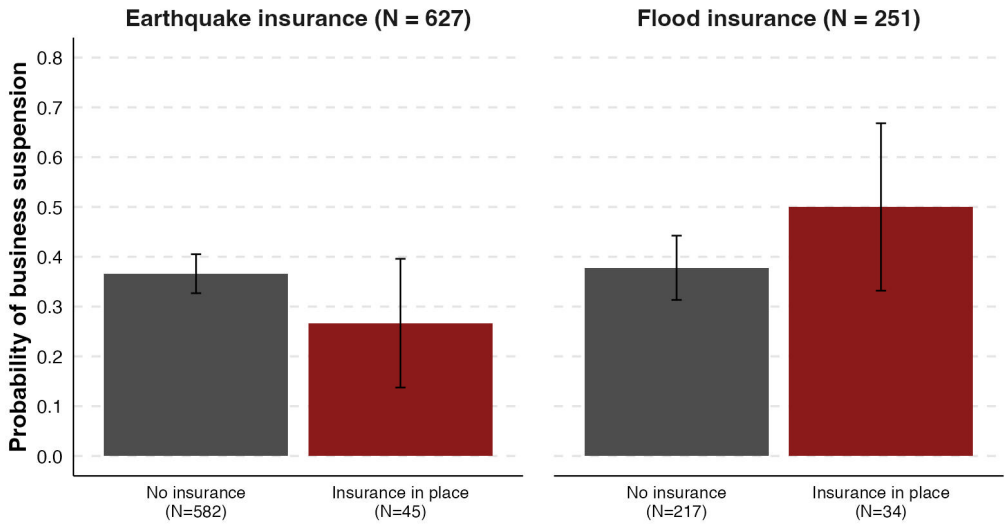
are often heavily influenced by the immediate psychological or operational relief of securing liquidity, which does not automatically translate into long-term structural recovery. However, the weak association does not necessarily imply that these financial countermeasures are universally ineffective. Rather, it suggests that merely securing a financial safety net—whether through insurance payouts or public relief—is insufficient on its own to guarantee robust financial health post-disaster.

3.3 Importance of Proactive Strategies

Next, we examine whether non-structural countermeasures translate into tangible objective outcomes, specifically the mitigation or avoidance of business interruption. Figure 4 illustrates the relationship between the possession of earthquake or flood insurance and the probability of operational suspension. Because the proportion of firms subscribing to voluntary earthquake or flood insurance remains limited, the estimated confidence intervals are wide; consequently, we observe no statistically significant differences in suspension rates based purely on insurance ownership. Nonetheless, the directional trends are indicative: whilst earthquake insurance is associated with a marginal reduction in business interruption, flood insurance paradoxically exhibits a positive correlation with suspension. Although a definitive causal mechanism cannot be established from this descriptive analysis alone, this pattern strongly points towards adverse selection, whereby firms operating in high-risk, flood-prone areas are systematically more susceptible to water damage and are thus more likely to secure flood coverage.

We turn next to the role of strategic preparedness by examining the relationship between BCP formulation and business interruption. Figure 5 reports the differences in the proportion of business suspension between firms that had formulated a BCP and those that had not, both

Figure 4: Insurance ineffective in preventing business suspension



in the aggregate and disaggregated by disaster type. In the aggregate sample, firms (or establishments) with a formulated BCP clearly avoided business interruption at a significantly higher rate than their unprepared counterparts. When broken down by specific disaster types, the differences lose statistical significance due to the diminished sample sizes of BCP-formulating firms within individual disaster cohorts. However, the consistent directional trend across all categories suggests that BCP formulation enhances operational resilience and mitigates suspension risks regardless of the specific nature of the hazard.

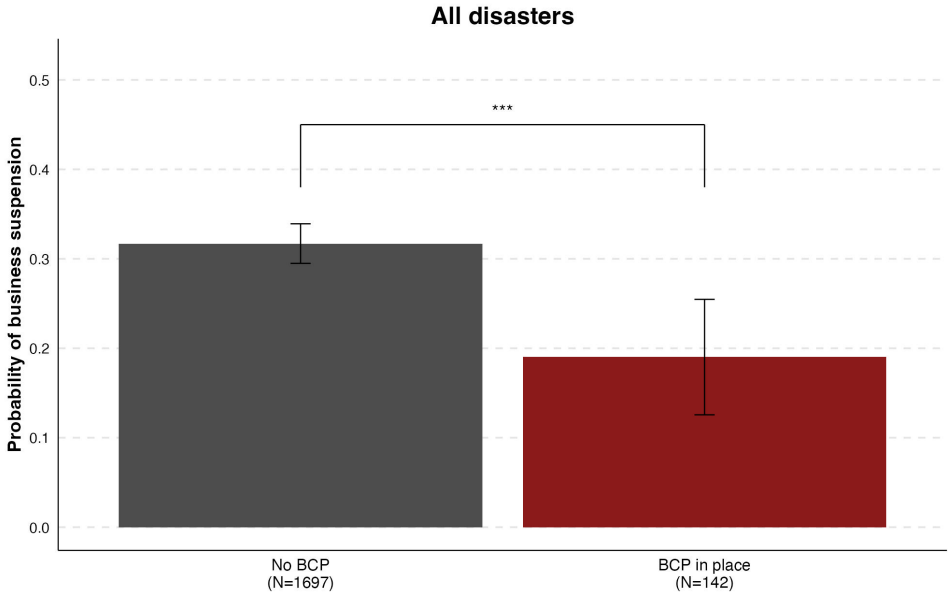
Beyond ex-ante preparedness tools like BCPs, a firm's ex-post strategic response is equally critical to long-term recovery. To evaluate this, we analyze how proactive modifications to business strategy following a disaster impact subsequent financial performance. In Figure 6, the CDF for the strategy-adjusting cohort exhibits a distinct rightward shift, indicating superior financial recovery across the distribution. This empirical pattern suggests that active strategic reorientation—rather than a passive reliance on financial compensation—serves as a primary driver of objective post-disaster success.

These combined findings underscore a critical theoretical insight: if the passive receipt of financial countermeasures does not automatically guarantee objective recovery, the analytical focus must shift to how firms actively utilize available resources. Our results highlight the importance of an enterprise adopting a proactive strategic stance. Financial tools essentially function to secure liquidity and to buy time. How a firm deploys that time and capital ultimately determines its post-disaster trajectory. Firms that treat recovery not merely as a return to the pre-disaster status quo, but as an opportunity to implement proactive strategic changes—such as right-sizing operational scale, adapting supply chains, or decisively executing an established BCP—demonstrate far more robust resilience.

This carries vital policy implications. Whilst addressing perceptual gaps and providing

Figure 5: Operations shutdown probability by BCP status across different disaster types.

(a) All Disasters



(b) By Disaster Type

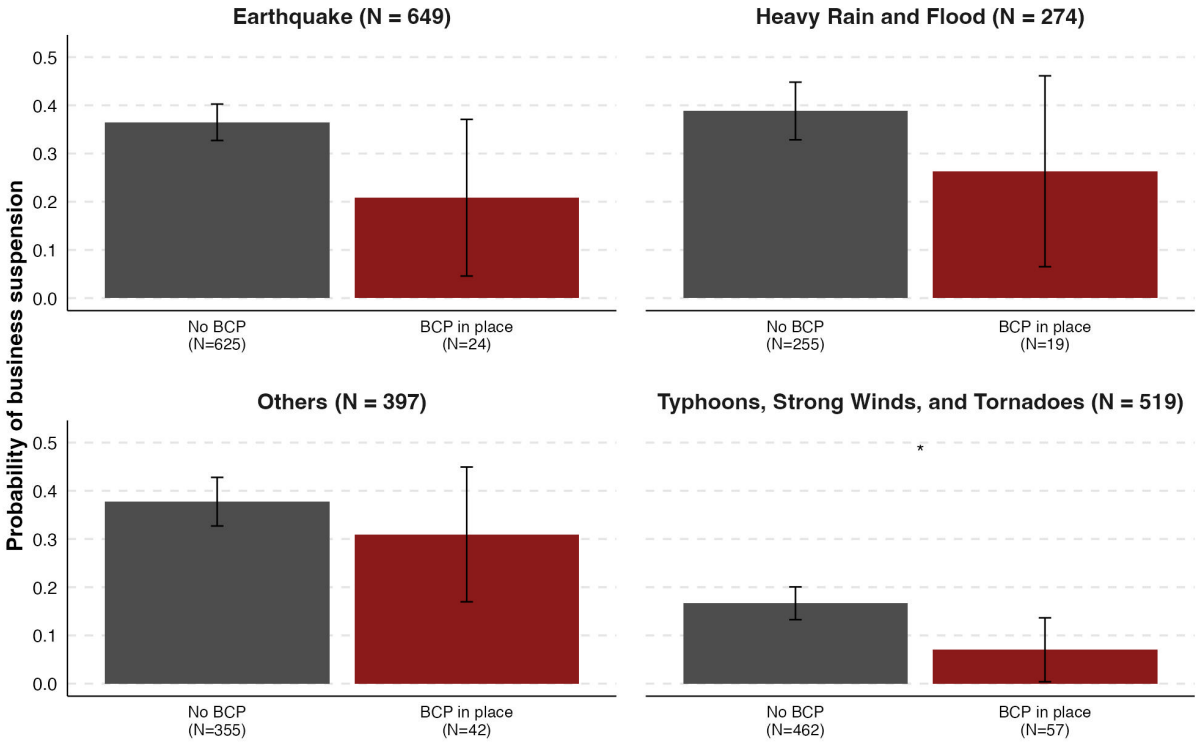
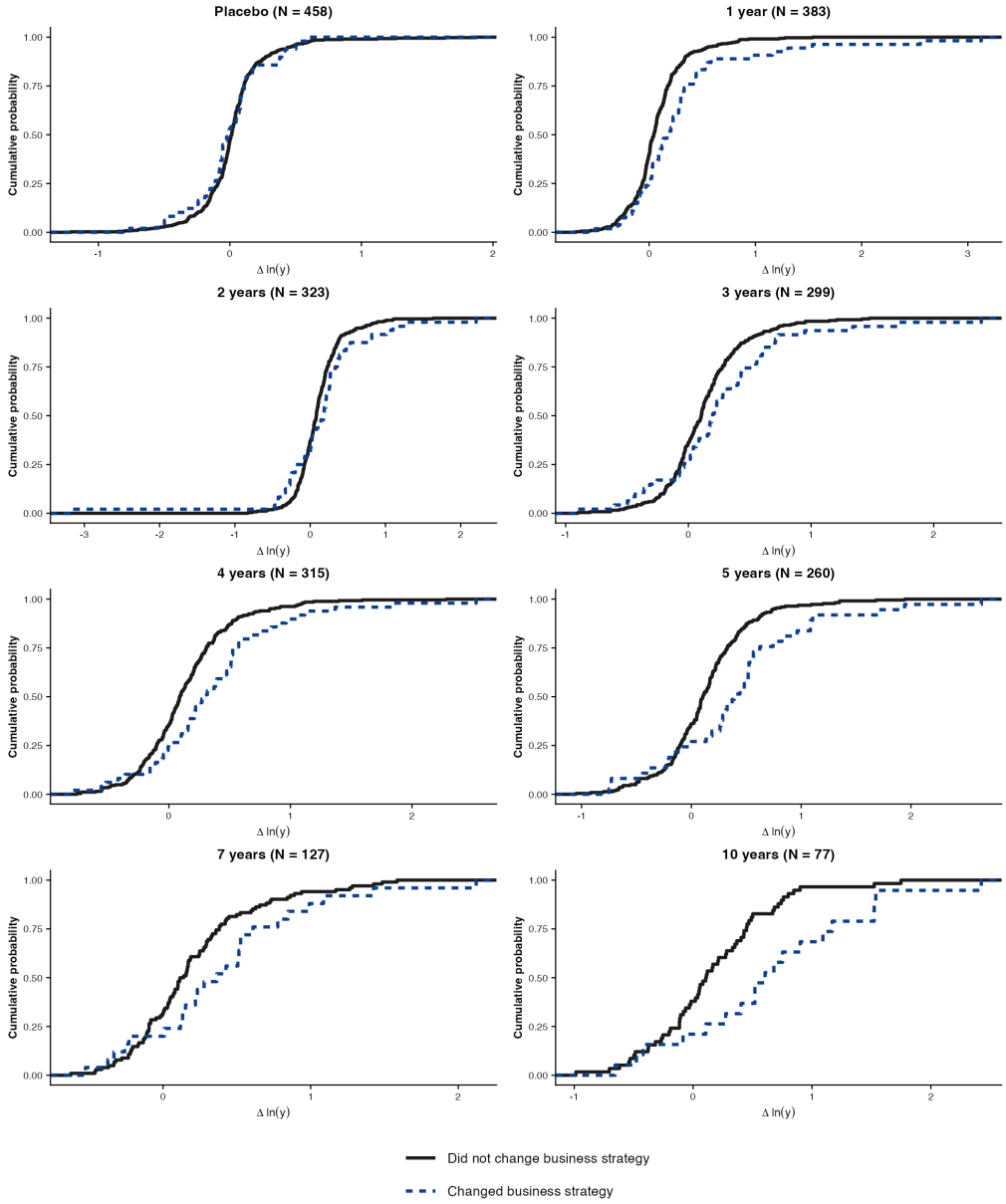


Figure 6: CDFs of total sales recovery by post-disaster business strategy change across time horizons



Notes: This figure plots empirical cumulative distribution functions of objective recovery in total sales across different time horizons. The placebo panel compares the log change in total sales from two years before the disaster to one year before the disaster, $\log(y_{i,t-1}) - \log(y_{i,t-2})$. The remaining panels define objective recovery as the log change in total sales from one year before the disaster to h years after the disaster, $\log(y_{i,t+h}) - \log(y_{i,t-1})$, where $h = 1, 2, 3, 4, 5, 7, 10$. The sample is divided according to whether the firm changed its business strategy after the disaster. A rightward shift of the CDF indicates a stronger recovery distribution.

financial safety nets are necessary policy interventions, they are entirely insufficient without strategic agility. BCPs serve precisely this function. Even though they cannot perfectly predict unforeseen contingencies, they effectively organize a firm's internal uncertainties and prime the organization to take proactive, decisive action when a crisis inevitably materializes.

4 Conclusion

This paper has examined the post-disaster effectiveness of various financial and strategic countermeasures among Japanese SMEs. To address this, we combined a unique dataset from a 2025 survey of over 3,500 firms with objective accounting data from Tokyo Shoko Research (TSR), allowing us to evaluate both subjective perceptions and actual financial recovery.

Our analysis provides clear answers to our three primary research questions. First, regarding how effectiveness varies across disaster types and scales, we document a significant perceptual gap driven by the inherent predictability of different disasters. While property insurance is highly valued for relatively predictable events like wind and water damage, its subjective effectiveness drops significantly for highly unpredictable and ambiguous events, such as earthquakes. In these scenarios of severe uncertainty, firms rely more heavily on commercial bank loans and public subsidies. These mechanisms function as flexible, incomplete contracts that provide critical liquidity when explicit, ex-ante insurance coverage is absent or insufficient.

Second, we find only a weak association between firms' subjective evaluations of these financial tools and their objective, long-term accounting performance. However—addressing our third research question—this disconnect does not imply that financial countermeasures are universally ineffective. Rather, the actual effectiveness of these tools is heavily contingent upon a firm's proactive attitude. Securing liquidity through insurance payouts, commercial bank and public loans, or public subsidies is merely a prerequisite for recovery. The true determinant of robust post-disaster resilience is whether a firm leverages these resources to implement proactive strategic adaptations. Furthermore, the decisive execution of Business Continuity Plans (BCPs) consistently reduces the likelihood of business interruption across various disaster scenarios, demonstrating that preparing for uncertainty yields tangible benefits.

These findings offer vital implications for both SME managers and policymakers. The effectiveness of policy interventions vary in accordance with the nature of the disaster, and policies should evolve beyond simply encouraging the uptake of disaster insurance or providing emergency public funding. While financial lifelines remain essential, policy frameworks must simultaneously foster strategic agility. Encouraging SMEs to formulate comprehensive BCPs and to view post-disaster recovery as an opportunity for proactive business adaptation will be critical for enhancing the overall resilience of the Japanese economy against future unforeseen contingencies.

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A RIETI Survey: Design and Fielding

The roster of 15,000 firms is divided evenly between two arms of 7,500 firms each: one drawn from firms certified under the Small and Medium Enterprise Agency's Business Continuity Enhancement Plan certification scheme (single-firm type), and one drawn from the TSR register at large. Within each arm the draw was allocated across seventeen industry divisions in numbers that are identical between the two arms to within a single firm, so that the certified and non-certified halves of the roster are matched on industry. The allocation embodies several further criteria: (i) restricting the target to the thirty-two prefectures containing municipalities affected by disasters designated as severe disasters, including localized designations;[3] (ii) accounting for the distribution of firms at the municipal level; (iii) concentrating the industry quotas where certified firms are numerous; and (iv) deliberately focusing on firms operating near the thresholds of the industry-specific SME definitions, particularly around the upper and lower limits of medium-sized enterprises, through allocation across cells defined by capital and employment size.

The questionnaires were distributed by mail, and responses were collected via mail, a dedicated website, and email, with a response deadline of February 21, 2025. To enhance the response rate, reminders were issued by mail and telephone three weeks after the initial distribution. 3,510 valid responses were obtained. Table 5 reports the number of responses to the questions.

[3] In Japan, a "severe disaster" is an administrative classification of a disaster, determined by the Cabinet under the Act on Special Financial Support to Deal with the Designated Disaster of Extreme Severity. The designation attaches to the disaster, either nationwide or as a localized designation naming the municipalities it covers, and triggers special financial measures including enhanced subsidy rates and special disaster-recovery credit guarantees and loans targeting affected SMEs.

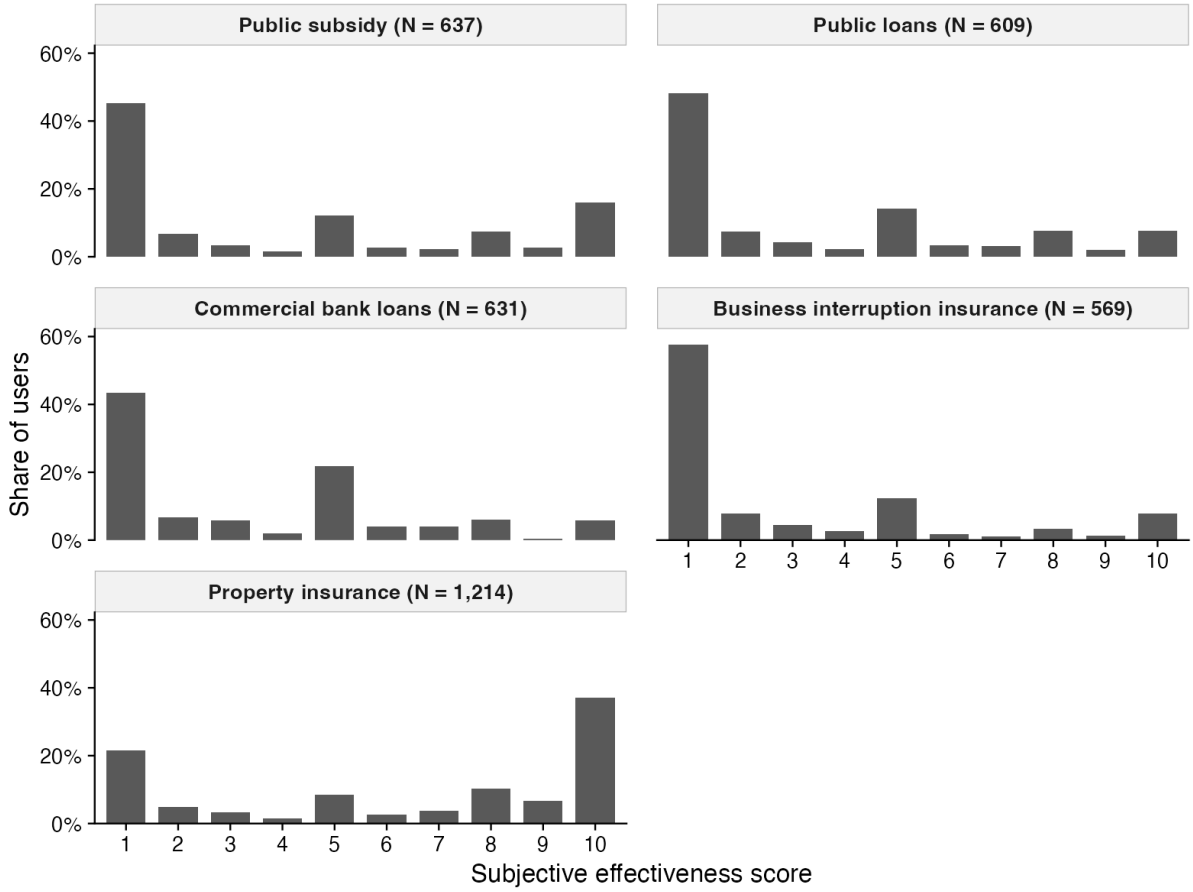
Table 5. Response rate for each relevant item in RIETI survey

Survey item	N	Share of "Reported disaster experiences"
Panel A. Disaster-event information		
Reported disaster experiences	2,570	100%
Disaster year	1,855	72.2%
Disaster month	1,778	69.2%
Disaster year and month	1,772	68.9%
Disaster type	1,884	73.3%
Panel B. Damage and disruption information		
Direct damage	1,609	62.6%
Indirect damage	1,110	43.2%
Tangible asset damage	2,478	96.4%
Operation suspension	2,247	87.4%
Direct and indirect damage	1,027	40.0%
Panel C. Financial coping measure evaluations		
Public subsidy evaluation	1,562	60.8%
Public loan evaluation	1,503	58.5%
Commercial bank loan evaluation	1,511	58.8%
Business interruption insurance evaluation	1,492	58.1%
Property insurance evaluation	1,850	72.0%
Panel D. Main analysis inputs (example)		
Year, disaster type, direct damage, and indirect damage	999	38.9%
Year, disaster type, damage, and public subsidy evaluation	791	30.8%

Notes: The unit of observation is a firm–establishment–disaster. As shown in Question 1 below, the RIETI survey allowed respondents to report up to five disaster experiences for each of the first and second establishments. A reported disaster experience is defined as a firm–establishment–disaster observation with at least one non-missing response to the disaster-event items in Question 1. The second column reports the number of reported disaster experiences for which the corresponding survey item, or combination of survey items, is non-missing. The third column reports this number as a share of all reported disaster experiences, using the 2,570 observations in the first row as the denominator. Other disaster-related questions, including questions on the effectiveness of financial coping measures, were also asked for each reported disaster at the establishment level.

B Additional Figures and Tables

Figure 7: Distribution of subjective effectiveness scores for financial coping measures.



Notes: The figure shows the distribution of subjective effectiveness scores among users of each financial coping measure. Scores range from 1 to 10, with higher values indicating greater perceived effectiveness. Scores equal to 0, missing responses, and invalid values above 10 are excluded. Shares are normalized within each financial coping measure.

Figure 8 reports the empirical cumulative distributions of total-sales recovery by perceived effectiveness of public subsidies across different time horizons, which complements Figure 3 in the main text. The weak association result remains here.

Tables 9 and 10 complement the distributional comparisons in Section 3.1 by regressing each subjective effectiveness score, among the users of the measure, on the disaster damage the establishment reported. Table 9 uses the logarithm of the reported direct and indirect damage amounts, so episodes without a reported amount are dropped; Table 10 instead uses indicators for positive direct and indirect damage, treating blank amounts as zero, which roughly doubles the sample. Both specifications control for firm size (log employees and log capital), the respondent's position, tangible-asset damage, and operation suspension, and include disaster-type, disaster-year, industry, and prefecture fixed effects, with standard errors clustered at the firm level. The evaluation of property insurance rises with direct damage and falls with indirect damage in both tables, consistent with property insurance indemnifying losses to stock but not

Table 6. Firm and Disaster-Event Summary Statistics

Variable	Mean	SD	Min	Median	Max	N
Panel A: Firm-level characteristics, *full survey sample*						
RIETI Survey						
Disaster experience	0.37	0.48	0.00	0.00	1.00	3,510
Number of disaster experiences	0.51	0.85	0.00	0.00	9.00	3,510
TSR Database (Accounting Data)						
Sales (mil. JPY)	579.79	1,508.62	0.00	147.09	23,968.97	2,203
Total sales (mil. JPY)	745.37	1,991.93	0.00	250.65	51,581.31	2,203
Number of employees (persons)	23.95	41.50	0.00	11.54	664.25	2,203
Total assets (mil. JPY)	637.33	1,624.90	0.00	202.61	30,801.53	2,203
Fixed assets (mil. JPY)	280.43	943.66	0.00	70.11	23,903.11	2,203
Labor productivity (mil. JPY / person)	30.13	36.40	0.00	20.32	629.50	2,157
Panel B: Disaster-event characteristics and responses, *reported disaster-event sample*						
RIETI Survey						
Direct damage (mil. JPY)	201.26	7,657.04	0.00	0.40	300,000.00	1,535
Indirect damage (mil. JPY)	190.32	6,105.53	0.00	0.01	200,000.00	1,073
Tangible asset damage	0.64	0.48	0.00	1.00	1.00	1,738
Operation suspended	0.31	0.46	0.00	0.00	1.00	1,761
Used public subsidy	0.45	0.50	0.00	0.00	1.00	1,260
Used public loans	0.44	0.50	0.00	0.00	1.00	1,234
Used commercial bank loans	0.46	0.50	0.00	0.00	1.00	1,241
Used business interruption insurance	0.42	0.49	0.00	0.00	1.00	1,222
Used property insurance	0.73	0.45	0.00	1.00	1.00	1,541
Changed business strategy	0.13	0.34	0.00	0.00	1.00	1,726
Scaled up or down business	0.15	0.35	0.00	0.00	1.00	1,702
Started new business	0.11	0.31	0.00	0.00	1.00	1,685
Seismic retrofitting before disaster	0.08	0.28	0.00	0.00	1.00	1,637
Flood protection before disaster	0.05	0.22	0.00	0.00	1.00	1,638
Earthquake insurance before disaster	0.36	0.48	0.00	0.00	1.00	1,681
Flood insurance before disaster	0.32	0.47	0.00	0.00	1.00	1,665
BCP before disaster	0.16	0.37	0.00	0.00	1.00	1,686

Notes: Panel A reports firm-level characteristics for the full firm sample, including firms with and without reported disaster experience. Panel B reports disaster-event characteristics and responses for the reported disaster-event sample. In Panel A, N denotes the number of firms with non-missing values; in Panel B, N denotes the number of firm-establishment-disaster observations with non-missing values. Firm financial variables are from the TSR accounting database. For each firm, sales, total sales, number of employees, total assets, fixed assets, and labor productivity are first averaged across available firm-year observations, and the table reports summary statistics of these firm-level averages. Labor productivity is defined as total sales divided by the number of employees. Damage and disaster-response variables are based on RIETI survey responses.

Table 7. Variable Definitions

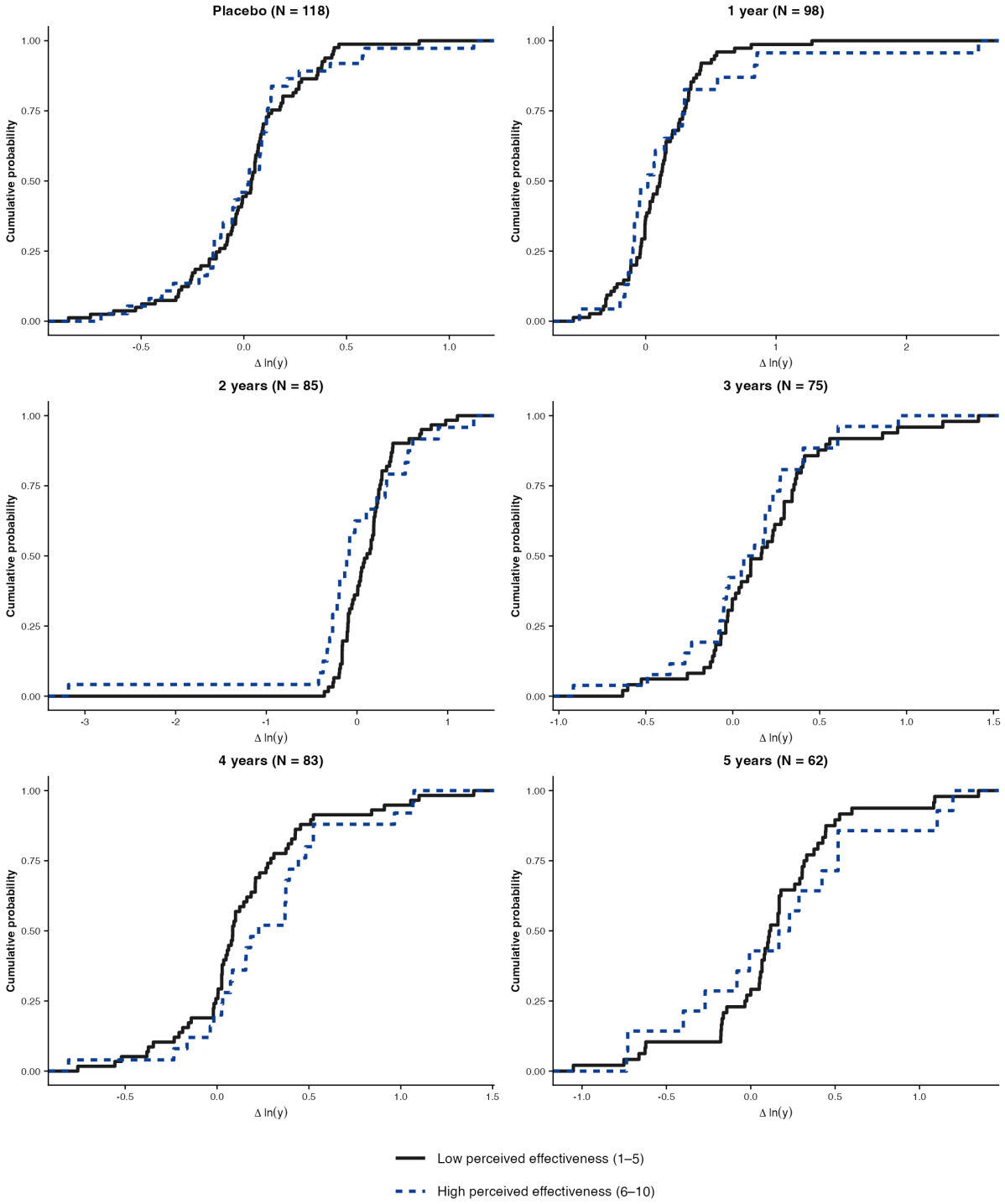
Variable	Definition	Unit
Sales	Revenue from the sale of products and merchandise, along with other sales-related income.	Million JPY
Total sales	Sum of sales, completed construction revenue, and operating revenue, minus sales discounts and returns.	Million JPY
Employees	Number of regular full-time employees, excluding part-time and temporary workers.	Persons
Assets	Total assets reported on the balance sheet.	Million JPY
Fixed assets	Sum of total tangible fixed assets, total intangible fixed assets, and total investments and other assets.	Million JPY
Labour productivity	Total sales divided by the number of employees.	Million JPY/person

Table 8. Financial Coping Measure Use and Perceived Effectiveness

Measure	Observed responses	Used: N	Used: %	Mean score	Median score	SD
Business interruption insurance	1,492	569	38.1%	2.93	1.00	2.89
Commercial bank loans	1,511	631	41.8%	3.54	2.00	2.81
Property insurance	1,848	1,214	65.7%	6.43	8.00	3.66
Public loans	1,503	609	40.5%	3.53	2.00	3.07
Public subsidy	1,562	637	40.8%	4.11	2.00	3.53

Notes: The unit of observation is a firm–establishment–disaster. A financial coping measure is coded as used when the corresponding evaluation score is positive. The second column reports the number of reported disaster experiences for which the corresponding evaluation item is non-missing. The third and fourth columns report, respectively, the number and share of observations in which the measure was used among observations with non-missing responses for that measure. The mean, median, and standard deviation of the effectiveness score are calculated among users of each measure. Effectiveness scores range from 1 to 10. Missing responses are excluded separately for each financial coping measure.

Figure 8: CDFs of total sales recovery by perceived effectiveness of public subsidies across time horizons



Notes: This figure plots empirical cumulative distribution functions of objective recovery in total sales across different time horizons. The placebo panel compares the log change in total sales from two years before the disaster to one year before the disaster, $\log(y_{i,t-1}) - \log(y_{i,t-2})$. The remaining panels define objective recovery as the log change in total sales from one year before the disaster to h years after the disaster, $\log(y_{i,t+h}) - \log(y_{i,t-1})$, where $h = 1, 2, 3, 4, 5$. The sample is restricted to firms that used public subsidies after experiencing a disaster. Firms are divided into two groups based on their perceived effectiveness score for public subsidies: low perceived effectiveness, defined as scores from 1 to 5, and high perceived effectiveness, defined as scores from 6 to 10. A rightward shift of the CDF indicates a stronger recovery distribution.

the flow losses from business interruption. Larger direct damage amounts are also associated with higher evaluations of public subsidies, whereas the mere presence of direct damage is associated with lower evaluations of commercial bank and public loans. The remaining associations are small and imprecisely estimated.

Table 9. Subjective effectiveness scores and reported disaster damage: damage amounts

	(1)	(2)	(3)	(4)	(5)
Outcome:	Property insurance	BI insurance	Commercial bank loans	Public loans	Public subsidy
Direct damage (log)	0.142**	0.093	0.135*	0.017	0.255***
	(0.070)	(0.088)	(0.079)	(0.100)	(0.095)
Indirect damage (log)	−0.100**	−0.012	0.063	0.091	−0.056
	(0.047)	(0.067)	(0.058)	(0.064)	(0.069)
Log employees	0.334*	0.239	0.079	0.005	−0.070
	(0.181)	(0.236)	(0.216)	(0.246)	(0.237)
Log capital	0.155	−0.139	−0.362*	−0.167	−0.093
	(0.192)	(0.256)	(0.201)	(0.226)	(0.241)
Respondent: representative/management	−0.455	−0.470	0.804*	0.827	−0.370
	(0.384)	(0.576)	(0.450)	(0.563)	(0.587)
Tangible-asset damage	1.800***	−0.405	−0.399	0.360	−0.620
	(0.490)	(0.621)	(0.532)	(0.672)	(0.639)
Operation suspension	−0.131	0.241	0.780*	0.645	0.752
	(0.364)	(0.502)	(0.416)	(0.473)	(0.530)
Observations	591	307	348	338	342
Firms	457	250	281	274	278
Disaster-type FE	✓	✓	✓	✓	✓
Disaster-year FE	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓	✓

Notes: 'Direct damage (log)' and 'Indirect damage (log)' are log(1 + damage) of the reported direct and indirect damage amounts in thousand yen; episodes with a missing damage amount are dropped. The dependent variable is the respondent's subjective effectiveness score for the measure in the column header, an integer from 1 (least effective) to 10 (most effective); each column is estimated on the episodes in which that measure was used (scores of 1–10; a score of 0 means the measure was not used, and invalid values above 10 are excluded). The unit of observation is a firm–establishment–disaster episode from the RIETI survey. BI insurance denotes business interruption insurance. 'Log employees' and 'Log capital' are the logarithms of the number of employees and of paid-in capital (thousand yen) from the survey roster. 'Respondent: representative/management' equals one if the questionnaire respondent is the firm's representative or a member of management. 'Tangible-asset damage' and 'Operation suspension' equal one if the establishment reported damage to tangible assets or a suspension of operations in the episode. All specifications include disaster-type (earthquake, wind, flood, other), disaster-year, industry (JSIC major division), and prefecture fixed effects; episodes with a missing disaster type or year are dropped. Standard errors clustered at the firm level are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10. Subjective effectiveness scores and reported disaster damage: damage indicators

Outcome:	(1) Property insurance	(2) BI insurance	(3) Commercial bank loans	(4) Public loans	(5) Public subsidy
Direct damage (any)	0.827**	−0.133	−0.764*	−1.004**	−0.547
	(0.383)	(0.404)	(0.393)	(0.442)	(0.489)
Indirect damage (any)	−0.831***	−0.173	0.329	0.371	−0.328
	(0.269)	(0.339)	(0.308)	(0.325)	(0.360)
Log employees	0.210	0.215	−0.028	−0.161	−0.107
	(0.138)	(0.162)	(0.150)	(0.162)	(0.170)
Log capital	0.135	−0.083	−0.267	0.017	0.054
	(0.135)	(0.164)	(0.186)	(0.183)	(0.183)
Respondent: representative/management	−0.207	−0.169	0.423	0.524	−0.088
	(0.285)	(0.444)	(0.366)	(0.426)	(0.452)
Tangible-asset damage	1.902***	0.052	0.593	0.781*	0.626
	(0.369)	(0.415)	(0.370)	(0.416)	(0.470)
Operation suspension	0.005	0.725**	0.837***	0.529	0.683*
	(0.254)	(0.352)	(0.318)	(0.338)	(0.376)
Observations	1052	477	536	517	546
Firms	782	371	417	404	419
Disaster-type FE	✓	✓	✓	✓	✓
Disaster-year FE	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓	✓

Notes: 'Direct damage (any)' and 'Indirect damage (any)' are indicators equal to one if the reported direct (indirect) damage amount is positive; blank amounts are coded as zero, so episodes without a reported amount remain in the sample. The dependent variable is the respondent's subjective effectiveness score for the measure in the column header, an integer from 1 (least effective) to 10 (most effective); each column is estimated on the episodes in which that measure was used (scores of 1–10; a score of 0 means the measure was not used, and invalid values above 10 are excluded). The unit of observation is a firm–establishment–disaster episode from the RIETI survey. BI insurance denotes business interruption insurance. 'Log employees' and 'Log capital' are the logarithms of the number of employees and of paid-in capital (thousand yen) from the survey roster. 'Respondent: representative/management' equals one if the questionnaire respondent is the firm's representative or a member of management. 'Tangible-asset damage' and 'Operation suspension' equal one if the establishment reported damage to tangible assets or a suspension of operations in the episode. All specifications include disaster-type (earthquake, wind, flood, other), disaster-year, industry (JSIC major division), and prefecture fixed effects; episodes with a missing disaster type or year are dropped. Standard errors clustered at the firm level are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Tables 11 and 12 turn from how a measure is evaluated to whether it is used at all. The dependent variable is an indicator equal to one if the measure was used in the episode (an effectiveness score of 1 to 10) and zero if the respondent reported that it was not used (a score of 0), so the sample now includes non-users; the specification is a linear probability model with the same regressors and fixed effects as Tables 9 and 10. Indirect damage is the main correlate of use: a larger reported indirect loss, or the presence of any indirect loss, raises the probability of using every measure, with property insurance the only one for which the association is weak. Direct damage, by contrast, mainly raises the use of property insurance and, in the indicator specification, of commercial bank loans. Together with the evaluation results, the pattern suggests that flow losses from business interruption push firms toward external finance, whereas stock losses are the domain of property insurance, which is then also evaluated more favorably the larger the direct loss.

Table 11. Use of financial coping measures and reported disaster damage: damage amounts

	(1)	(2)	(3)	(4)	(5)
Outcome:	Property insurance	BI insurance	Commercial bank loans	Public loans	Public subsidy
Direct damage (log)	0.021***	0.003	0.010	0.002	0.009
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Indirect damage (log)	0.011*	0.031***	0.038***	0.035***	0.032***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)
Log employees	−0.029	−0.038	−0.035	−0.025	−0.020
	(0.018)	(0.024)	(0.023)	(0.023)	(0.023)
Log capital	0.017	0.043*	0.024	0.024	0.012
	(0.022)	(0.026)	(0.026)	(0.027)	(0.027)
Respondent: representative/management	0.040	0.036	0.046	0.058	0.047
	(0.047)	(0.055)	(0.052)	(0.052)	(0.053)
Tangible-asset damage	0.185***	−0.067	−0.096*	−0.046	−0.058
	(0.053)	(0.059)	(0.057)	(0.057)	(0.057)
Operation suspension	−0.008	0.043	0.014	0.018	0.033
	(0.045)	(0.053)	(0.052)	(0.051)	(0.052)
Observations	854	743	752	749	756
Firms	655	566	572	572	578
Disaster-type FE	✓	✓	✓	✓	✓
Disaster-year FE	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓	✓

Notes: 'Direct damage (log)' and 'Indirect damage (log)' are $\log(1 + \text{damage})$ of the reported direct and indirect damage amounts in thousand yen; episodes with a missing damage amount are dropped. The dependent variable is an indicator equal to one if the measure in the column header was used in the episode (an effectiveness score of 1–10) and zero if the respondent reported that it was not used (a score of 0); each column is a linear probability model estimated on the episodes with a valid answer for that measure (invalid values above 10 are excluded). The unit of observation is a firm–establishment–disaster episode from the RIETI survey. BI insurance denotes business interruption insurance. 'Log employees' and 'Log capital' are the logarithms of the number of employees and of paid-in capital (thousand yen) from the survey roster. 'Respondent: representative/management' equals one if the questionnaire respondent is the firm's representative or a member of management. 'Tangible-asset damage' and 'Operation suspension' equal one if the establishment reported damage to tangible assets or a suspension of operations in the episode. All specifications include disaster-type (earthquake, wind, flood, other), disaster-year, industry (JSIC major division), and prefecture fixed effects; episodes with a missing disaster type or year are dropped. Standard errors clustered at the firm level are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 12. Use of financial coping measures and reported disaster damage: damage indicators

	(1)	(2)	(3)	(4)	(5)
Outcome:	Property insurance	BI insurance	Commercial bank loans	Public loans	Public subsidy
Direct damage (any)	0.178***	0.064	0.114**	0.080	0.075
	(0.046)	(0.049)	(0.048)	(0.049)	(0.048)
Indirect damage (any)	0.054*	0.127***	0.148***	0.140***	0.130***
	(0.031)	(0.042)	(0.040)	(0.041)	(0.040)
Log employees	−0.019	0.008	0.004	0.008	0.019
	(0.014)	(0.021)	(0.020)	(0.020)	(0.020)
Log capital	0.005	−0.008	−0.009	−0.008	−0.018
	(0.016)	(0.021)	(0.020)	(0.021)	(0.021)
Respondent: representative/management	0.017	0.082*	0.120***	0.120***	0.133***
	(0.034)	(0.044)	(0.043)	(0.043)	(0.043)
Tangible-asset damage	0.147***	−0.065	−0.081*	−0.058	−0.044
	(0.042)	(0.047)	(0.046)	(0.047)	(0.045)
Operation suspension	0.029	0.113***	0.091**	0.087**	0.100***
	(0.031)	(0.039)	(0.039)	(0.038)	(0.038)
Observations	1457	1163	1182	1173	1197
Firms	1068	857	870	866	880
Disaster-type FE	✓	✓	✓	✓	✓
Disaster-year FE	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓
Prefecture FE	✓	✓	✓	✓	✓

Notes: 'Direct damage (any)' and 'Indirect damage (any)' are indicators equal to one if the reported direct (indirect) damage amount is positive; blank amounts are coded as zero, so episodes without a reported amount remain in the sample. The dependent variable is an indicator equal to one if the measure in the column header was used in the episode (an effectiveness score of 1–10) and zero if the respondent reported that it was not used (a score of 0); each column is a linear probability model estimated on the episodes with a valid answer for that measure (invalid values above 10 are excluded). The unit of observation is a firm–establishment–disaster episode from the RIETI survey. BI insurance denotes business interruption insurance. 'Log employees' and 'Log capital' are the logarithms of the number of employees and of paid-in capital (thousand yen) from the survey roster. 'Respondent: representative/management' equals one if the questionnaire respondent is the firm's representative or a member of management. 'Tangible-asset damage' and 'Operation suspension' equal one if the establishment reported damage to tangible assets or a suspension of operations in the episode. All specifications include disaster-type (earthquake, wind, flood, other), disaster-year, industry (JSIC major division), and prefecture fixed effects; episodes with a missing disaster type or year are dropped. Standard errors clustered at the firm level are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

C RIETI Survey: Questionnaire

The FY2024 "Survey on Small and Medium-Sized Enterprises' Disaster Countermeasures" (Chūshō Kigyō no Saigai e no Taishosaku ni kansuru Chōsa) was administered in Japanese by Tokyo Shoko Research (TSR) on behalf of the Research Institute of Economy, Trade and Industry (RIETI). Respondents answered online, by email, or by returning the printed questionnaire by mail; the response deadline was February 21, 2025. The translation below is by the authors and reproduces the structure of the original answer grids. Question numbering follows the original instrument; circled sub-item numbers (①, ②, …) are rendered as (a), (b), …. Blank rules (____) mark write-in fields. Administrative instructions (web login details) and the entry-example rows are omitted, and the grids in Q1–Q3, which the instrument printed twice (once per establishment), are shown once. Bracketed italic notes reproduce the survey's routing instructions.

Q1. Please report your experience of disaster damage over the past 15 years, separately for each establishment. For the type of disaster, choose the applicable number from the choice list below and enter it in the answer column.

Type of disaster (choice list)

1. Earthquake	2. Wind damage (typhoon, storm, tornado, etc.)	3. Flood (heavy rain, river flooding, etc.)
4. Lightning	5. Heavy snow	6. Storm surge and other abnormal tides, wave damage
7. Tsunami	8. Volcanic eruption	9. Landslide
10. Drought / water shortage		11. Other (specify: _____)

Episode	Year and month	Disaster type (enter no.)	Direct damage*1 (thousand yen)	Indirect damage*2 (thousand yen)	Tangible assets damaged	Operations suspended
1st	____/__	____	_____	_____	1. Yes 2. No	1. Yes 2. No
2nd	____/__	____	_____	_____	1. Yes 2. No	1. Yes 2. No
3rd	____/__	____	_____	_____	1. Yes 2. No	1. Yes 2. No
4th	____/__	____	_____	_____	1. Yes 2. No	1. Yes 2. No
5th	____/__	____	_____	_____	1. Yes 2. No	1. Yes 2. No

*1: For the direct damage amount, report the damage to stocks, such as buildings and equipment.

*2: For the indirect damage amount, report the damage to flows caused by the suspension of business.

[An identical grid was provided for a second establishment; respondents with no second establishment were instructed to leave it blank. "Operations suspended" options read "1. Suspended; 2. Not suspended" in the original.]

Q2. For each disaster episode reported in Q1, please rate how effective each form of financial coping, such as insurance and loans, was. Rate on a 10-point scale from "1. least effective" to "10. most effective" by entering the applicable number. If you did not use the instrument, enter "0".

Least effective 1 2 3 4 5 6 7 8 9 10 Most effective

Episode	Property insurance	Business interruption insurance	Private bank loans	Public loans	Public subsidies
	(enter a number)	(enter a number)	(enter a number)	(enter a number)	(enter a number)
1st	____	____	____	____	____
2nd	____	____	____	____	____
3rd	____	____	____	____	____
4th	____	____	____	____	____
5th	____	____	____	____	____

[An identical grid was provided for a second establishment.]

Q3. For each disaster episode reported in Q1, was there any change in your business strategy or business scale after the disaster? Please select the applicable option for each item.

Episode	Change in business strategy after the disaster (select one)	Expansion or contraction of the business after the disaster (select one)	New business after the disaster (select one)
1st	1. Changed 2. Not changed	1. Expanded 2. Contracted 3. No change	1. New business 2. No new business
2nd	1. Changed 2. Not changed	1. Expanded 2. Contracted 3. No change	1. New business 2. No new business
3rd	1. Changed 2. Not changed	1. Expanded 2. Contracted 3. No change	1. New business 2. No new business
4th	1. Changed 2. Not changed	1. Expanded 2. Contracted 3. No change	1. New business 2. No new business
5th	1. Changed 2. Not changed	1. Expanded 2. Contracted 3. No change	1. New business 2. No new business

[An identical grid was provided for a second establishment.]

Q4. This question asks about the implementation and timing of disaster countermeasures such as seismic retrofitting and flood protection. For each of the measures (a)–(e), answer (1) the current implementation status. For measures answered "1. Implemented" in (1), also answer (2) and (3) (for measures (a) and (b), only (3)).

Measure	(1) Current implementation status (select one)	(2) Implementation before and after disasters (select one)	(3) Year and month implemented
(a) Seismic retrofitting	1. Implemented → (3) 2. Not implemented	—	_____/__
(b) Flood protection measures	1. Implemented → (3) 2. Not implemented	—	_____/__
(c) Earthquake insurance	1. Implemented → (2) 2. Not implemented	1. Newly enrolled after a disaster 2. Revised the contract after a disaster 3. Continued the contract from before the disaster	_____/__
(d) Flood insurance†	1. Implemented → (2) 2. Not implemented	1. Newly enrolled after a disaster 2. Revised the contract after a disaster 3. Continued the contract from before the disaster	_____/__
(e) BCP formulation‡	1. Implemented → (2) 2. Not implemented	1. Newly formulated after a disaster 2. Revised the content after a disaster 3. Continued the content from before the disaster	_____/__

†: Including flood coverage attached to fire insurance policies.

‡: Including simplified plans such as the Business Continuity Enhancement Plan (*jigyō keizokuryoku kyōka keikaku*, "Jigyōkei").

[Routing: respondents who answered "1. Implemented" for BCP formulation in Q4(e) proceed to Q5; respondents who answered "2. Not implemented" skip to Q7.]

Q5. *[Asked only of respondents who answered "1. Implemented" for BCP formulation in Q4(e).]* This question asks about the disasters covered by your BCP. For each of the disaster types (a)–(e), answer (1) the current status of BCP formulation. For disaster types answered "1. Formulated" in (1), also answer (2) and (3).

Disaster type	(1) Current status of BCP formulation (select one)	(2) Certification status of the Business Continuity Enhancement Plan (select one)	(3) Year and month the plan was certified
(a) Earthquake / volcanic eruption	1. Formulated → (2) 2. Not formulated	1. Certified 2. Not certified	_____/__
(b) Water damage / flood	1. Formulated → (2) 2. Not formulated	1. Certified 2. Not certified	_____/__
(c) Typhoon	1. Formulated → (2) 2. Not formulated	1. Certified 2. Not certified	_____/__
(d) Information security	1. Formulated → (2) 2. Not formulated	1. Certified 2. Not certified	_____/__
(e) Infectious disease	1. Formulated → (2) 2. Not formulated	1. Certified 2. Not certified	_____/__

Q6. *[Asked only of respondents who answered "1. Implemented" for BCP formulation in Q4(e).]* Please rate the importance of each of the following motives for formulating your BCP (select one rating per item).

Motive	Importance (1 = very low, 10 = very high)									
(a) Loss of business opportunities	1	2	3	4	5	6	7	8	9	10
(b) Human damage	1	2	3	4	5	6	7	8	9	10
(c) Requests from business partners	1	2	3	4	5	6	7	8	9	10
(d) Requests from client firms	1	2	3	4	5	6	7	8	9	10
(e) Disaster experience	1	2	3	4	5	6	7	8	9	10
(f) Bonus points in screening for various subsidies	1	2	3	4	5	6	7	8	9	10

[Routing: after answering, proceed to Q8.]

Q7. *[Asked only of respondents who answered "2. Not implemented" for BCP formulation in Q4(e).]* When formulating a BCP for disasters, please rate the importance of each of the following requirements (select one rating per item).

Requirement	Importance (1 = very low, 10 = very high)									
(a) Outsourcing costs (e.g., consulting)	1	2	3	4	5	6	7	8	9	10
(b) Personnel costs (assigning staff in charge)	1	2	3	4	5	6	7	8	9	10
(c) Relationships with business partners	1	2	3	4	5	6	7	8	9	10
(d) Relationships with client firms	1	2	3	4	5	6	7	8	9	10
(e) Disaster experience	1	2	3	4	5	6	7	8	9	10

Q8. This question asks about your perception of various disaster risks.

*Large-scale disasters: disasters causing especially widespread and severe damage spanning multiple prefectures — for example, among disasters designated as Extremely Severe Disasters, those designated at the national level (the disaster itself is designated, with no region specified).

*Medium-scale disasters: disasters causing widespread and severe damage spanning multiple municipalities — for example, among disasters designated as Extremely Severe Disasters, those designated at the municipality level, or disasters in municipalities to which the Disaster Relief Act was applied.

*Small-scale disasters: more localized, smaller-scale disasters than the above.

For (1) small-scale, (2) medium-scale, and (3) large-scale disasters in turn, please report your perception of the probability that your company will be affected by each disaster type, from "1. very low" to "10. very high" (select one rating per disaster type).

Disaster type	Perceived probability (1 = very low, 10 = very high)									
(1) Small-scale disasters										
(a) Earthquake / volcanic eruption	1	2	3	4	5	6	7	8	9	10
(b) Water damage / flood	1	2	3	4	5	6	7	8	9	10
(c) Typhoon	1	2	3	4	5	6	7	8	9	10
(d) Information security	1	2	3	4	5	6	7	8	9	10
(e) Infectious disease	1	2	3	4	5	6	7	8	9	10
(2) Medium-scale disasters										
(a) Earthquake / volcanic eruption	1	2	3	4	5	6	7	8	9	10
(b) Water damage / flood	1	2	3	4	5	6	7	8	9	10
(c) Typhoon	1	2	3	4	5	6	7	8	9	10
(d) Information security	1	2	3	4	5	6	7	8	9	10
(e) Infectious disease	1	2	3	4	5	6	7	8	9	10
(3) Large-scale disasters										
(a) Earthquake / volcanic eruption	1	2	3	4	5	6	7	8	9	10
(b) Water damage / flood	1	2	3	4	5	6	7	8	9	10
(c) Typhoon	1	2	3	4	5	6	7	8	9	10
(d) Information security	1	2	3	4	5	6	7	8	9	10
(e) Infectious disease	1	2	3	4	5	6	7	8	9	10

Q9. This question asks about changes in your perception of the probability that your company will be affected. For (1) small-scale, (2) medium-scale, and (3) large-scale disasters in turn: compared with ten years ago, has your perception changed for each disaster type?

Disaster type	Perception compared with ten years ago (select one)
(1) Small-scale disasters	
(a) Earthquake / volcanic eruption	1. Increased 2. Unchanged 3. Decreased
(b) Water damage / flood	1. Increased 2. Unchanged 3. Decreased
(c) Typhoon	1. Increased 2. Unchanged 3. Decreased
(d) Information security	1. Increased 2. Unchanged 3. Decreased
(e) Infectious disease	1. Increased 2. Unchanged 3. Decreased
(2) Medium-scale disasters	
(a) Earthquake / volcanic eruption	1. Increased 2. Unchanged 3. Decreased
(b) Water damage / flood	1. Increased 2. Unchanged 3. Decreased
(c) Typhoon	1. Increased 2. Unchanged 3. Decreased
(d) Information security	1. Increased 2. Unchanged 3. Decreased
(e) Infectious disease	1. Increased 2. Unchanged 3. Decreased
(3) Large-scale disasters	
(a) Earthquake / volcanic eruption	1. Increased 2. Unchanged 3. Decreased
(b) Water damage / flood	1. Increased 2. Unchanged 3. Decreased
(c) Typhoon	1. Increased 2. Unchanged 3. Decreased
(d) Information security	1. Increased 2. Unchanged 3. Decreased
(e) Infectious disease	1. Increased 2. Unchanged 3. Decreased

Q10. This question asks about the impact of COVID-19.

(1) Did COVID-19 have any of the following impacts on your company? (multiple answers allowed)

1. Suspension of operations (duration: ____ days);
2. Decline in sales (largest decline relative to normal times: __0%);
3. Reduction in personnel (largest reduction relative to normal times: __0%);
4. No particular impact.

(2) Were there any support or subsidy schemes that your company made use of? (multiple answers allowed)

1. Various cash-flow support measures;
2. Business Continuation Grant (*jizokuka kyūfukin*), Rent Support Grant, One-Time Grant, Monthly Grant, and Business Revival Grant;
3. Productivity Revolution Promotion Program (Manufacturing Subsidy, Business Sustainability Subsidy, IT Introduction Subsidy, and Business Succession Subsidy);
4. Business Restructuring Subsidy;
5. Subsidy for Promoting Domestic Investment to Strengthen Supply Chains;
6. "Event Discount" program;
7. Support measures of individual prefectural or municipal governments (specify: _____);
8. Other (specify: _____);
9. No support or subsidy was used.

Q11. This question asks about the internal structure for implementing disaster countermeasures.

(1) Who takes the lead in deciding on disaster countermeasures such as those asked about in the preceding questions? (select one)

1. The representative (e.g., representative director or business owner);
2. Senior management (e.g., board members);
3. General affairs department;
4. Accounting department;
5. Crisis management department;
6. Operational (front-line) departments;
7. Other (department name: _____).

(2) Is the respondent (department) completing this survey the same as your answer to (1)? (select one)

1. The same;
2. Different (department completing this survey: _____; choose a number from the options in (1); if "7. Other," also write the specific department name).