Discussion Paper Series

RIEB

Kobe University

DP2026-33

The Price of Isolation: Bank Lock-in and the Illusion of the Mean

Tomoko AIZAWA-TANEMURA

November 18, 2026

Research Institute for Economics and Business Administration

Kobe University

2-1 Rokkodai, Nada, Kobe 657-8501 JAPAN

The Price of Isolation: Bank Lock-in and the Illusion of the Mean

Tomoko Aizawa-Tanemura*
Associate Professor, College of Commerce, Nihon University
Visiting Researcher, University of Jyväskylä
Research Member, Financial System Research Group,
Research Institute for Economics and Business Administration, Kobe University

November 2026

Abstract

This paper investigates the pricing dynamics of the relationship banking lock-in effect and the efficacy of post-crisis public interventions. Exploiting the 2011 Great East Japan Earthquake as an exogenous shock, we analyze a loan-level dataset of Japanese SMEs. We show that standard conditional mean estimators mask lender information monopoly premiums. Using a simultaneous quantile regression framework, we reveal that the structural pricing friction operates as a right-tail phenomenon. Structurally isolated firms—standalone SMEs lacking internal capital markets—face markups of 24.9 basis points in gross interest rates and 22.5 basis points in net interest margins at the 75th percentile, whereas low-risk borrowers face no penalty. While public certifications are ineffective against this structural lock-in, direct pricing interventions offset the premium by up to 30.3 basis points. Our findings highlight the need for targeted financial interventions to protect standalone borrowers during systemic credit freezes.

JEL classification: C21, D82, G21, G28, G32
Keywords: Relationship banking, lock-in effect, structural isolation, government intervention, Knightian uncertainty, quantile regression

* The author thanks Nobuyoshi Yamori (Kobe University), Kozo Harimaya (Ritsumeikan University), Kari Heimonen (University of Jyväskylä), and seminar participants at the 42nd Summer Seminar of Finnish Economists (June 2026) for helpful comments and discussions. This work was supported by the Nihon University Research Grant for 2025 Overseas Researchers, the Interdisciplinary Collaborative Research Project Grant from the Institute of Business Research, Nihon University, and the Regional Industry Revitalization Research Project Grant from Tohoku University. All remaining errors are the author's own.
Email: aizawa-tanemura.tomoko@nihon-u.ac.jp

1. Introduction

Relationship banking serves as a fundamental mechanism for mitigating information asymmetries, particularly for small and medium-sized enterprises (SMEs) (Petersen and Rajan, 1994; Berger and Udell, 1995). Through continuous interactions, an incumbent lender accumulates proprietary soft information about a borrower's credit quality, enabling continued credit access even when public information is scarce.

However, as theories by Sharpe (1990), Rajan (1992), and von Thadden (2004) demonstrate, this informational advantage generates a fundamental trade-off. The accumulation of private information creates an information-driven barrier to entry, structurally locking the borrower into the relationship. Unable to credibly signal their true quality to outside lenders, structurally isolated SMEs become susceptible to the lock-in effect, wherein the incumbent bank extracts an information monopoly premium by charging above-market interest rates.

Subsequent empirical literature provides support for this lock-in mechanism (Santos and Winton, 2008; Ioannidou and Ongena, 2010; Bolton et al., 2016). While these studies establish the existence of these information premiums, they share a critical methodological limitation: they predominantly rely on conditional mean estimators (OLS) to quantify the penalty. This mean-centric approach implicitly assumes that the structural pricing friction is a uniform cost penalty applied across the borrower pool. Because the incumbent bank's soft information allows it to differentiate between borrowers with credible outside options and structurally isolated ones, this premium should not manifest as a uniform mean-shift. Instead, it operates as a distributional tail phenomenon.

To identify this lock-in penalty, empirical research requires an exogenous setting where borrowers are abruptly stripped of their outside financing options. While cyclical downturns exacerbate information asymmetries (Santos and Winton, 2008), large-scale natural disasters offer a clean identification setting. Specifically, the 2011 Great East Japan Earthquake introduces severe Knightian uncertainty into regional credit markets. Because outside lenders cannot reliably assign probabilities to local default risks, this unquantifiable environment acts as an uncertainty shock (Bloom, 2009). Facing an inability to accurately price risk under heightened opacity, outside lenders systematically withdraw from affected markets, exhibiting a flight to quality (Bernanke et al., 1996; Albertazzi and Marchetti, 2010; Bolton et al., 2016). As outside credit freezes, the incumbent bank's local market power is solidified, maximizing its capacity for pricing based on its information monopoly.

While the real economic consequences and quantitative credit constraints of such exogenous shocks are well-documented (Chodorow-Reich, 2014; Hosono et al., 2016; Uesugi et al., 2018; Carvalho et al., 2021), the micro-level distributional mechanics of financial frictions—specifically, how incumbent banks exploit this uncertainty to impose information monopoly premiums via loan pricing—remain largely unexplored. In the context of Japanese credit markets, previous literature has primarily focused on the left tail of the interest rate distribution, where banks prop up poorly performing firms through subsidized credit and forbearance—a phenomenon known as zombie lending (e.g., Peek and Rosengren, 2005; Caballero et al., 2008; Hoshi et al., 2023).

This literature highlights distortions driven by regulatory forbearance. Our study, however, sheds light on the overlooked right tail. By employing a simultaneous quantile regression (SQR) framework (Koenker and Bassett, 1978; Koenker and Hallock, 2001)

to capture parameter heterogeneity across the credit distribution, we shift the focus to distortions driven by profit-maximizing motives, revealing a structural lock-in where banks apply information monopoly premiums to standalone firms through high interest rates. By controlling for insolvency risk and bank capital constraints, we ensure our findings capture this structural friction rather than standard credit risk premiums.

Building on the extensive literature documenting that corporate group affiliations and internal capital markets serve as crucial safety nets (Hoshi et al., 1991; Gopalan et al., 2007), we argue that rational incumbent banks extract premium from borrowers based on their current structural inability to escape. In contrast to affiliated firms, standalone firms lacking such internal capital networks are exposed to the primary bank's pricing power when external markets freeze.

Previewing our main results, we find that the structural pricing friction operates as a right-tail phenomenon. At the 75th percentile of the pricing distribution, structurally isolated standalone firms incur a structural markup that represents a 12.9% premium relative to the mean gross interest rate, while low-risk borrowers face no penalty. This premium generates a marginal profit equivalent to 73.5% of the lender's baseline ROA.

Furthermore, we evaluate how post-crisis public interventions transmit under such structural isolation. While public certifications prove ineffective at the right tail due to adverse selection by outside lenders, direct pricing interventions mechanically alter contractual payoff structures, directly offsetting the extraction by up to 30.3 basis points.

Finally, to address the concern that our policy estimates might be driven by non-random policy allocation, an Oster (2019) bounds test confirms that our causal inferences regarding public relief are robust to selection on unobservables.

2. Hypothesis Development

2.1. Private Stigma versus Structural Isolation

Traditional banking theories emphasize past reputational history—a private stigma (Diamond, 1991)—as the primary driver of high borrowing costs. We argue, however, that under systemic credit freezes, a borrower's pricing penalty stems not from its past reputation, but from its current structural isolation. While internal capital markets through group affiliations shield some disaster-affected SMEs from information monopoly pricing (Hoshi et al., 1991; Gopalan et al., 2007), standalone firms remain exposed to the incumbent lender's pricing power. Because incumbent banks leverage their informational advantage (Sharpe, 1990; Rajan, 1992) to target borrowers lacking outside options, an information monopoly premium does not manifest as a uniform mean penalty. Instead, it operates as a tail phenomenon, disproportionately penalizing standalone borrowers at the right tail of the pricing distribution.

2.2. Hypotheses

Based on this interplay between informational frictions, structural isolation, and policy interventions, we propose three core hypotheses:

- Hypothesis 1 (Structural Lock-in): Following an exogenous shock, the lock-in premium is driven by a borrower's structural isolation rather than its past reputational stigma, manifesting predominantly at the right tail of the pricing distribution.
- Hypothesis 2 (Inefficacy of Public Certifications): Generic public support and certifications (Public Badge)—encompassing broad subsidies and tax relief without direct pricing interventions—fail to overcome the lender's

information-driven pricing power, leaving the lock-in premium at the right tail unmitigated.

- Hypothesis 3 (Efficacy of Direct Pricing Interventions): Targeted direct pricing interventions (Public Relief, such as local government interest rate and guarantee fee subsidies) mechanically alter the contractual payoff structure, offsetting the structural markup at the right tail.

Hypothesis 2 builds on the premise that while government grants can serve as positive signals (Lerner, 1999; Meuleman and De Maeseneire, 2012), they are insufficient to resolve adverse selection among outside lenders and restore credible outside options, leaving the borrower structurally locked into the incumbent relationship. Conversely, Hypothesis 3 aligns with recent evidence highlighting the efficacy of targeted credit support programs during systemic crises (Uesugi et al., 2018; Bachas et al., 2021; Aizawa-Tanemura and Nishiyama, 2022; Granja et al., 2022).

3. Data and Empirical Strategy

3.1. Sample Construction

We construct a firm-bank matched panel dataset of loan contracts using the Tohoku University Earthquake Recovery Firm Survey (TERFS), conducted across four consecutive waves from fiscal years 2012 to 2015 (Uesugi et al., 2018; Aizawa-Tanemura and Nishiyama, 2022)[1]. TERFS targets firms with at least one employee headquartered in Iwate, Miyagi, and Fukushima, as well as Hachinohe City in Aomori

[1] The 2012–2015 sample period excludes the immediate post-disaster fiscal year (2011), during which emergency liquidity injections and blanket government credit guarantees temporarily suspended commercial underwriting standards.

Prefecture. All target regions were designated under the Disaster Relief Act. Response rates peaked at 52.1% in the 2014 wave[2], producing an unbalanced panel that tracks post-disaster credit terms and firm characteristics[3].

To focus on commercial pricing behavior and information monopoly premiums, we restrict the sample to private regional intermediaries: regional banks, second-tier regional banks, *shinkin* banks (cooperative regional financial institutions), and credit cooperatives. We exclude government-affiliated policy lenders, which operate under non-profit-maximizing policy mandates, and major city banks, which primarily engage in transactional lending and lack proprietary soft-information ties with regional SMEs. These regional intermediaries account for over 80% of total loan counts and outstanding balances in the sample, reflecting the dominant role of relationship lending in the region[4].

Finally, we restrict our baseline sample to new loans issued by the firm's pre-shock primary bank. This restriction isolates the relationship lock-in effect from classical adverse selection inherent in outside credit markets.

[2] The 2012 wave surveyed 30,000 firms, yielding 7,021 valid responses (23.4% response rate). The 2013 wave replenished the survey pool to 30,000 firms (6,983 prior respondents and 23,017 newly sampled firms), obtaining 7,481 responses (24.9%). The 2014 wave surveyed a consolidated panel of 10,956 prior respondents, yielding 5,713 responses (52.1%). The 2015 wave followed 10,560 surviving firms from the 2014 cohort, securing 4,116 responses (39.0%). Pooling these waves into an unbalanced panel mitigates potential attrition and survivorship biases.

[3] To mitigate reporting noise, we handle extreme outliers via two-sided trimming based on non-parametric tolerance intervals (95% coverage, 95% confidence), following Cheng and Young (2023). We remove duplicate records across the 2012–2015 survey waves and aggregate multiple within-year loans into firm-year observations using loan-amount-weighted average interest rates. Finally, continuous firm-level ratios and the dependent variables (Gross Interest Rate and Net Interest Margin) are winsorized at the 1st and 99th percentiles.

[4] This structural dominance of local intermediaries remains persistent. For example, Teikoku Databank (2025) reports that local financial institutions account for 92.5% of the main bank relationships among the top 30 lenders in Miyagi Prefecture, the primary economic center of the Tohoku region.

3.2. Variables and Control Framework

We analyze two dependent variables to capture the incumbent bank's pricing power: the Gross Interest Rate and the Net Interest Margin. To precisely quantify this premium, we evaluate loan-level markups using both measures. While the gross rate captures the absolute cost of borrowing for the firm, the net interest margin—which nets out the lender's deposit funding costs (Aizawa-Tanemura and Nishiyama, 2022)—explicitly isolates the bank's information monopoly premium. This dual approach ensures that the estimated lock-in premium is not confounded by macroeconomic funding shocks or bank-specific liquidity premiums.

Our primary variables of interest capture structural isolation, past reputation, and public policy interventions. These include Standalone Firm (unaffiliated with any business group or parent company)[5], Private Stigma (past debt relief)[6], Public Badge (generic recovery support), and Public Relief (targeted pricing subsidies)[7].

[5] In the survey, firms self-report their organizational structure by selecting from the following categories: (1) an independent firm, (2) a consolidated subsidiary with a parent company, (3) a firm affiliated with a specific corporate group (*keiretsu*), or (4) other. The Standalone Firm indicator equals one for firms that self-identified as independent, and zero for those selecting either the consolidated subsidiary or group-affiliated categories. Firms selecting "other" (category 4) are excluded from the baseline sample.

[6] In the TERFS questionnaire, the Private Stigma indicator equals one if a firm self-reports having received formal debt relief or restructuring from its pre-shock primary bank. Specifically, this captures the following interventions: repayment moratoriums, maturity extensions, interest rate reductions or exemptions, debt forgiveness, the release or reduction of pledged collateral and personal guarantees, and/or the subordination of existing debt.

[7] Public Badge equals one if a firm received post-disaster public support administered by local governments (prefectures or municipalities), encompassing rent or lease subsidies, one-time cash grants, tax relief, or designation under the SME Disaster Recovery Group Subsidy program. In contrast, Public Relief equals one if a firm received targeted interest rate or guarantee fee subsidies from local governments. Eligibility for both public interventions is governed by administrative criteria—such as certified revenue declines or formal business recovery plans—rather than bank discretion. While certain specialized disaster interventions require physical damage certificates (*risai shoumei*), these generic support allocations do not. Because the approval process relies on municipal evaluation, this institutional framework mitigates lender-driven endogenous selection bias, allowing Public Badge to function as a plausibly exogenous public certification, and Public Relief as a direct, policy-driven pricing intervention.

We control for pre-loan bank capital constraints to separate this pricing friction from bank supply shocks. We employ a dual-measurement approach: an accounting-based leverage measure (Bank Capital Ratio) and a regulatory measure (Bank BIS Capital Buffer). We enter these measures separately to avoid multicollinearity. Following standard literature, Bank BIS Capital Buffer is adjusted for Japan's dual-tier statutory minimums (e.g., Aizawa et al., 2001; Ito and Sasaki, 2002; Woo, 2003; Hosono and Miyakawa, 2014). Additionally, we control for bank liquidity, specifically liability-side maturity mismatches. Liquidity shocks independently restrict credit supply during crises (Aizawa et al., 2001; Khwaja and Mian, 2008).

We also control for lagged firm characteristics measured prior to loan origination: Firm Size, Capital Turnover, Leverage, and a Negative Equity indicator. These variables capture informational opacity, operating efficiency, default risk, and balance sheet deterioration, respectively. Controlling for non-linear insolvency risk ensures that rate markups reflect information monopoly premiums rather than standard risk premiums.

At the loan level, we control for contract features, including Loan Amount, Maturity, and Fixed-Rate provisions. We also control for relationship duration (Petersen and Rajan, 1994) and risk-mitigating pledges (Collateral and Credit Guarantee). Finally, we include Disaster Damage and Supply Chain Shock indicators to absorb exogenous physical distress (Uesugi et al., 2018; Carvalho et al., 2021).

We first estimate parsimonious OLS specification focusing on Standalone Firm. We then add the firm, bank, loan, and macroeconomic controls. While loan terms such as Maturity and Collateral are conceptually determined simultaneously with interest rates (Berger and Udell, 1995), we include these potentially endogenous contract features in

the full specifications. This ensures our main results are not confounded by variations in other loan dimensions.

3.3. Empirical Strategy: Simultaneous Quantile Regression

To examine distributional heterogeneity in lock-in frictions, we estimate a simultaneous quantile regression (SQR) framework following Koenker and Bassett (1978) and Koenker and Hallock (2001). Our baseline specification is formulated as follows:

$$Q_\tau\left(Y_{ibt} \mid \text{Standalone}_i, \text{Stigma}_i, \text{Badge}_i, \text{Relief}_i, \mathbf{X}_{i,b,t-1}\right) \quad (1)$$

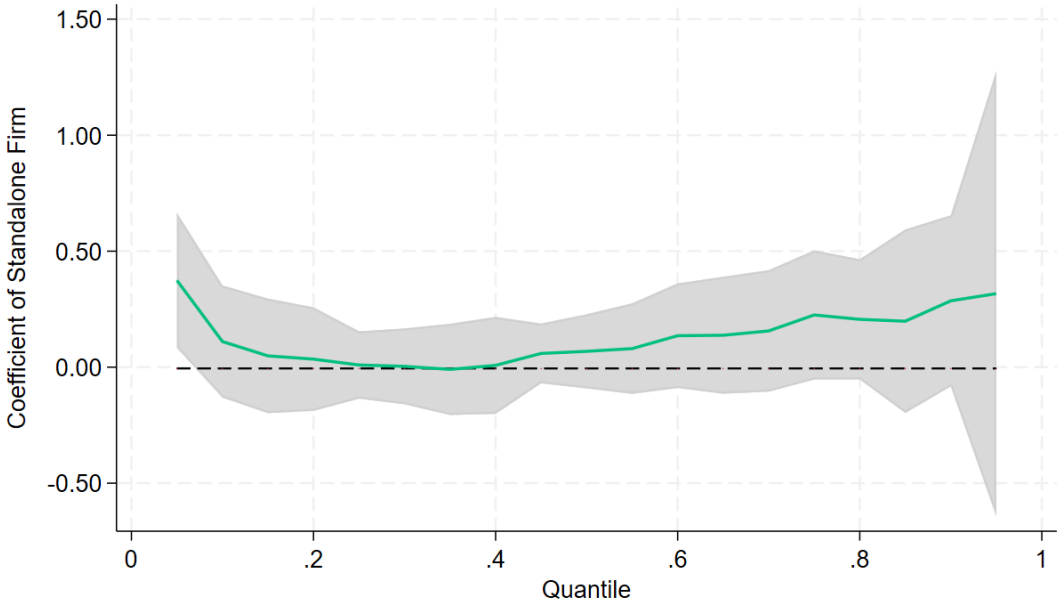
$$= \alpha^{(\tau)} + \beta_1^{(\tau)}\text{Standalone}_i + \beta_2^{(\tau)}\text{Stigma}_i + \beta_3^{(\tau)}\text{Badge}_i + \beta_4^{(\tau)}\text{Relief}_i + \mathbf{X}_{i,b,t-1}{}'\boldsymbol{\gamma}^{(\tau)} + \delta_t^{(\tau)}$$

where $Q_\tau(\cdot|\cdot)$ denotes the τ-th conditional quantile of loan pricing Y_{ibt} (Gross Interest Rate or Net Interest Margin) for firm i borrowing from bank b in period t. The four primary variables of interest capture the borrower's structural isolation, past reputation, and public policy interventions. $\mathbf{X}_{i,b,t-1}$ represents the vector of lagged firm-level, loan-level, and bank-level controls, and $\delta_t^{(\tau)}$ denotes a comprehensive set of year and quarter fixed effects.

We evaluate parameters simultaneously at the 25th ($\tau = 0.25$), 50th ($\tau = 0.50$), and 75th ($\tau = 0.75$) percentiles. We anchor our right-tail analysis at the 75th percentile rather than the extreme tail (such as $\tau \geq 0.90$). Econometrically, extreme-tail estimations suffer from data sparsity and wide confidence intervals (Buchinsky, 1998; Koenker, 2005), as illustrated in Figure 1. Economically, the extreme tail is dominated by credit-risk

premiums from firms facing imminent default. Focusing on $\tau = 0.75$ thus isolates the lock-in premium for viable but captive borrowers.

Figure 1. *Quantile Plot*



We cluster standard errors at the bank level to account for intra-cluster correlation among loans issued by the same lender (Parente and Santos Silva, 2016). Additionally, we employ a bank-level block bootstrap to estimate the joint variance-covariance matrix across quantiles, which enables formal inter-quantile hypothesis testing (Buchinsky, 1998).

4. Empirical Results

4.1. Descriptive Statistics and Baseline Equivalence

Table 1 reports summary statistics for the full firm-bank matched sample (N = 1,022). Univariate comparisons reveal structural differences between the two firm types:

standalone firms are smaller than group-affiliated firms in terms of total assets (difference = -0.756, $p < 0.001$), exhibit a higher incidence of negative equity (difference = 0.095, $p = 0.034$) and rely more heavily on external credit guarantees (difference = 0.160, $p = 0.011$).

However, bank capitalization does not differ significantly between the two groups. The mean Bank BIS Capital Buffer is 7.499% for standalone firms and 7.140% for group-affiliated firms (difference = 0.359, $p = 0.208$). This equivalence mitigates the concern that standalone firms systematically match with capital-constrained lenders.

Unconditional mean interest rates (Gross Interest Rate and Net Interest Margin) show no statistically significant differences between standalone and group-affiliated firms ($p = 0.549$ and $p = 0.533$, respectively). Because average pricing effects can mask potential information monopoly premiums, this finding directly motivates the application of SQR framework to examine structural pricing friction at the right tail of the rate distribution.

Table 1. *Summary Statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max	Group-Affiliated	Standalone	Difference	*p*-value
[Panel A: Dependent Variables]									
Gross Interest Rate (%)	1022	1.923	1.818	0.050	15	1.795	1.932	0.138	0.549
Net Interest Margin (%)	1022	1.862	1.817	0.015	14.923	1.728	1.871	0.143	0.533
[Panel B: Key Variables of Interest]									
Standalone Firm	1022	0.934	0.248	0	1	0	1	-	-
Private Stigma	1022	0.264	0.441	0	1	0.164	0.271	0.107*	0.055
Public Relief	1022	0.310	0.463	0	1	0.373	0.306	-0.067	0.250
Public Badge	1022	0.279	0.449	0	1	0.179	0.286	0.107*	0.060
[Panel C: Firm Characteristics & Financial Health]									
Firm Size (Ln)	1022	9.984	1.362	2.565	13.04	10.691	9.935	-0.756***	0.001
Firm Leverage (%)	1022	84.228	65.388	1.818	500	75.694	84.827	9.132	0.269
Negative Equity	1022	0.149	0.356	0	1	0.060	0.155	0.095**	0.034
Firm Capital Turnover	1022	2.150	3.243	0.157	32.333	1.745	2.179	0.434	0.290
[Panel D: Loan Contract & Relationship Characteristics]									
Loan Amount (Ln)	1022	7.789	1.083	4.828	10.463	8.233	7.758	-0.476***	0.001
Loan Maturity (Ln)	1022	3.847	1.066	1.099	5.193	3.777	3.852	0.075	0.577
Fixed Rate Provision	1022	0.796	0.403	0	1	0.731	0.801	0.070	0.171
Collateral Pledged	1022	0.578	0.494	0	1	0.522	0.582	0.060	0.338
Credit Guarantee	1022	0.493	0.500	0	1	0.343	0.504	0.160**	0.011
Relationship Length (Ln)	1022	3.264	0.640	1.099	4.159	3.133	3.273	0.140*	0.083
Number of Banks (Ln)	1022	0.757	0.558	0	2.303	0.659	0.764	0.104	0.140
[Panel E: Bank Characteristics]									
Bank Size (Ln)	1022	19.170	1.183	15.638	20.926	19.308	19.161	-0.148	0.323
Bank ROA (%)	1022	0.306	0.102	-0.057	0.867	0.332	0.304	-0.028**	0.032
Bank Capital Ratio (%)	1022	4.266	0.965	1.597	11.690	4.092	4.278	0.187	0.126

Bank BIS Capital Buffer (%)	1022	7.476	2.255	3	35.870	7.140	7.499	0.359	0.208
Bank Liquidity (%)	1022	30.072	7.180	13.946	58.612	29.068	30.142	1.075	0.236
[Panel F: Exogenous Shock Controls]									
Direct Disaster Hit	1022	0.183	0.387	0	1	0.224	0.180	-0.044	0.371
Supply Chain Shock	1022	0.134	0.341	0	1	0.194	0.130	-0.064	0.136

Notes: This table reports summary statistics for the full firm-bank matched sample (N = 1,022). Differences in unconditional means between group-affiliated and standalone firms are tested using two-sample t-tests. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

4.2. Conditional Mean vs. Quantile Dynamics

Table 2 reports the main OLS and SQR estimation results for both Gross Interest Rate and Net Interest Margin. In parsimonious specifications (Columns 1 and 7), Standalone Firm exhibits a positive coefficient that is statistically indistinguishable from zero. Once standard firm controls are included in the full specification OLS models (Columns 2, 3, 8, and 9)[8], the coefficient on Standalone Firm attenuates toward zero. Estimating conditional means thus suggests no borrowing penalty for standalone firms after controlling for observable fundamentals.

The SQR estimations (Columns 4–6 and 10–12) reveal a distributional asymmetry. At the 25th and 50th percentiles, Standalone Firm shows no statistically significant pricing effect. At the 75th percentile, however, Standalone Firm yields a statistically significant markup of 24.9 basis points in Gross Interest Rate ($p < 0.01$) and 22.5 basis points in Net Interest Margin ($p < 0.05$). Relative to the unconditional mean Gross Interest Rate (1.923%), the 24.9 basis point penalty represents a 12.9% premium.

This right-tail markup generates substantial returns for regional lenders. Given that the mean Bank ROA in our sample is 0.306%, extracting an additional 22.5 basis points in Net Interest Margin from captive borrowers generates a marginal profit contribution equivalent to 73.5% of baseline bank profitability. This magnitude highlights the strong economic incentive for incumbent banks to extract premiums from structurally isolated firms.

[8] Regarding other control variables, we observe a positive and significant coefficient on Credit Guarantee across the quantiles. Consistent with the standard features of Japanese SME finance, this reflects the well-documented selection bias where only the riskiest, observationally opaque borrowers—those who would otherwise be excluded from the credit market—rely heavily on external public guarantees.

As reported in Table 2, formal inter-quantile tests confirm this asymmetric effect: the lock-in premium is significantly larger at the 75th percentile than at the 25th percentile for both Gross Interest Rate (difference = 23.6 bps, $p = 0.068$) and Net Interest Margin (difference = 21.6 bps, $p = 0.090$). Figure 2 illustrates this non-linear dynamic. The quantitative consistency between Gross Interest Rate and Net Interest Margin markups confirms that the observed penalty reflects bank information monopoly premiums rather than variations in lender funding costs. These results align with models of informational lock-in (Sharpe, 1990; Rajan, 1992).

Table 2. *OLS and Simultaneous Quantile Regression Estimates*

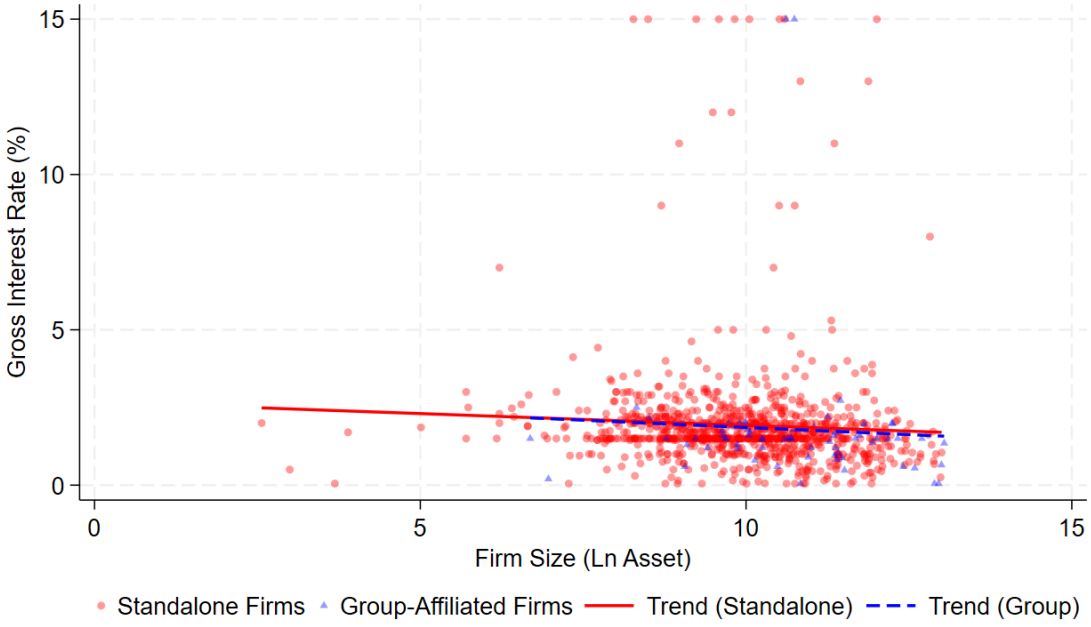
	(1)	(2)	(3)	(4)	(5)	(6)
Estimator:		**OLS**			**SQR**	
Specification:	No Controls	Full(Acct.)	Full(Reg.)	τ=0.25	τ=0.50	τ=0.75
Panel A: Gross Interest Rate (%)						
Standalone Firm	0.146	-0.013	-0.007	0.013	0.057	0.249***
	(0.262)	(0.252)	(0.253)	(0.128)	(0.087)	(0.080)
Private Stigma	-	0.170	0.170	0.094*	0.058	0.068
		(0.144)	(0.143)	(0.051)	(0.050)	(0.086)
Public Relief	-	-0.349***	-0.353***	-0.150***	-0.178***	-0.266***
		(0.107)	(0.106)	(0.031)	(0.042)	(0.062)
Public Badge	-	0.014	0.015	-0.101**	-0.007	-0.056
		(0.117)	(0.116)	(0.045)	(0.057)	(0.075)
Firm & Loan Controls	No	Yes	Yes	Yes	Yes	Yes
Bank Controls	No	Yes	Yes	Yes	Yes	Yes
Year & Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Test: Standalone Firm (q75 - q25)						0.236*
						[p=0.068]
Observations	1,022	1,022	1,022	1,022	1,022	1,022
R-squared / Pseudo R-squared	0.023	0.062	0.061	0.016	0.022	0.022

	(7)	(8)	(9)	(10)	(11)	(12)
Estimator:		**OLS**			**SQR**	
Specification:	No Controls	Full(Acct.)	Full(Reg.)	τ=0.25	τ=0.50	τ=0.75
Panel B: Net Interest Margin (%)						
Standalone Firm	0.150	-0.012	-0.005	0.009	0.068	0.225**
	(0.262)	(0.251)	(0.252)	(0.112)	(0.096)	(0.089)
Private Stigma	-	0.170	0.170	0.106**	0.050	0.048
		(0.144)	(0.143)	(0.043)	(0.053)	(0.095)

Public Relief	-	-0.351***	-0.356***	-0.161***	-0.179***	-0.303***
		(0.106)	(0.106)	(0.035)	(0.039)	(0.057)
Public Badge	-	0.013	0.015	-0.114**	-0.004	-0.015
		(0.116)	(0.116)	(0.046)	(0.063)	(0.083)
Firm & Loan Controls	No	Yes	Yes	Yes	Yes	Yes
Bank Controls	No	Yes	Yes	Yes	Yes	Yes
Year & Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Test: Standalone Firm (q75 - q25)						0.216*
						[p=0.090]
Observations	1,022	1,022	1,022	1,022	1,022	1,022
R-squared / Pseudo R-squared	0.025	0.063	0.063	0.017	0.024	0.023

Notes: This table presents the baseline regression results for Gross Interest Rate and Net Interest Margin. For brevity, coefficients for control variables are suppressed. Columns 1 and 7 report parsimonious OLS specifications. Columns 2 and 8 report full OLS specifications with accounting-based bank controls, while Columns 3 and 9 use regulatory-based bank controls. Columns 4–6 and 10–12 report simultaneous quantile regression (SQR) estimates at the 25th, 50th, and 75th percentiles using the regulatory-based controls. All specifications include loan origination year and quarter fixed effects. Standard errors, reported in parentheses, are clustered at the bank level. The bottom row reports the inter-quantile difference for the Standalone Firm coefficient. The corresponding *p*-values, reported in brackets, are obtained via 1,000 cluster-bootstrap replications at the bank level. Full estimation results are reported in Appendix Table B1. Detailed variable definitions are in Appendix Table A1. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Figure 2. *Gross Interest Rate and Firm Size: Standalone vs. Group-Affiliated Firms*



Notes: This figure plots Gross Interest Rate against Firm Size. The linear trend lines for standalone firms (red, solid) and group-affiliated firms (blue, dashed) are nearly identical, reflecting similar conditional means. However, the upper tail of the rate distribution is populated predominantly by standalone firms.

4.3. Structural Isolation vs. Past Reputation

We use the SQR framework to evaluate our structural isolation hypothesis against traditional reputation-based theories (Diamond, 1991). In the conditional mean specifications (Columns 2, 3, 8, and 9), neither Standalone Firm nor Private Stigma exhibits a statistically significant effect, suggesting that neither friction systematically affects average borrowing costs.

The SQR estimates, however, reveal a marked divergence across the loan pricing distribution. At the 25th percentile, Private Stigma emerges as a significant determinant (+9.4 basis points in Gross Interest Rate, $p < 0.10$; +10.6 basis points in Net Interest Margin, $p < 0.05$), while the coefficient on Standalone Firm is economically and statistically indistinguishable from zero (1.3 basis points and 0.9 basis points,

respectively). This indicates that for lower-risk borrowers, past debt relief functions as a conventional risk signal.

At the 75th percentile, this relationship reverses: the effect of Private Stigma diminishes and becomes statistically indistinguishable from zero (0.068, standard error = 0.086 in Gross Interest Rate; 0.048, standard error = 0.095 in Net Interest Margin), while structural isolation emerges as the primary friction, driving a markup of 24.9 basis points in Gross Interest Rate ($p < 0.01$) and 22.5 basis points in Net Interest Margin ($p < 0.05$). This shift demonstrates that at the right tail, loan pricing logic transitions from standard risk compensation to structural pricing based on informational lock-in. These findings support Hypothesis 1: the structural markup is triggered not by a borrower's historical credit reputation, but by their structural lack of access to internal capital safety nets.

4.4. Bank Capital Constraints: Accounting vs. Regulatory Regimes

To rule out the alternative capital crunch hypothesis—whereby financially constrained banks inflate lending margins to rebuild depleted capital (Peek and Rosengren, 1995; Ito and Sasaki, 2002; Woo, 2003)—Table 2 explicitly compares an accounting-based leverage specification, Full (Acct.) in Columns 2 and 8, with an institutional regulatory specification, Full (Reg.) in Columns 3 and 9. As defined in Section 3.2, the latter captures statutory capital adequacy pressure via the adjusted Bank BIS Capital Buffer (full estimation results, including coefficients on all bank controls, are reported in Appendix Table B1).

In the OLS specifications, the coefficient on Standalone Firm remains close to zero regardless of whether bank capitalization is measured using accounting leverage or regulatory capital buffers. Furthermore, in the SQR estimates (Columns 4–6 and 10–12),

the right-tail lock-in premium for standalone firms remains robust at 24.9 basis points for Gross Interest Rate and 22.5 basis points for Net Interest Margin, even after explicitly partialling out the effect of statutory capital pressure. These results confirm that the observed asymmetric pricing reflects relationship-based premiums from structurally isolated firms rather than banks passing on the costs of regulatory capital replenishment.

4.5. Asymmetric Transmission of Crisis Interventions

Public interventions transmit asymmetrically across the borrower distribution. While public certifications (Public Badge) lower margins at $\tau = 0.25$ (10.1 basis points for Gross Interest Rate, $p < 0.05$; and 11.4 basis points for Net Interest Margin, $p < 0.05$), they are ineffective at the upper tail ($\tau = 0.75$). This indicates that while public signaling reduces information asymmetries for low-risk borrowers, it is insufficient to overcome informational lock-in at the tail. In contrast, direct pricing interventions (Public Relief) offset the tail structural premium by 26.6 basis points in Gross Interest Rate and 30.3 basis points in Net Interest Margin.

Control variables in Appendix Table B1 provide evidence supporting the structural lock-in interpretation over standard risk pricing. First, Negative Equity is significant at the median ($\tau = 0.50$, +14.8 basis points in Gross Interest Rate and +16.6 basis points in Net Interest Margin) but insignificant at the tail ($\tau = 0.75$). If the right-tail premium were a standard credit-risk premium, Negative Equity would dominate right-tail pricing. Its insignificance, combined with the significance of Standalone Firm, indicates that tail markups represent a structural premium rather than solvency risk premiums.

Second, Bank ROA is insignificant in OLS but negative and significant at $\tau = 0.75$ (-0.642 for Gross Interest Rate and -0.767 for Net Interest Margin). This suggests that bank-side financial constraints matter primarily at the right tail: more profitable lenders reduce these premiums, while financially fragile lenders extract higher premiums from standalone borrowers, consistent with relationship banking theories in crises (Banerjee et al., 2021).

Finally, while Direct Disaster Hit is insignificant across all models, Supply Chain Shock is positive and significant at the median (+12.6 basis points in Gross Interest Rate and +15.8 basis points in Net Interest Margin). Consistent with Carvalho et al. (2021), this indicates that indirect supply network disruptions, rather than physical asset destruction, drive firm-level economic shocks post-disaster.

5. Robustness and Policy Implications

5.1. Selection on Unobservables: Oster Bounds Test

To address potential omitted variable bias, we apply the bounding methodology of Oster (2019) to our policy intervention variable, Public Relief. We focus on this variable because, unlike Standalone Firm—a pre-determined structural attribute—Public Relief is an ex-post policy allocation more susceptible to selection on unobservables, such as local government targeting or unobserved distress severity. Establishing the robustness of this policy effect is therefore essential.

Table 3 reports the proportional selection parameters (δ) generated from coefficient and R^2 movements between our uncontrolled and full specifications. Under the standard baseline of $R_{max} = 1.3\tilde{R}$ in the regulatory specification, the estimated δ values for

Public Relief are 7.79 for Gross Interest Rate and 7.50 for Net Interest Margin. Because these values significantly exceed the critical threshold of $\delta = 1$, unobservables would need to be more than seven times as influential as our extensive set of observable controls to nullify the estimated policy effect. This stability supports a causal interpretation of Public Relief in mitigating the right-tail structural lock-in premium.

Table 3. *Oster Bounds Test for Selection on Unobservables in Public Relief*

	(1) δ ($R_{\max} = 1.3\tilde{R}$)	(2) δ ($R_{\max} = 1.5\ \tilde{R}$)	(3) δ ($R_{\max} = 2.0\ \tilde{R}$)
Panel A: Gross Interest Rate			
Public Relief (Regulatory specification)	7.791	5.282	2.926
Panel B: Net Interest Margin			
Public Relief (Regulatory specification)	7.496	5.075	2.808

Notes: This table reports the Oster (2019) proportional selection parameters (δ) for Public Relief. The parameter δ indicates the relative importance of unobservables to observables necessary to explain away the coefficient on Public Relief. The uncontrolled specification includes only Public Relief and year-quarter fixed effects; the full specification adds the baseline controls listed in Section 3.2. Columns (1)–(3) evaluate δ under alternative maximum R^2 bounds ($R_{\max} = 1.3\tilde{R}$, $1.5\tilde{R}$, and $2.0\tilde{R}$, where $\tilde{R}$ is the R^2 of the full specification). The critical threshold is $\delta = 1$.

5.2. Policy Implications: The Necessity of Direct Pricing Intervention

Our findings inform optimal policy design during systemic liquidity freezes (Granja et al., 2022; Hoshi et al., 2023). When standalone borrowers face structural lock-in, public certifications (Public Badge) fail to restore market competition and are ineffective at the right tail of the rate distribution.

Therefore, to protect these isolated borrowers from information monopoly premiums, state interventions must bypass standard signaling channels. Policymakers must prioritize direct financial instruments—such as municipal interest relief and guarantee fee subsidies

(Public Relief)—that mechanically alter the loan's payoff structure, directly constraining bank structural markups.

6. Conclusion

This paper provides a distributional perspective on the relationship banking lock-in effect and the design of post-crisis state interventions. Exploiting the 2011 Great East Japan Earthquake as an exogenous shock to informational frictions, we show that conditional mean estimators (OLS) mask bank information monopoly premiums. Using a SQR framework, we demonstrate that structural lock-in operates as a right-tail phenomenon, penalizing standalone borrowers while leaving low-risk borrowers unaffected.

Our quantile approach reveals a dichotomy in credit market pricing. For lower-risk borrowers, standard corporate finance mechanisms operate as expected: Public Badge certifications reduce borrowing costs, while Private Stigma incurs standard credit risk penalties. However, at the right tail, this conventional pricing mechanism fails to hold. For standalone firms, isolation-driven lock-in dominates standard reputation effects, allowing banks to extract structural premiums.

These findings yield two central insights. First, we document a shift in the determinants of credit pricing at the tail: the structural premium is triggered not by a borrower's historical reputation, but by its current structural isolation. Lacking internal capital safety nets, standalone firms face significant markups. Right-tail evidence reveals these borrowers are solvent and asset-rich yet locked into narrow banking pools, ruling out standard default risk or bank-capital-crunch explanations.

Second, we highlight the asymmetric efficacy of state interventions across the rate distribution. While public certification is ineffective at the right tail due to adverse selection by outside lenders, targeted pricing subsidies successfully offset the lock-in markup at the 75th percentile.

Ultimately, when credit markets freeze under macroeconomic uncertainty, banks exercise their local pricing power against standalone borrowers. This underscores an essential distinction for policy design: compensating for physical disaster losses differ from correcting crisis-induced market failures. To protect standalone borrowers during systemic crises, state interventions cannot rely on standard signaling mechanisms. Policymakers must instead deploy targeted financial instruments that mechanically alter the payoff structure, thereby mitigating the real economic costs of financial isolation.

Appendix A. Variable Definitions

Table A1 provides detailed definitions and construction methodologies for all variables used throughout the empirical analyses.

Table A1. *Definitions and Sources of Variables*

Variable	Source	Definition
[Panel A: Dependent Variables]		
Gross Interest Rate (%)	TERFS	The annualized gross interest rate applied to the new loan after the earthquake disaster, expressed as a percentage.
Net Interest Margin (%)	TERFS, FFS	The difference between the gross interest rate applied to the loan and the lender bank's deposit rate, calculated as total interest payments on deposits divided by total deposit balances, expressed as a percentage.
[Panel B: Key Variables of Interest]		
Standalone Firm	TERFS	A dummy variable equal to 1 if the firm is an independent entity, and 0 if it is a consolidated subsidiary or affiliated with a specific corporate group (*keiretsu*).
Private Stigma	TERFS	A dummy variable equal to 1 if the firm received any formal debt relief or restructuring from its pre-shock primary bank (including repayment moratoriums, maturity extensions, interest rate reductions, debt forgiveness, release of collateral/guarantees, or debt subordination), and 0 otherwise.
Public Relief	TERFS	A dummy variable equal to 1 if the firm received any interest rate or guarantee fee subsidies from local governments (prefectures or municipalities) in the post-earthquake period, and 0 otherwise.

Public Badge	TERFS	A dummy variable equal to 1 if the firm received post-disaster public support from local governments (rent/lease subsidies, lump-sum grants, tax relief, or group subsidies), and 0 otherwise.
[Panel C: Firm Characteristics & Financial Health]		
Firm Size (Ln)	TERFS	The natural logarithm of the firm's total assets.
Firm Leverage (%)	TERFS	The ratio of the firm's total debt to total assets, expressed as a percentage.
Negative Equity	TERFS	A dummy variable equal to 1 if the firm's total liabilities exceed its total assets, and 0 otherwise.
Firm Capital Turnover	TERFS, TSR	The ratio of the firm's total sales (obtained from Tokyo Shoko Research) to its total assets (reported in TERFS).
[Panel D: Loan Contract & Relationship Characteristics]		
Loan Amount (Ln)	TERFS	The natural logarithm of the loan amount.
Loan Maturity (Ln)	TERFS	The natural logarithm of the loan maturity in months.
Fixed Rate Provision	TERFS	A dummy variable equal to 1 if the loan contract specifies a fixed interest rate, and 0 if floating.
Collateral Pledged	TERFS	A dummy variable equal to 1 if the loan is secured by physical collateral or personal guarantees, and 0 otherwise.
Credit Guarantee	TERFS	A dummy variable equal to 1 if the loan is guaranteed by a public Credit Guarantee Corporation, and 0 otherwise.
Relationship Length (Ln)	TERFS	The natural logarithm of the duration of the firm-bank relationship, measured as the number of years since the firm initiated its first transaction of any kind (not limited to borrowing) with the lender bank.
Number of Banks (Ln)	TERFS	The natural logarithm of the total number of financial institutions (including government-affiliated financial institutions and non-bank lenders) from which the firm was borrowing at the time of the Great East Japan Earthquake (as of March 11, 2011).
[Panel E: Bank Characteristics]		
Bank Size (Ln)	FFS	The natural logarithm of the bank's total assets.

Bank ROA (%)	FFS	The ratio of the bank's net business profit to its total assets, expressed as a percentage.
Bank Capital Ratio (%)	FFS	The bank's accounting equity-to-asset ratio, expressed as a percentage.
Bank BIS Capital Buffer (%)	FFS	The bank's regulatory capital ratio minus the minimum requirement by the BIS framework, expressed as a percentage.
Bank Liquidity (%)	FFS	The ratio of the bank's liquid assets (the sum of cash, government and municipal bonds including those held for trading, and call loans) to total assets, expressed as a percentage.
[Panel F: Exogenous Shock Controls]		
Direct Disaster Hit	TERFS	A dummy variable equal to 1 if the firm experienced direct physical damage from any of the primary disaster shocks (earthquake, tsunami, or nuclear accident), and 0 otherwise.
Supply Chain Shock	TERFS	A dummy variable equal to 1 if the firm experienced indirect disaster-related damage through its supply chain network (damage to either its suppliers or clients), and 0 otherwise.

Notes: FFS refers to the banks' Financial Statements and disclosure magazines. TERFS refers to the Tohoku University Earthquake Recovery Firm Survey. TSR refers to the corporate database provided by Tokyo Shoko Research, a major credit reporting agency in Japan.

Appendix B. Full Estimation Results

Table B1 reports the estimated coefficients and standard errors for all control variables that were suppressed for brevity in Table 2 of the main text.

Table B1. *Full OLS and Simultaneous Quantile Regression Estimates*

	(1)	(2)	(3)	(4)	(5)	(6)
Estimator:		**OLS**			**SQR**	
Specification:	No Controls	Full(Acct.)	Full(Reg.)	τ=0.25	τ=0.50	τ=0.75
Panel A: Gross Interest Rate (%)						
Standalone Firm	0.146	-0.013	-0.007	0.013	0.057	0.249***
	(0.262)	(0.252)	(0.253)	(0.128)	(0.087)	(0.080)
Private Stigma	-	0.170	0.170	0.094*	0.058	0.068
		(0.144)	(0.143)	(0.051)	(0.050)	(0.086)
Public Relief	-	-0.349***	-0.353***	-0.150***	-0.178***	-0.266***
		(0.107)	(0.106)	(0.031)	(0.042)	(0.062)
Public Badge	-	0.014	0.015	-0.101**	-0.007	-0.056
		(0.117)	(0.116)	(0.045)	(0.057)	(0.075)
Firm Size (Ln)	-	-0.115***	-0.115***	-0.053	-0.043	-0.006
		(0.041)	(0.041)	(0.033)	(0.032)	(0.026)
Firm Leverage (%)	-	0.001	0.001	0.001**	0.001***	0.002**
		(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Negative Equity	-	0.136	0.139	-0.050	0.148*	0.122
		(0.167)	(0.168)	(0.070)	(0.076)	(0.114)
Firm Capital Turnover	-	-0.056***	-0.056***	-0.022*	-0.034***	-0.036**

		(0.011)	(0.011)	(0.013)	(0.010)	(0.016)
Loan Amount (Ln)	-	0.026	0.026	-0.029	-0.047	-0.077**
		(0.066)	(0.066)	(0.023)	(0.033)	(0.038)
Loan Maturity (Ln)	-	-0.158**	-0.159**	-0.086***	-0.122***	-0.197***
		(0.067)	(0.067)	(0.018)	(0.018)	(0.025)
Fixed Rate Provision	-	0.031	0.035	0.207***	0.024	-0.076
		(0.107)	(0.107)	(0.069)	(0.081)	(0.072)
Relationship Length (Ln)	-	0.141**	0.141**	0.024	0.021	-0.030
		(0.066)	(0.065)	(0.033)	(0.040)	(0.072)
Number of Banks (Ln)	-	-0.072	-0.069	-0.034	-0.006	-0.022
		(0.098)	(0.099)	(0.075)	(0.059)	(0.051)
Collateral Pledged	-	0.080	0.081	0.099**	0.067*	0.030
		(0.105)	(0.105)	(0.047)	(0.036)	(0.067)
Credit Guarantee	-	0.126	0.124	0.304***	0.136***	0.130***
		(0.109)	(0.110)	(0.085)	(0.040)	(0.046)
Bank Size (Ln)	-	-0.085	-0.089	-0.030	-0.027	-0.046
		(0.055)	(0.056)	(0.023)	(0.024)	(0.030)
Bank ROA (%)	-	-0.571	-0.445	0.074	-0.082	-0.642**
		(0.394)	(0.327)	(0.260)	(0.197)	(0.274)
Bank Capital Ratio (%)	-	0.044	-	-	-	-
		(0.048)				
Bank BIS Capital Buffer (%)	-	-	0.013	0.006	0.023	0.059**
			(0.023)	(0.009)	(0.021)	(0.029)
Bank Liquidity (%)	-	-0.002	-0.003	0.002	0.001	-0.004
		(0.009)	(0.010)	(0.004)	(0.007)	(0.007)
Direct Disaster Hit	-	0.012	0.015	-0.021	0.021	-0.069
		(0.097)	(0.098)	(0.070)	(0.082)	(0.105)
Supply Chain Shock	-	0.213***	0.215***	0.083	0.126***	0.119
		(0.053)	(0.052)	(0.068)	(0.047)	(0.088)

Constant	1.469***	4.331***	4.441***	2.367***	2.943***	4.096***
	(0.300)	(1.077)	(1.073)	(0.546)	(0.712)	(0.684)
Test: Standalone Firm (q75 - q25)						0.236*
						[p=0.068]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered SE	Bank	Bank	Bank	Bank	Bank	Bank
Observations	1,022	1,022	1,022	1,022	1,022	1,022
R-squared / Pseudo R-squared	0.023	0.062	0.061	0.016	0.022	0.022

	(7)	(8)	(9)	(10)	(11)	(12)
Estimator:		**OLS**			**SQR**	
Specification:	No Controls	Full(Acct.)	Full(Reg.)	τ=0.25	τ=0.50	τ=0.75
Panel B: Net Interest Margin (%)						
Standalone Firm	0.150	-0.012	-0.005	0.009	0.068	0.225**
	(0.262)	(0.251)	(0.252)	(0.112)	(0.096)	(0.089)
Private Stigma	-	0.170	0.170	0.106**	0.050	0.048
		(0.144)	(0.143)	(0.043)	(0.053)	(0.095)
Public Relief	-	-0.351***	-0.356***	-0.161***	-0.179***	-0.303***
		(0.106)	(0.106)	(0.035)	(0.039)	(0.057)
Public Badge	-	0.013	0.015	-0.114**	-0.004	-0.015
		(0.116)	(0.116)	(0.046)	(0.063)	(0.083)
Firm Size (Ln)	-	-0.115***	-0.116***	-0.054*	-0.045	-0.013
		(0.041)	(0.041)	(0.030)	(0.031)	(0.023)
Firm Leverage (%)	-	0.001	0.001	0.001**	0.001**	0.003*
		(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
Negative Equity	-	0.141	0.144	-0.038	0.166**	0.096
		(0.167)	(0.167)	(0.075)	(0.071)	(0.127)
Firm Capital Turnover	-	-0.056***	-0.056***	-0.020	-0.033***	-0.042**

		(0.011)	(0.011)	(0.014)	(0.011)	(0.019)
Loan Amount (Ln)	-	0.026	0.026	-0.025	-0.045	-0.092**
		(0.066)	(0.066)	(0.022)	(0.031)	(0.036)
Loan Maturity (Ln)	-	-0.158**	-0.158**	-0.090***	-0.120***	-0.194***
		(0.067)	(0.067)	(0.019)	(0.020)	(0.027)
Fixed Rate Provision	-	0.033	0.037	0.216***	0.045	-0.068
		(0.107)	(0.107)	(0.060)	(0.075)	(0.075)
Relationship Length (Ln)	-	0.143**	0.143**	0.028	0.022	-0.029
		(0.066)	(0.066)	(0.032)	(0.040)	(0.065)
Number of Banks (Ln)	-	-0.072	-0.069	-0.035	0.003	0.003
		(0.098)	(0.099)	(0.075)	(0.061)	(0.044)
Collateral Pledged	-	0.080	0.082	0.105**	0.076**	0.051
		(0.105)	(0.105)	(0.050)	(0.036)	(0.083)
Credit Guarantee	-	0.125	0.123	0.312***	0.138***	0.118**
		(0.109)	(0.109)	(0.078)	(0.039)	(0.048)
Bank Size (Ln)	-	-0.077	-0.080	-0.019	-0.024	-0.040
		(0.055)	(0.056)	(0.024)	(0.023)	(0.029)
Bank ROA (%)	-	-0.606	-0.473	0.089	-0.146	-0.767***
		(0.401)	(0.334)	(0.282)	(0.177)	(0.297)
Bank Capital Ratio (%)	-	0.047	-	-	-	-
		(0.048)				
Bank BIS Capital Buffer (%)	-	-	0.013	0.007	0.024	0.062**
			(0.023)	(0.009)	(0.020)	(0.031)
Bank Liquidity (%)	-	-0.001	-0.001	0.003	0.003	-0.003
		(0.009)	(0.011)	(0.004)	(0.007)	(0.007)
Direct Disaster Hit	-	0.013	0.016	-0.009	-0.004	-0.061
		(0.097)	(0.098)	(0.065)	(0.077)	(0.103)
Supply Chain Shock	-	0.215***	0.217***	0.085	0.158***	0.106
		(0.052)	(0.051)	(0.076)	(0.043)	(0.089)

Constant	1.362***	4.030***	4.147***	1.986***	2.721***	4.050***
	(0.295)	(1.075)	(1.074)	(0.568)	(0.694)	(0.726)
Test: Standalone Firm (q75 - q25)						0.216*
						[p=0.090]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Clustered SE	Bank	Bank	Bank	Bank	Bank	Bank
Observations	1,022	1,022	1,022	1,022	1,022	1,022
R-squared / Pseudo R-squared	0.025	0.063	0.063	0.017	0.024	0.023

Notes: This table reports the full estimation results corresponding to the baseline specifications presented in Table 2 of the main text. Columns 1 and 7 report parsimonious OLS specifications. Columns 2 and 8 report full OLS specifications with accounting-based bank controls, while Columns 3 and 9 use regulatory-based bank controls. Columns 4–6 and 10–12 report simultaneous quantile regression (SQR) estimates at the 25th, 50th, and 75th percentiles using the regulatory-based controls. All specifications include loan origination year and quarter fixed effects. Standard errors, reported in parentheses, are clustered at the bank level. The bottom row reports the inter-quantile difference for the Standalone Firm coefficient. The corresponding *p*-values, reported in brackets, are obtained via 1,000 cluster-bootstrap replications at the bank level. Detailed variable definitions are in Appendix Table A1. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Appendix C. Anatomy of the Extreme Right Tail

While baseline SQR estimates establish the structural lock-in premium at the 75th percentile, Table C1 characterizes the most affected borrowers at the extreme tail (Gross Interest Rate ≥ 10%). Compared to the full baseline sample, these borrowers exhibit lower rates of Negative Equity, fewer banking relationships, and longer lending relationships. They also rely less on pledged collateral and external credit guarantees. This profile—financially viable but structurally locked-in to an incumbent lender—illustrates the mechanics of structural pricing driven by informational lock-in.

Figure C1 plots loan amounts against firm size, revealing a positive correlation within this extreme tail. This confirms that extreme structural premiums are not an artifact of micro-loans issued to small, opaque enterprises. Instead, incumbent lenders scale these premiums in proportion to the standalone borrower's balance sheet.

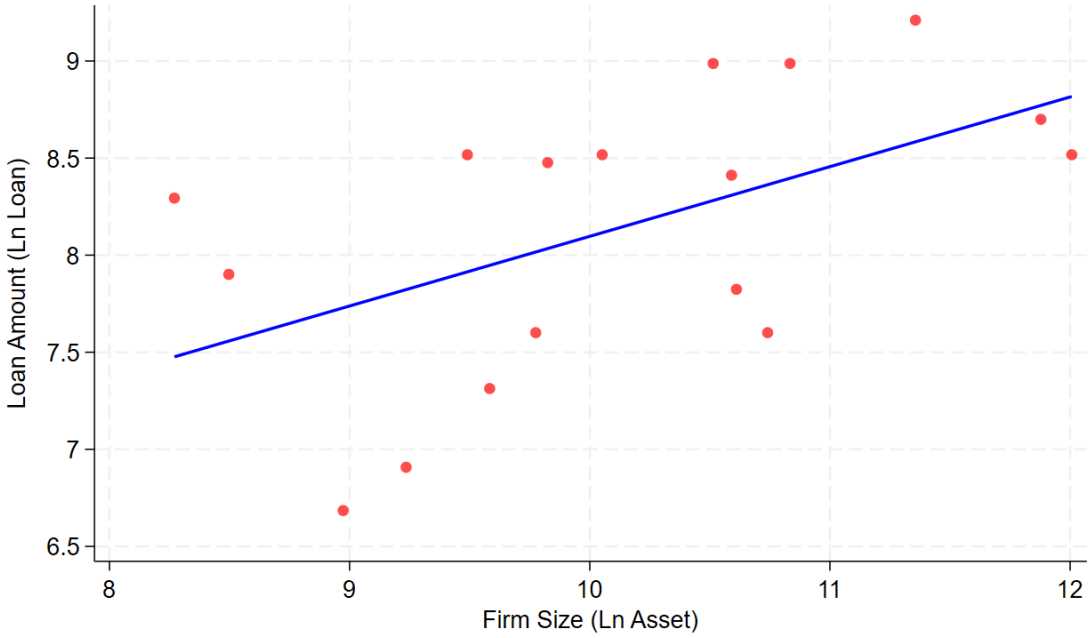
Panel F reveals that none of the borrowers in this tail experienced direct or indirect disaster damage, indicating that high markups reflect structural lock-in rather than physical disaster risk premiums. Although a higher proportion of these firms possess generic certifications (Public Badge) compared to the baseline average, they still face significant markups. This confirms that for structurally locked-in borrowers, generic public signaling is ineffective against monopolistic pricing.

Table C1. *Descriptive Statistics for Borrowers with Extreme Interest Rates (≥ 10%)*

Variable	Obs	Mean	Std. Dev.	Min	*p*50 (Median)	Max
[Panel A: Dependent Variables]						
Gross Interest Rate (%)	17	13.941	1.560	11	15	15
Net Interest Margin (%)	17	13.874	1.547	10.946	14.923	14.923
[Panel B: Key Variables of Interest]						
Standalone Firm	17	0.882	0.332	0	1	1

Private Stigma	17	0.353	0.493	0	0	1
Public Relief	17	0.176	0.393	0	0	1
Public Badge	17	0.294	0.470	0	0	1
[Panel C: Firm Characteristics & Financial Health]						
Firm Size (Ln)	17	10.131	1.082	8.271	10.052	12.007
Firm Leverage (%)	17	78.757	28.524	35.598	83.466	133.888
Negative Equity	17	0.118	0.332	0	0	1
Firm Capital Turnover	17	1.747	1.101	0.157	1.623	4.479
[Panel D: Loan Contract & Relationship Characteristics]						
Loan Amount (Ln)	17	8.144	0.733	6.685	8.412	9.210
Loan Maturity (Ln)	17	3.660	1.319	1.099	4.094	5.193
Fixed Rate Provision	17	0.765	0.437	0	1	1
Collateral Pledged	17	0.471	0.514	0	0	1
Credit Guarantee	17	0.412	0.507	0	0	1
Relationship Length (Ln)	17	3.506	0.674	1.946	3.784	4.127
Number of Banks (Ln)	17	0.651	0.598	0	0.693	1.946
[Panel E: Bank Characteristics]						
Bank Size (Ln)	17	18.645	1.233	16.410	18.250	20.568
Bank ROA (%)	17	0.268	0.049	0.166	0.267	0.338
Bank Capital Ratio (%)	17	4.314	0.621	3.123	4.163	5.349
Bank BIS Capital Buffer (%)	17	6.760	1.409	4.860	6.370	9.730
Bank Liquidity (%)	17	28.740	8.605	17.880	27.196	44.546
[Panel F: Exogenous Shock Controls]						
Direct Disaster Hit	17	0	0	0	0	0
Supply Chain Shock	17	0	0	0	0	0

Figure C1. *Loan vs. Firm Size Tail*



References

Aizawa, T., Seshimo, H., & Yamada, S. (2001). Ginko no kashishiburi to yokinsha kodo [Bank credit crunches and depositor behavior]. Nihon Keizai Kenkyu [Journal of Japanese Economic Studies], (42), 162–184 (in Japanese).

Aizawa-Tanemura, T., & Nishiyama, S. I. (2022). The effects of firm and bank balance sheet conditions to net interest margins: Evidence from loan-level firm survey data (Discussion Paper No. 2215). Graduate School of Economics, Kobe University.

Albertazzi, U., & Marchetti, D. J. (2010). Credit supply, flight to quality and evergreening: an analysis of bank-firm relationships after Lehman. Bank of Italy Temi di Discussione (Working Paper) No, 756.

Bachas, N., Kim, O. S., & Yannelis, C. (2021). Loan guarantees and credit supply. *Journal of Financial Economics*, *139*(3), 872–894.

Banerjee, R. N., Gambacorta, L., & Sette, E. (2021). The real effects of relationship lending. Journal of Financial Intermediation, 48, Article 100923.

Berger, A. N., & Udell, G. F. (1995). Relationship lending and lines of credit in small firm finance. *Journal of Business*, *68*(3), 351–381.

Bernanke, B., Gertler, M., & Gilchrist, S. (1996). The financial accelerator and the flight to quality. *The Review of Economics and Statistics*, *78*(1), 1–15.

Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica*, *77*(3), 623–685.

Bolton, P., Freixas, X., Gambacorta, L., & Mistrulli, P. E. (2016). Relationship and transaction lending in a crisis. *The Review of Financial Studies*, *29*(10), 2643–2676.

Buchinsky, M. (1998). Recent advances in quantile regression models: A practical guideline for empirical research. *Journal of Human Resources*, *33*(1), 88–126.

Caballero, R. J., Hoshi, T., & Kashyap, A. K. (2008). Zombie lending and depressed restructuring in Japan. *American Economic Review*, *98*(5), 1943–1977.

Carvalho, V. M., Nirei, M., Saito, Y. U., & Tahbaz-Salehi, A. (2021). Supply chain disruptions: Evidence from the Great East Japan Earthquake. *The Quarterly Journal of Economics*, *136*(2), 1255–1321.

Cheng, K., & Young, D. S. (2023). An approach for specifying trimming and Winsorization cutoffs. *Journal of Agricultural, Biological and Environmental Statistics*, *28*(2), 299–323.

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008-9 financial crisis. The Quarterly Journal of Economics, 129(1), 1-59

Diamond, D. W. (1991). Monitoring and reputation: The choice between bank loans and directly placed debt. *Journal of Political Economy*, *99*(4), 689–721.

Gopalan, R., Nanda, V., & Seru, A. (2007). Affiliated firms and financial support: Evidence from Indian business groups. *Journal of Financial Economics*, *86*(3), 759–795.

Granja, J., Makridis, C., Yannelis, C., & Zwick, E. (2022). Did the Paycheck Protection Program hit the target? *Journal of Financial Economics*, *145*(3), 725–761.

Hoshi, T., Kashyap, A., & Scharfstein, D. (1991). Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups. *The Quarterly Journal of Economics*, *106*(1), 33–60.

Hoshi, T., Kawaguchi, D., & Ueda, K. (2023). Zombies, again? The COVID-19 business support programs in Japan. *Journal of Banking & Finance*, *147*, 106421.

Hosono, K., & Miyakawa, D. (2014). Business cycles, monetary policy, and bank lending: Identifying the bank balance sheet channel with firm-bank match-level loan data (RIETI Discussion Paper Series 14-E-026). Research Institute of Economy, Trade and Industry.

Hosono, K., Miyakawa, D., Uchino, T., Hazama, M., Ono, A., Uchida, H., & Uesugi, I. (2016). Natural disasters, damage to banks, and firm investment. *International Economic Review*, *57*(4), 1335–1370.

Ioannidou, V., & Ongena, S. (2010). "Time for a change": Loan conditions and bank switching behavior. *The Journal of Finance*, *65*(5), 1847–1877.

Ito, T., & Sasaki, Y. N. (2002). Impacts of the Basle capital standard on Japanese banks' behavior. *Journal of the Japanese and International Economies*, 16(3), 372–397.

Khwaja, A. I., & Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review*, *98*(4), 1413–1442.

Koenker, R. (2005). *Quantile regression*. Cambridge University Press.

Koenker, R., & Bassett, G. (1978). Regression quantiles. *Econometrica*, *46*(1), 33–50.

Koenker, R., & Hallock, K. F. (2001). Quantile regression. Journal of Economic Perspectives, 15(4), 143–156.

Lerner, J. (1999). The government as venture capitalist: The long-run impact of the SBIR program. *Journal of Business*, *72*(3), 285–318.

Meuleman, M., & De Maeseneire, W. (2012). Do R&D subsidies affect SMEs' access to external financing? *Research Policy*, *41*(3), 580–591.

Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business & Economic Statistics*, *37*(2), 187–204.

Parente, P. M. D. C., & Santos Silva, J. M. C. (2016). Quantile regression with clustered data. *Journal of Econometric Methods*, *5*(1), 1–15.

Peek, J., & Rosengren, E. S. (1995). The capital crunch: Neither a borrower nor a lender be. Journal of Money, Credit and Banking, 27(3), 625–638.

Peek, J., & Rosengren, E. S. (2005). Unnatural selection: Perverse incentives and the misallocation of credit in Japan. *American Economic Review*, *95*(4), 1144–1166.

Petersen, M. A., & Rajan, R. G. (1994). The benefits of lending relationships: Evidence from small business data. *The Journal of Finance*, *49*(1), 3–37.

Rajan, R. G. (1992). Insiders and outsiders: The choice between informed and arm's-length debt. *The Journal of Finance*, *47*(4), 1367–1400.

Santos, J. A., & Winton, A. (2008). Bank loans, bonds, and information monopolies across the business cycle. *The Journal of Finance*, *63*(3), 1315–1359.

Sharpe, S. A. (1990). Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships. *The Journal of Finance*, *45*(4), 1069–1087.

Teikoku Databank. (2025). *National "main bank" trend survey (2025)* (in Japanese).

Uesugi, I., Miyakawa, D., Hosono, K., Ono, A., & Uchida, H. (2018). The collateral channel versus the bank lending channel: Evidence from a massive earthquake (HIT-REFINED Working Paper Series No. 79).

von Thadden, E. L. (2004). Asymmetric information, bank lending and implicit contracts: The winner's curse. *Finance Research Letters*, *1*(1), 11–23.

Woo, D. (2003). In search of "capital crunch": Supply factors behind the credit slowdown in Japan. *Journal of Money, Credit and Banking*, *35*(6), 1019–1038.