Distorted by Design: Size-Dependent Guarantees and Capital Misallocation

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Abstract

This paper studies the allocative and welfare consequences of government credit guarantees, focusing on Japan's uniquely large and persistent Credit Guarantee Scheme (CGS). Using a quasi-experimental design based on a 1999 policy reform that raised the capital thresholds for SME eligibility, I show that *newly eligible firms contracted in size relative to always-eligible peers*, suggesting strategic adjustment to retain access to subsidized credit. I also document that banks with lower equity ratios issue a disproportionately high share of guaranteed loans, indicating that bank fragility amplifies distortive effects. To quantify these patterns, I develop and calibrate a general equilibrium model in which size-dependent guarantees generate endogenous bunching and misallocation. The model maps reduced-form estimates into a structural borrowing cost wedge and computes counterfactual welfare across sectors. Results show that the guarantee program reduced output by approximately 5% prior to the reform, and that raising the eligibility cutoff in 2000 improved welfare by roughly 1% of pre-reform output. These findings highlight the hidden costs of tying financial support to adjustable firm characteristics in settings with heterogeneous firm productivity and financial frictions.

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1 Introduction

Small and medium-sized enterprises (SMEs) constitute the backbone of most economies, representing over 90% of all businesses globally and employing more than half of the world's workforce (OECD, 2024). Despite their economic prominence, SMEs face disproportionately high financial constraints due to their limited collateral, short credit histories, and higher perceived risk by lenders. In response, governments across the world have adopted a variety of policy tools to promote SME development, with the goal of alleviating financing frictions and fostering inclusive economic growth.

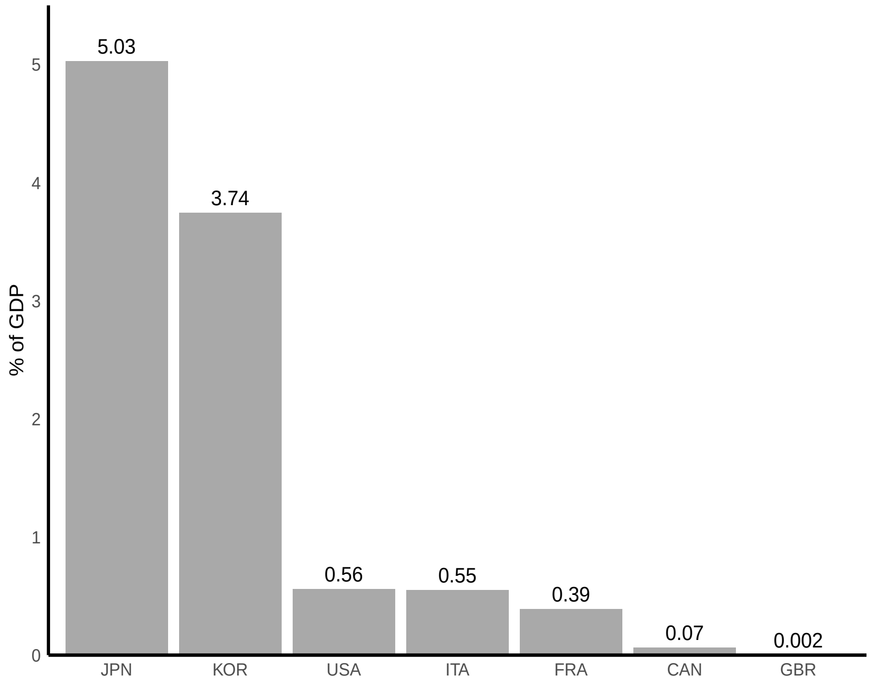
Credit guarantees have become a cornerstone of public policy aimed at sustaining SME credit access, especially during episodes of macroeconomic stress. While most countries deploy such guarantees primarily in response to severe downturns, Japan is notable for its persistent and large-scale application of government-backed credit guarantees, even in normal economic conditions. Between 2011 and 2019, Japan's credit guarantees averaged nearly 5% of GDP—far exceeding the levels observed in other G7 countries, where the average remained below 0.6% (see Figure 1).[1]

This paper studies how size-dependent eligibility for public credit guarantees affects firm behavior, resource allocation, and welfare. In particular, it focuses on Japan's unique practice of defining SME status partly based on a firm's level of paid-in capital—a balance-sheet measure that can be strategically adjusted. Unlike employment or total assets, paid-in capital directly constrains a firm's ability to issue external equity. Therefore, the capital-based eligibility rule introduces a direct and quantifiable distortion to firm financing choices. If firms bunch below the SME cutoff to remain eligible for credit subsidies, they may underinvest in productive capacity, leading to long-run misallocation.

To identify the impact of credit guarantee eligibility on firm outcomes, I exploit a major institutional reform: the 1999 revision of Japan's Basic Law on SMEs, which raised the capital thresholds for SME classification across industries. The reform generated discrete changes in eligibility for a well-defined set of firms, without directly altering underlying

[1] Another country with relatively high credit guarantee coverage is South Korea. However, Japan's system differs significantly: it typically guarantees 80% or 100% of loan principal, whereas South Korea imposes a cap of 60%, implying greater risk-sharing by lenders such as banks or credit associations.

Figure 1: Government loan guarantees for SMEs, 2011–2019



Note: Country-level credit loan guarantee data from *Financing SMEs and Entrepreneurs 2024: An OECD Scoreboard*.

fundamentals. For example, the paid-in capital ceiling for manufacturing SMEs rose from 100 million yen to 300 million yen, while the retail threshold increased from 10 to 50 million yen. These changes broadened access to guarantee subsidies for previously ineligible firms and created a natural experiment to test whether firms adjust their scale to maintain eligibility. Using a panel of over 427,000 firms from 1995 to 2022, I track how firm size and financing behavior evolved around the policy change.

The empirical analysis yields three main findings. First, I document persistent and sharp bunching in the distribution of paid-in capital just below the SME threshold—both before and after the reform—indicating strong behavioral responses to eligibility rules. Second, using an event-study difference-in-differences strategy, I show that newly eligible firms—those that gained SME status due to the reform—experienced a significant contraction in real outcomes relative to firms that were always treated. Employment, physical capital, and revenue all declined post-reform, suggesting that these firms scaled back intentionally to remain below the new capital cutoff. In contrast, newly eligible firms did not differ significantly from firms that were always ineligible, reinforcing the interpretation that guarantee access, not intrinsic characteristics, drives behavior. Third, I find that the marginal treatment effect on paid-in capital is consistent across sectors, allowing for direct calibration of structural parameters in the theoretical model.

To interpret these findings and quantify aggregate welfare implications, I develop a general equilibrium model of entrepreneurial entry and firm investment with endogenous capital choice. Entrepreneurs differ in productivity and select their paid-in capital level before choosing scale subject to an exogenous leverage cap. A size-dependent guarantee program offers both a lump-sum subsidy and an interest rate discount for firms that remain below the statutory threshold. This institutional design induces bunching among intermediate-productivity firms that prefer to cap their growth rather than lose access to subsidized credit. By solving the firm's two-stage optimization problem and embedding it in a capital market clearing condition, the model delivers closed-form productivity thresholds and a unique general equilibrium interest rate that varies with guarantee generosity.

A central feature of the model is that it delivers a tractable mapping between the reduced-form treatment effect on log equity and the structural policy wedge induced by the credit guarantee. I show that the estimated coefficient from the difference-in-differences regression directly identifies the effective interest subsidy under the guarantee program. Using this mapping, I estimate that the program lowers marginal borrowing costs by approximately 2.2% for firms below the SME threshold. The estimated wedge, combined with bunching patterns observed in the data, allows me to calibrate the full model and simulate counterfactual regimes.

Welfare is computed for each statutory sector (manufacturing, wholesale, retail, services) under the actual policy and under a benchmark without size-dependent guarantees. Results show that the guarantee program reduced welfare by 5.2% of output in the pre-reform period. After the 1999 policy change, which expanded eligibility, the welfare loss declined to 4.1%, reflecting modest gains from relaxing the bunching constraint. The magnitude of loss varies across sectors, but the distortion is substantial in every case. These welfare effects arise not only from inefficiently small firm scale, but also from elevated borrowing costs for unconstrained firms due to general equilibrium reallocation of funds.

Together, the results demonstrate that public credit guarantees, while successful in improving SME credit access, can generate significant misallocation when eligibility is tied to adjustable firm characteristics. The Japanese experience illustrates how persistent and generous support, in the absence of design safeguards, can entrench distorted firm behavior and limit the growth of productive enterprises. The paper highlights the importance of evaluating industrial policy not just by its reach, but by its long-run efficiency consequences. When eligibility thresholds become focal constraints in firm decision-making, well-intentioned support can produce sizable losses in aggregate output.

The remainder of the paper is structured as follows. Section 2 describes related literature. Section 3 introduces the theoretical framework of firm investment under size-dependent guarantees. Section 4 outlines the institutional background and presents the firm-level data. Section 5 provides empirical evidence on firm bunching and the effect of the 1999 SME reform. Section 6 calibrates the general equilibrium model, estimates policy wedges, and quantifies the welfare impact of the guarantee program. Section 7 concludes.

2 Related Literature

This paper contributes to three strands of literature. First, it builds on the growing literature examining the economic impact of government credit guarantee programs.[2] Evidence from Italy (Zecchini and Ventura, 2009), Japan (Uesugi et al., 2010; Ono et al., 2013), South Korea (Kang et al., 2008), the UK (Cowling, 2010), and the United States (Elenev et al., 2022) shows that CGSs have been effective in enhancing SME credit access, particularly during economic downturns. However, studies by Gropp et al. (2014), Elenev et al. (2016), and Tsuruta (2023) highlight the risk of moral hazard induced by such guarantees. Barrot et al. (2024), in the context of France, find that a crisis-era guarantee program reduced labor reallocation toward more productive firms. This paper contributes to the literature by providing direct evidence on how Japan's size-dependent credit guarantee program distorts capital allocation, particularly by inducing bunching in firms' paid-in capital around the

[2]This paper also relates to broader work on public credit interventions. Jiménez et al. (2018) study a targeted credit facility by a Spanish state-owned bank during the 2008–2009 crisis and find positive social value despite attracting riskier borrowers. Joaquim et al. (2022) analyze a large-scale lending expansion by Brazilian government-owned banks and document increased firm leverage and default with limited employment growth.

SME threshold.

Second, this study relates to the literature on distortions created by size-dependent policies and bunching. A closely related paper is Garicano et al. (2016), which examines the welfare loss from bunching in response to France's employment size based tax rules. In contrast, Japan's policy primarily incentivizes bunching in paid-in capital, which directly limits firms' ability to raise external financing. The 1999 reform serves as an exogenous policy shock, allowing identification of structural parameters. Other extensions of this literature explore firm responses through employment composition (Sollaci, 2018), occupational sorting (López and Torres, 2020), and entrepreneurial risk (Ando, 2021).[3]

Third, this paper contributes to the broader literature on how policies and frictions contribute to misallocation of production resources. Policy channels studied include capital liberalization (Bau and Matray, 2023), firm subsidies (Jo and Senga, 2019; Rotemberg, 2019; Hughes and Majerovitz, 2023), taxation (Kaymak and Schott, 2023), and trade liberalization (Bai et al., 2019). Additional sources of misallocation emphasized in the literature include adjustment costs (Asker et al., 2014), financial frictions (Buera et al., 2011; Midrigan and Xu, 2014; Moll, 2014; Gopinath et al., 2017; Bai et al., 2018), information frictions (David et al., 2016), and risk (David et al., 2022).[4] In the Japanese context, much of this literature focuses on zombie lending. Peek and Rosengren (2005) and Caballero et al. (2008) show that evergreening by Japanese banks suppressed market efficiency and hindered job creation. A key challenge in this literature is isolating the effect of a single policy or friction from broader structural distortions. To address this, Sraer and Thesmar (2023) and Hughes and Majerovitz (2023) propose methods that map micro-level variation from quasi-experiments into macroeconomic misallocation measures. This paper adopts a similar approach by focusing on a well-defined, size-dependent industrial policy—Japan's SME credit guarantee program.

[3] Kleven (2016) provides a detailed review of the bunching literature.

[4] David and Venkateswaran (2019) develop a methodology for decomposing sources of capital misallocation, accounting for uncertainty, adjustment costs, and firm heterogeneity.

3 Theory

The economy lasts for two periods, $t \in \{0, 1\}$. Each agent in this economy draws a permanent productivity α from density $f(\alpha)$ on $[\underline{\alpha}, \bar{\alpha}]$ with $\alpha\, f(\alpha)$ weakly decreasing, and is endowed with one unit of financial wealth at $t = 0$. In each period t an agent with productivity α *deposits* her unit endowment at the competitive rate r_t and consumes the return at the end of the period; or *enters* as an entrepreneur, choosing equity E and assets K according to the firm's optimization problem. All operating profits are consumed at the end of the period and do not roll over into the next period's funding pool.

Environment

Technology. With equity $E \geq 0$ and debt $D \geq 0$ a firm has assets $K = E + D$ and produces

$$Y = \alpha K^{\theta}, \qquad 0 < \theta < 1. \tag{1}$$

Leverage cap. All debt, whether subsidized or not, is bounded by a prudential rule

$$D \leq (\bar{\lambda} - 1)E, \qquad \bar{\lambda} > 1. \tag{2}$$

Guarantee program. If $E \leq \overline{E}_t$, the firm may borrow up to the cap at the discounted rate σr_t with $0 < \sigma < 1$ and receives a lump-sum subsidy $S \geq 0$. If $E > \overline{E}_t$, all borrowing pays the market rate r_t and no lump-sum is paid. The reform is an exogenous increase $\overline{E}_0 \to \overline{E}_1 > \overline{E}_0$.

Financial market. Agents who do not enter deposit their unit of wealth in a competitive credit market. Let S_t be the mass of such exiters; equilibrium requires that aggregate asset demand equal S_t. The gross rate r_t clears the market.

Firm optimization

The entrepreneur makes two sequential decisions.

Stage 0 (equity issuance). An entrant of productivity α chooses paid-in capital $E \geq 0$. Raising equity beyond the owner's one-unit endowment entails a convex issuance cost cE^2 with $c > 0$.

Stage 1 (scale choice under a leverage ceiling). Given E, the firm may set its asset stock anywhere in the interval $K \in [E, \bar{\lambda}E]$, where $\bar{\lambda} > 1$ is an exogenous leverage cap. The entire debt $D := K - E$ is guaranteed at cost σr_t if $E \leq \overline{E}_t$, and unguaranteed at cost r_t otherwise.

Because debt is never more expensive than equity ($\sigma r_t \leq r_t < r_t + 2cE$), the cheapest financing plan for any firm uses the maximal debt allowed by the prudential rule. Thus, $K = \bar{\lambda}E$ holds for every firm in this context.

Define the effective finance wedge

$$\tilde{\sigma}(E) = \begin{cases} \sigma_\lambda := 1 - \dfrac{\bar{\lambda} - 1}{\bar{\lambda}}(1 - \sigma), & E \leq \overline{E}_t \quad \text{(eligible)}, \\ 1, & E > \overline{E}_t \quad \text{(ineligible)}. \end{cases} \tag{3}$$

Stage 1 objective. For given (α, E, r_t), the entrepreneur chooses the scale

$$\max_{E \leq K \leq \bar{\lambda}E} \left\{ \alpha K^\theta - \tilde{\sigma}(E) r_t K \right\} \tag{4}$$

The first-order condition yields the interior (optimal) scale

$$K_t^{\text{FOC}}(\alpha) = \left(\tfrac{\theta}{\tilde{\sigma}(E) r_t} \right)^{\frac{1}{1-\theta}} \alpha^{\frac{1}{1-\theta}} \tag{5}$$

Therefore

$$K_t^*(\alpha, E) = \begin{cases} K_t^{\text{FOC}}(\alpha), & \text{if } K_t^{\text{FOC}}(\alpha) \leq \bar{\lambda}E, \\ \bar{\lambda}E, & \text{if } K_t^{\text{FOC}}(\alpha) > \bar{\lambda}E. \end{cases} \tag{6}$$

Definition (cap binding). The leverage cap *binds* for type α when the legal ceiling restricts the firm's desired scale, i.e. $K_t^*(\alpha, E) = \bar{\lambda}E < K_t^{\text{FOC}}(\alpha)$. Otherwise the cap is *slack*.

When the cap binds the firm chooses $E = \overline{E}_t$, borrows the maximum allowed ($D = (\bar{\lambda} - 1)\overline{E}_t$), and accepts a smaller scale in order to enjoy the subsidized interest rate σr_t. Lower-productivity firms keep the cap slack because their unconstrained optimum could be obtained, while higher-productivity firms prefer to forgo the subsidy, raise additional equity despite the issuance cost, and expand to the unconstrained optimum.

Stage 0 objective. Substituting K_t^*, period-t profit net of issuance cost is

$$\Pi_t(\alpha, E) = \begin{cases} \alpha(\bar{\lambda}E)^{\theta} - \bar{\lambda}\tilde{\sigma}(E)r_t E + S\mathbf{1}_{E \leq \overline{E}_t} - cE^2, & K_t^{\text{FOC}}(\alpha) > \bar{\lambda}E, \\ \\ \alpha K_t^{\text{FOC}}(\alpha)^{\theta} - \tilde{\sigma}(E)r_t K_t^{\text{FOC}}(\alpha) + S\mathbf{1}_{E \leq \overline{E}_t} - cE^2, & K_t^{\text{FOC}}(\alpha) \leq \bar{\lambda}E. \end{cases} \tag{7}$$

Because cE^2 renders $\Pi_t(\alpha, E)$ strictly concave in E, the optimal equity choice $E_t^*(\alpha)$ is unique.

Productivity thresholds and general equilibrium

The economy is segmented by three productivity cut-offs that depend on the policy parameters $\sigma < 1$, $S \geq 0$, and the leverage cap $\bar{\lambda} > 1$.

Entry cut-off $\alpha_{\min,t}$. The marginal entrepreneur solves

$$\Pi_t\big(\alpha_{\min,t}, E_t^*(\alpha_{\min,t})\big) = r_t \tag{8}$$

so agents with $\alpha < \alpha_{\min,t}$ prefer to remain depositors.

Cap-slack / cap-bind cut-off $\alpha_{c,t}$. Setting the interior eligible optimum equal to the statutory ceiling yields

$$\alpha_{c,t} = \left(\tfrac{\sigma_\lambda r_t}{\theta}\right)^{1-\theta} (\bar{\lambda}\overline{E}_t)^{1-\theta} \tag{9}$$

Bunching / unconstrained cut-off $\alpha_{b,t}$. Indifference between bunching at the ceiling and leaving the program gives

$$\alpha_{b,t}(\bar{\lambda}\overline{E}_t)^{\theta} - \sigma_{\lambda} r_t \bar{\lambda}\overline{E}_t + S = \alpha_{b,t} K_{u,t}(\alpha_{b,t})^{\theta} - r_t K_{u,t}(\alpha_{b,t}) \tag{10}$$

where $K_{u,t}(\alpha) = (\theta/r_t)^{1/(1-\theta)}\alpha^{1/(1-\theta)}$. If $0 \leq S < (\sigma_{\lambda}^{-1} - 1)r_t\bar{\lambda}\overline{E}_t$, then $\alpha_{c,t} < \alpha_{b,t}$, so $[\alpha_{c,t}, \alpha_{b,t})$ is a genuine bunching region.

Optimal assets.

$$K_t^*(\alpha) = \begin{cases} 0, & \alpha < \alpha_{\min,t} \quad \text{(depositor, no production)}, \\ (\theta/\sigma_{\lambda} r_t)^{\frac{1}{1-\theta}} \alpha^{\frac{1}{1-\theta}}, & \alpha_{\min,t} \leq \alpha < \alpha_{c,t} \quad \text{(eligible, cap slack)}, \\ \bar{\lambda}\,\overline{E}_t, & \alpha_{c,t} \leq \alpha < \alpha_{b,t} \quad \text{(eligible, cap binds)}, \\ (\theta/r_t)^{\frac{1}{1-\theta}} \alpha^{\frac{1}{1-\theta}}, & \alpha \geq \alpha_{b,t} \quad \text{(ineligible, cap slack)}. \end{cases} \tag{11}$$

Behavior across the productivity distribution. Agents with productivity below the entry cut-off $\alpha_{\min,t}$ do not operate a firm in time t. They deposit their one-unit endowment in the credit market and earn the competitive return r_t; their wealth therefore finances the projects of more productive entrepreneurs.

Those whose productivity lies between $\alpha_{\min,t}$ and the cap–slack threshold $\alpha_{c,t}$ do enter, and they optimally keep paid-in capital below the statutory ceiling ($E < \overline{E}_t$). These firms borrow up to the discounted rate σr_t yet operate at a scale strictly below $\bar{\lambda}\overline{E}_t$.

Entrepreneurs whose productivity falls in the intermediate band $\alpha_{c,t} \leq \alpha < \alpha_{b,t}$ also remain eligible, but for them the unconstrained optimum would exceed the legal ceiling. They deliberately register equity at exactly $E = \overline{E}_t$ in order to secure both the interest discount σr_t and the lump-sum subsidy S. As a consequence they are forced to operate at the asset ceiling $K = \bar{\lambda}\overline{E}_t$; in this range the bunching spike emerges.

Finally, agents with productivity above the upper cut-off $\alpha_{b,t}$ value scale more than the financial subsidy. They voluntarily exit the guarantee program, issue additional equity despite the issuance cost, borrow at the full market rate r_t, and choose the unconstrained optimum $K_{u,t}(\alpha) = (\theta/r_t)^{1/(1-\theta)}\alpha^{1/(1-\theta)}$. For these high-productivity firms the asset choice rises smoothly with α.

Aggregate supply of funds. Depositors supply

$$S_t = \int_{\underline{\alpha}}^{\alpha_{\min,t}} f(\alpha)\, d\alpha \tag{12}$$

Aggregate demand for funds. Entrepreneurs invest assets following the optimal rules as defined in equation 11, so

$$K_t^{\text{agg}}(r_t) = \int_{\alpha_{\min,t}}^{\bar{\alpha}} K_t^*(\alpha)\, f(\alpha)\, d\alpha \tag{13}$$

which is continuous and strictly decreasing in r_t.

General equilibrium. A period-t equilibrium is a tuple $\{r_t, \alpha_{\min,t}, \alpha_{c,t}, \alpha_{b,t}, K_t^*(\cdot)\}$ such that

i. the entry condition 8 holds;

ii. asset demand follows rule 11;

iii. capital-market clearing is satisfied: $K_t^{\text{agg}}(r_t) = S_t$.

Because aggregate demand 13 declines strictly with r_t, there is a unique equilibrium rate r_t^*, which pins down all three cut-offs and the corresponding asset choices.

Welfare

Aggregate output and welfare. With optimal assets $K_t^*(\alpha)$, period-t output is

$$Y_t = \int_{\alpha_{\min,t}}^{\bar{\alpha}} \alpha\, [K_t^*(\alpha)]^{\theta}\, f(\alpha)\, d\alpha \tag{14}$$

Let $M_t := \Pr\big[E_t^* \leq \overline{E}_t\big]$ be the share of firms that qualify for the guarantee in period t. Period-t welfare is therefore

$$W_t \;=\; Y_t - S\, M_t \tag{15}$$

where the term $S\, M_t$ is the lump-sum subsidy paid out of tax revenue.

Scenario 1 – removing the size-dependent program in an arbitrary period t. Let r_t^{N} and $\alpha_{\min,t}^{\mathrm{N}}$ be the equilibrium deposit rate and the entry cutoff point in the *no-program* economy for period t ($\sigma = 1$, $S = 0$, no statutory ceiling). Denote the corresponding unconstrained scale by

$$K_u^{\mathrm{N}}(\alpha) := \left(\theta/r_t^{\mathrm{N}}\right)^{1/(1-\theta)} \alpha^{1/(1-\theta)}$$

The welfare effect of scrapping the guarantee in period t is

$$\Delta Y_t^{\text{no-prog}} := Y_t - Y_t^{\mathrm{N}}$$

which decomposes into four regions:

$$\begin{aligned}\Delta Y_t^{\text{no-prog}} &= \underbrace{\int_{\alpha_{\min,t}}^{\alpha_{\min,t}^{\mathrm{N}}} \alpha\, K_t^*(\alpha)^\theta\, f(\alpha)\, d\alpha}_{\text{(i) drop-outs}} + \underbrace{\int_{\alpha_{\min,t}^{\mathrm{N}}}^{\alpha_{c,t}} \alpha\big[K_t^*(\alpha)^\theta - K_u^{\mathrm{N}}(\alpha)^\theta\big] f(\alpha)\, d\alpha}_{\text{(ii) formerly slack}} \\ &\quad + \underbrace{\int_{\alpha_{c,t}}^{\alpha_{b,t}} \alpha\big[K_t^*(\alpha)^\theta - K_u^{\mathrm{N}}(\alpha)^\theta\big] f(\alpha)\, d\alpha}_{\text{(iii) formerly bunched}} + \underbrace{\int_{\alpha_{b,t}}^{\bar{\alpha}} \alpha\big[K_{u,t}(\alpha)^\theta - K_u^{\mathrm{N}}(\alpha)^\theta\big] f(\alpha)\, d\alpha}_{\text{(iv) always large}} \quad (16)\end{aligned}$$

(i) Agents with $\alpha_{\min,t} \le \alpha < \alpha_{\min,t}^{\mathrm{N}}$ cease operating once the credit guarantee is removed, so output declines.

(ii) For $\alpha_{\min,t}^{\mathrm{N}} \le \alpha < \alpha_{c,t}$, the leverage cap is slack, but the program had lowered the marginal cost of capital; output falls again.

(iii) For $\alpha_{c,t} \le \alpha < \alpha_{b,t}$, the guarantee had forced bunching at $K = \bar{\lambda}\overline{E}_t$; removing it lets these firms expand to $K_u^{\mathrm{N}}(\alpha)$, raising output.

(iv) Always-large firms $\alpha \ge \alpha_{b,t}$ are unconstrained in both economies; the change comes only from the interest-rate difference $r_t^{\mathrm{N}} \neq r_t^*$. If $r_t^{\mathrm{N}} < r_t^*$ they grow (positive contribution); if $r_t^{\mathrm{N}} > r_t^*$ they shrink.

Welfare loss of the actual program =

$$\Delta W_t^{\text{no-prog}} := W_t - W_t^{\mathrm{N}} = \underbrace{\left[Y_t - Y_t^{\mathrm{N}}\right]}_{\text{output difference}} - S\,M_t \tag{17}$$

The output term $Y_t - Y_t^{\mathrm{N}}$ is exactly the four-part decomposition already given for $\Delta Y_t^{\text{no-prog}}$; the second term is the subsidy that would be saved if the program were abolished.

Scenario 2 – raising the statutory cut-off $\overline{E}_0 \to \overline{E}_1$.

$$\Delta W \;:=\; W_1 - W_0 \;=\; \left[Y_1 - Y_0\right] \;-\; S\,(M_1 - M_0) \tag{18}$$

An increase in the cut-off enlarges the set of entrants and relaxes the bunching cap, which raises output, but it also pushes up the equilibrium rate r_1^*, which reduces the scale of very productive firms. The government pays the lump-sum to an enlarged set of subsidized firms, reducing net welfare. The reform is welfare improving whenever the entry and de-bunching gains exceed (i) the contraction of large firms and (ii) the extra fiscal cost.

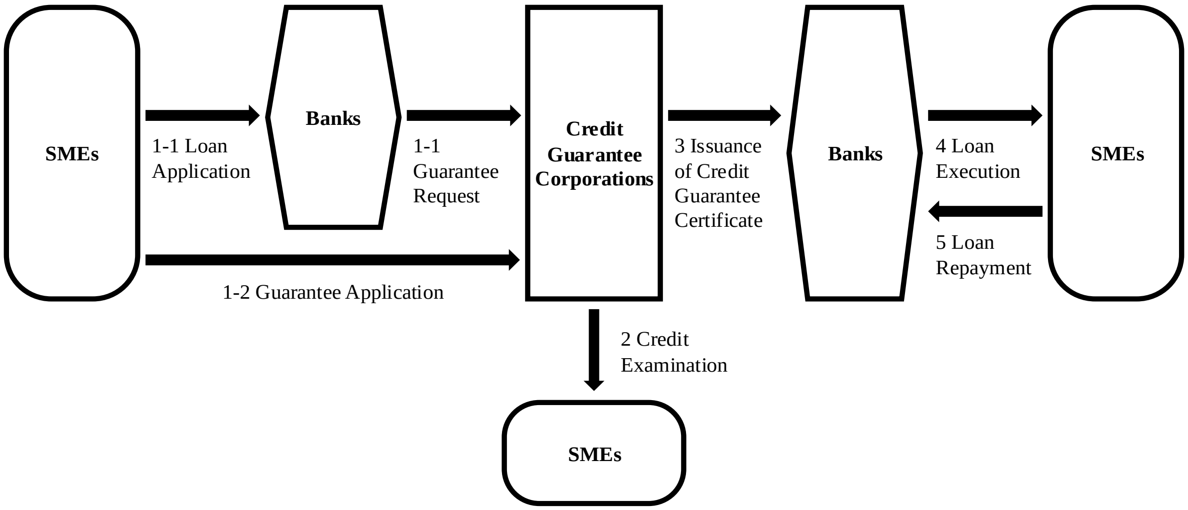
4 Institutional Setting and Data

4.1 History of Government Guarantee Scheme in Japan

The CGS is depicted in Figure 2. SMEs can apply for credit guarantees in two ways. The most common way is for the SME to first approach a bank, which then submits a guarantee application on the firm's behalf. Alternatively, SMEs may apply directly to the Credit Guarantee Corporations (CGCs). In either case, the CGC conducts a credit evaluation and decides whether to approve the guarantee for the specific loan. If the guarantee is approved, the CGC issues a guarantee certificate to the bank.[5] The bank is informed about the guarantee status before setting the interest rate and disbursing the loan. Both local and national governments provide oversight and financial support. If the SME defaults, the CGC

[5] If the SME applies directly to a CGC, the CGC will assign a partner bank to handle the loan.

Figure 2: Credit Guarantee Scheme in Japan



Note: This figure illustrates the CGS in Japan. A total of 51 CGCs serve as the direct guarantee providers for SMEs. If firms are unable to repay their loans, the local and national governments provide the ultimate backup.

reimburses the bank for the guaranteed portion of the loan.[6]

The evolution of Japan's CGS can be traced back to its inception and through several pivotal changes leading up to the emergency lending program implemented in 2020. Japan's credit guarantee program began in 1950 with the establishment of the Small and Medium-sized Enterprise Credit Insurance Act. Initially, the program featured a 100% guarantee in the event of firm defaults.

In December 1999, Japan revised the Basic Law on SMEs, and this serves to be the primary policy shock exploited in this paper. Japan introduced a new SME definition that took effect in 2000. The reform aimed to modernize the classification criteria to better reflect the actual scale and financial conditions of firms, thereby improving the targeting of policy

[6]The Japan Federation of Credit Guarantee Corporations (JFG) compensates CGCs for losses arising from defaults on guaranteed loans. The Japan Finance Corporation (JFC) mitigates risks through its credit insurance program, aiming to distribute the financial burden faced by CGCs. Part of the credit guarantee fees, which are payments made by SMEs to CGCs for guarantees, are used to pay for credit insurance premiums.

Table 1: SME Definition Change in 1999

Industry	**Before 1999**		**After 2000**	
	Capital	Employees	Capital	Employees
Manufacturing, etc.	100 million	300	300 million	300
Wholesale	30 million	100	100 million	100
Retail	10 million	50	50 million	50
Service	10 million	50	50 million	100

Note: This table summarizes the official criteria for defining SMEs in Japan before and after the 1999 revision to the Basic Law on SMEs, which came into effect in 2000. The classification thresholds are defined by industry and are based on maximum capital and number of employees. For example, under the new definition, the capital threshold for manufacturing firms increased from 100 million yen to 300 million yen, while the employee threshold remained unchanged. In contrast, service-sector firms saw both capital and employee thresholds increase. These revised criteria expanded the pool of firms eligible for credit guarantees. The data are sourced from the Small and Medium Enterprise Agency of Japan.

support. Previously, SME definitions were based on relatively low paid-in capital thresholds and varied significantly across sectors. The updated criteria raised the capital limits across industries while retaining or modestly adjusting employee thresholds. For instance, the capital ceiling for manufacturing firms was increased from 100 million yen to 300 million yen, and that for wholesale firms from 30 million yen to 100 million yen. These changes broadened the scope of firms eligible for credit guarantees. Following the policy reform, it is possible to identify firms that became newly eligible under the revised SME definition and compare their outcomes with those of firms that were always eligible and those that were never eligible. A detailed summary of the pre- and post-reform definitions is provided in Table 1.

A distinctive feature of Japan's SME classification is its reliance on paid-in capital as a formal eligibility criterion. Unlike employment or total assets, paid-in capital is legally defined and subject to strict regulation under the Companies Act. According to Article 445, Paragraph 2 of the Companies Act (Act No. 86 of 2005), when a firm raises capital through the issuance of new shares, at least 50% of the contributed amount must be recorded as paid-in capital. This requirement makes paid-in capital a rigid margin: firms cannot raise external equity without mechanically increasing their registered capital. As a result, privately held firms that seek to remain under the SME eligibility threshold face a direct trade-off between accessing new outside financing and maintaining policy benefits.

Later, the Japanese government embarked on a series of reforms in 2005 to encourage better risk management by financial institutions. A risk-related guarantee-fee scheme was introduced, classifying firms into nine risk categories with differentiated guarantee fees for each.[7] Furthermore, a partial guarantee system was adopted in 2006, where CGCs would cover 80% of loan defaults, prompting banks to assume the remaining risk. This "responsibility-sharing system" aimed to incentivize banks to enhance their screening and monitoring of loan recipients.

The momentum for reform was interrupted by the financial crisis in 2008. To mitigate the financing difficulties of Japanese SMEs, the government rolled out the Emergency Credit Guarantee Program (ECGP). This emergency intervention featured a 100% guarantee for SMEs, extending the duration of ECG loans to over ten years (longer than standard programs), and a uniform guarantee fee, disregarding the risk categorization.

In April 2018, significant reforms were implemented, marking a notable shift in the system. These reforms aimed to balance increased risk-sharing by financial institutions with continued support for the early stages of SMEs. The key changes in 2018 included: Reducing the coverage of credit guarantees from 100% to 80% for non-emergency related loans to encourage financial institutions to engage in more robust risk assessment and lending practices. Limiting the use of 100% guarantees to exceptional situations of substantial crises, to avoid the overextension of government support that could lead to market distortions. Upholding the 100% guarantee for start-ups and micro-businesses, with an increase in the ceiling on loan amounts to aid business successions and support new enterprises. These reforms were introduced with the overarching goal of fostering a more diligent credit environment, reducing moral hazard, and ensuring that the CGS served as a facilitator of healthy business growth rather than a perpetual lifeline for failing enterprises.

Since the onset of the COVID-19 pandemic in January 2020, the Japanese government has implemented various financial support measures for SMEs to mitigate economic difficulties. These measures included establishing consultation desks, easing "Safety net loans" criteria, and urging financial institutions to offer leniency. In March 2020, the No.4 Safety Nets[8] for

[7]Credit guarantee fee rates vary across different risk categories, ranging from a 0.5% annual rate for the lowest risk group to a 2% annual rate for the highest risk group.

[8]No.4 Safety Nets: If an SME operates in a designated area where various industries are impacted by

Financing Guarantee was designated as a nationwide program, providing a 100% guarantee and expanding industry coverage under the No.5 Safety Nets[9].

4.2 Data

This study uses several complementary datasets to examine how government credit guarantees interact with bank capitalization and influence lending behavior. The analysis leverages firm-level, bank-level, and policy-level data spanning the period from 1995 to 2022.

The primary source of firm-level data is the ORBIS database provided by Bureau van Dijk. The sample covers Japanese firms across all industries except agriculture, finance, and public administration. In Japan, legal requirements mandate firms to submit their financial reports to industry-specific regulatory authorities. As a result, the ORBIS database offers a comprehensive representation of companies across various sizes. Listed firms represent less than 1 percent of the sample.

ORBIS also includes information on the main financial institutions from which each firm borrows, enabling the construction of firm-bank-year panels. Key financial variables used in the analysis include paid-in capital, employmee number which are used to define SMEs; total liabilities, shareholders' equity, and operating earnings which are used to evaluate firm's financial quality. I exclude firm-year observations with missing values for these key balance sheet information. I also divide the firm sample into two periods: 1995-2010 and 2011-2022 where the first sample is used to do the event study analysis and the second sample is used to be paired with bank-level guarantee information and do bank-firm analysis. The whole sample comprises 2,332,420 observations (96.54% of which are SME observations). This dataset includes 427,953 firms.

Table 2 summarizes the financial disparities between SMEs and non-SMEs from 1995 to 2010. A persistent feature throughout the sample is the higher debt-to-equity ratio among

the disease and experiences a sales decline of 20% or more compared to the previous year, it qualifies for a full loan amount financing guarantee. This guarantee is provided under a special framework that is distinct from the general financing guarantee.

[9]No.5 Safety Nets: If an SME operates in an industry severely impacted by the disease and experiences a sales decline of 5% or more compared to the previous year, it qualifies for a financing guarantee that covers 80% of the loan amount. This guarantee is provided under a special framework separate from the general financing guarantee.

Table 2: Summary Statistics by Year and Size

	Non-SME					SME				
Year	Observations	Debt	Equity	D/E	Revenue	Observations	Debt	Equity	D/E	Revenue
1995	508	134.0	61.7	2.2	162.1	11280	0.4	0.1	2.9	0.7
1996	608	138.0	59.7	2.3	183.3	15683	0.4	0.1	2.9	0.6
1997	717	130.0	52.5	2.5	168.4	21029	0.3	0.1	2.7	0.6
1998	1178	109.0	44.4	2.5	143.5	25739	0.3	0.1	2.5	0.6
1999	2650	69.3	29.6	2.3	95.4	38363	0.5	0.2	2.4	0.9
2000	3469	64.5	33.3	1.9	96.8	57611	0.9	0.4	2.5	1.7
2001	3643	61.5	32.5	1.9	90.7	61942	0.9	0.4	2.2	1.6
2002	3937	55.2	30.5	1.8	84.4	72399	0.8	0.4	2.0	1.6
2003	4118	53.8	32.3	1.7	84.8	80111	0.8	0.4	1.9	1.5
2004	4191	56.1	34.5	1.6	89.8	85225	0.8	0.4	1.9	1.5
2005	4282	57.7	37.9	1.5	95.2	87887	0.8	0.4	1.8	1.5
2006	4440	59.0	38.7	1.5	98.2	91564	0.8	0.4	1.8	1.6
2007	4544	67.8	41.6	1.6	112.4	93668	0.7	0.4	1.8	1.5
2008	4554	69.4	38.0	1.8	111.4	96342	0.6	0.4	1.7	1.3
2009	4618	67.4	41.2	1.6	100.6	101406	0.6	0.4	1.6	1.2
2010	4961	64.4	40.4	1.6	102.5	112541	0.6	0.4	1.6	1.2

Note: All financial values in this table are measured in billions of 2010 Japanese yen. The "Observation" column documents the number of firms (Non-SME or SME) in each year in the data sample. Debt, equity, and revenue are summarized as the mean of all firms (Non-SME or SME) within each year. The D/E ratio measures the ratio of debt to equity.

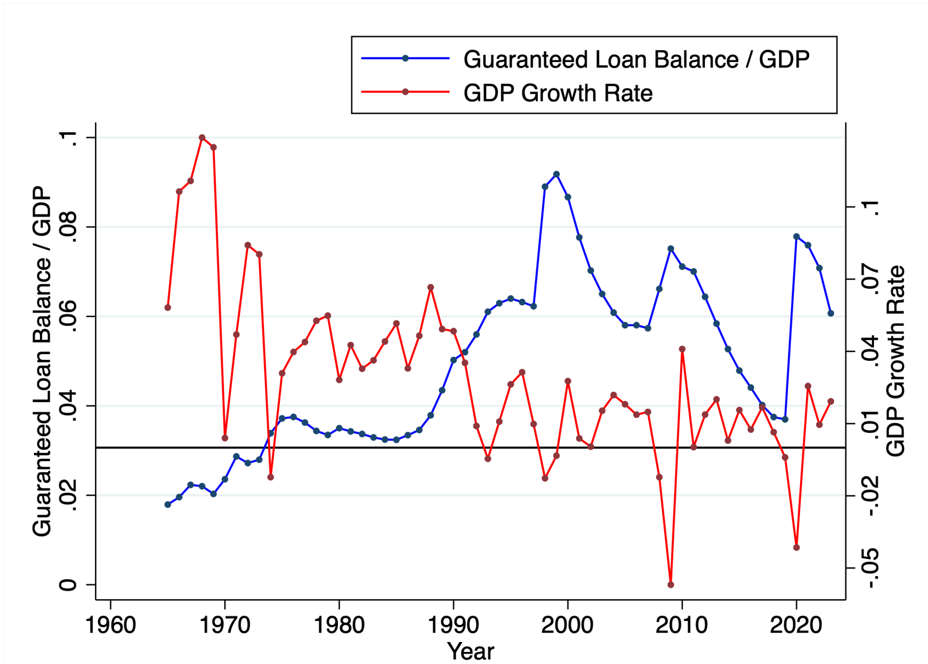
SMEs relative to non-SMEs, implying a heavier reliance on debt financing by smaller firms. This contrasts with patterns observed in other economies—for instance, Whited and Zhao (2021) find that in both China and the United States, larger firms tend to carry higher debt-to-equity ratios. One notable discontinuity appears in the revenue figures around 1999 and 2000: average revenue for non-SMEs drops sharply in 1999, while SME revenue rises abruptly. This pattern reflects the SME eligibility reform enacted in late 1999.

To capture bank characteristics, I use the Nikkei Financial Institutions dataset, which provides annual balance sheet data for all city banks, regional banks, and shinkin banks in Japan. This dataset includes total assets, liabilities, and equity, allowing for the construction of time-varying measures of bank capitalization such as the equity ratio. These indicators are merged with firm-level data based on bank identities.

Finally, I use administrative data on public credit guarantee programs from 2011 to 2022.[10] These data are compiled by the National Federation of Credit Guarantee Corpo-

[10] Prefecture-level data from 1968 to 2005 is also available from the *Gyoumu Yoran* (Business Directory) published by the Japan Federation of Credit Guarantee Corporations. This historical series is used in Figure

Figure 3: Total Guaranteed Loan Balance as a Share of GDP



Note: This plot displays the time series of guaranteed loan balance as a share of annual GDP from 1964 to 2023. The guaranteed loan balance data is adjusted to 2015 Japanese yen. Data for the period from 1964 to 2004 is derived from the "gyoumu yoran" (business directory) issued by the Japan Federation of Credit Guarantee Corporations. Data from 2005 to 2023 is obtained from the Credit Guarantee Performance Report published by the National Federation of Credit Guarantee Associations. GDP data is sourced from the World Bank's dataset on GDP (constant local currency).

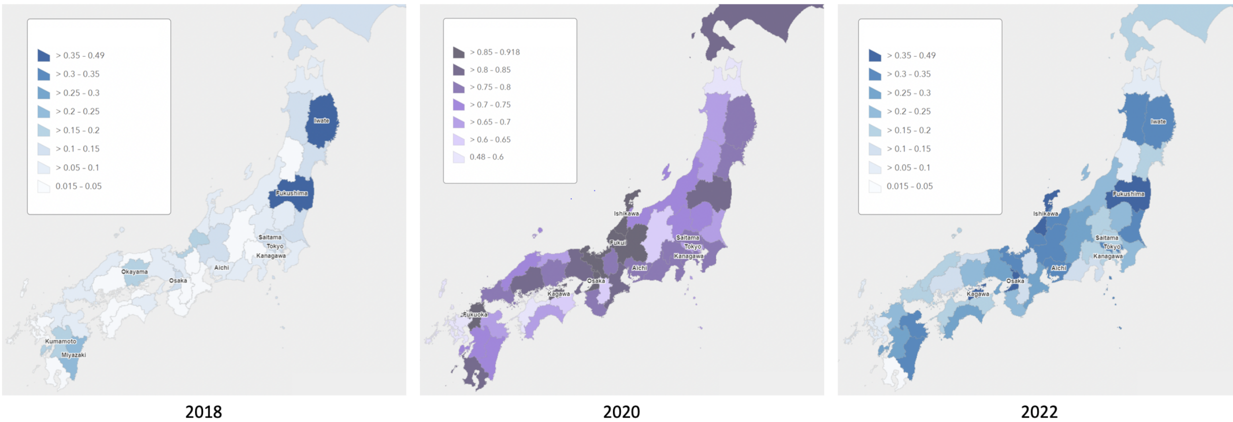
rations based on information submitted by financial institutions during the guarantee application process. The dataset covers both the bank and prefecture levels and records the total annual volume of credit-guaranteed loans issued by each bank. This information is used to compute the share of guaranteed loans in total lending at the bank-year level. The disaggregated structure of the data enables analysis of regional and institutional variation in guarantee usage.

4.3 Stylized Facts about CGCs

First, since the 1960s, the guaranteed debt balance to GDP ratio has been on the rise, experiencing significant growth during the 1990s due to the housing bubble burst and the Asian financial crisis. This increase continued until around 2000, when the ratio reached a

3.

Figure 4: Ratio of Fully Guaranteed Loan



Note: This figure presents the ratio of fully guaranteed loans as a share of all guaranteed loans across prefectures. The legends for the years 2018 and 2022 are identical but differ from that of 2020. The loan guarantee amounts for the four cities with their own CGCs are aggregated with the prefectures to which they belong. The share of fully guaranteed loans increased for all prefectures in 2020 due to the emergency lending program. The data source is the online publication of the Small and Medium Enterprises Agency.

local maximum (Figure 3). After 2000, the ratio oscillated but generally trended downward. By 2019, the ratio had fallen below 4%, returning to pre-housing bubble levels. However, during the COVID year of 2020, the ratio experienced its most significant jump, doubling from around 4% to 8%.

Second, during the COVID-19 pandemic in 2020, all prefectures markedly increased the share of fully guaranteed loans.[11] As shown in Figure 4, this share remained elevated through 2022 relative to pre-pandemic levels. This persistence suggests that temporary emergency guarantee programs may have lasting effects. In particular, when the government assumes substantial credit risk during periods of crisis, that exposure continues to have fiscal and allocative consequences even after the emergency has passed.

Third, banks with lower equity ratios tend to issue a higher share of guaranteed loans. Across all specifications in Table 3, the estimated coefficients on the equity ratio are negative and statistically significant, indicating a robust inverse relationship. Column (1) reports the regression with time fixed effects only, while Columns (2) and (3) sequentially add fixed effects

[11] Japan's 51 CGCs include one in each of the 47 prefectures, as well as four additional cities with their own CGC: Gifu, Kawasaki, Nagoya, and Yokohama. Osaka-shi used to have its own CGC, which was later restructured and combined with Osaka prefecture's CGC. There are significant regional differences in the intensity of government guarantee usage.

Table 3: Bank Equity and Share of Guaranteed Lending

	Guaranteed Loan/Total Loan		
	(1)	(2)	(3)
Equity Ratio	-0.086**	-0.285***	-0.215***
	(0.043)	(0.038)	(0.037)
N	4,165	4,165	4,165
Bank Controls	yes	yes	yes
Time FE	yes	yes	yes
Bank Type FE	no	yes	yes
Prefecture FE	no	no	yes

Note: This table reports the results from regressions of the share of guaranteed loans in total loans on the bank equity ratio. The dependent variable in all columns is the ratio of guaranteed loans to total loans at the bank-year level. The key explanatory variable is the bank equity ratio, measured as equity over total assets. A control for the (log) total loan volume of the bank is included in all regressions to account for size-related differences in guarantee usage. Column (1) includes time fixed effects only. Column (2) additionally includes fixed effects for bank type (City Banks, Regional Banks, and Shinkin Banks). Column (3) further includes prefecture fixed effects to account for regional variation in guarantee take-up. Standard errors are reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

for bank type and prefecture. The magnitude of the relationship remains sizable, with the coefficient ranging from -0.086 to -0.285. These results suggest that less-capitalized banks rely more heavily on government credit guarantees, possibly due to their limited capacity to absorb credit risk. This pattern persists after controlling for heterogeneity across bank types and regional conditions.

5 Empirical Methodology and Reduced-Form Results

5.1 Bunching Around the SME Capital Cutoff

To test how firms respond to SME eligibility thresholds in practice, I first analyze the distribution of paid-in capital across firms in the ORBIS dataset, focusing on the last available observation for each firm before 2000 and after 2010.

Figure 5 Panel (a) presents the firm size distribution by paid-in capital before the 1999 SME definition reform. Across all sectors, there is visible bunching just below the pre-reform capital thresholds: 100 million yen for manufacturing, 30 million yen for wholesale, and 10 million yen for retail and service. This excess mass near the eligibility cutoff suggests strategic behavior by firms to remain classified as SMEs and retain access to subsidized credit. The pattern is strongest in the retail and service sectors, where a significant portion of firms cluster immediately below the 10 million yen mark.

Panel (b) shows the distribution using each firm's latest post-2010 observation, after the capital thresholds were raised. Bunching behavior persists under the new regime. For wholesale, retail, and service firms, the distributions exhibit a marked shift upward, with pronounced spikes just below the new eligibility thresholds (100 million yen for wholesale; 50 million yen for retail and service). This shift suggests that many firms expanded their capital base following the reform but still maintained levels just under the new thresholds to remain eligible for SME classification. The sharp discontinuities indicate that firms continue to respond to policy incentives embedded in the capital-based SME definition.

In contrast, manufacturing firms show less dramatic change. Although there remains some bunching below 300 million yen after 2010, the overall distribution appears relatively stable, with the bulk of firms still concentrated below 100 million yen—similar to the pre-2000 period. This persistence may reflect the existence of a universal corporate tax benefit threshold in Japan that applies to firms with paid-in capital below 100 million yen, regardless of industry.[12] As a result, even after the SME eligibility cutoff was raised to 300 million yen for manufacturing, many firms may have chosen to remain below the 100 million yen threshold to preserve favorable tax treatment. In addition, fixed capital requirements or technological constraints might have made capital restructuring more difficult for manufacturing firms.

Overall, the distributional evidence supports the view that SME classification thresholds shape firm behavior in capital registration. The persistent bunching around eligibility cutoffs reinforces concerns that policy-induced incentives distort firm growth trajectories and capital allocation.

Appendix Figure B1 illustrates how firms respond to employment-based SME eligibility

[12] Under Japan's corporate tax system, firms with paid-in capital below 100 million yen are classified as SMEs for tax purposes and are eligible for preferential tax treatment. As of the 2000s, these benefits include a reduced corporate income tax rate on a portion of taxable income (e.g., 15% on income up to 8 million yen, versus 23.2% for standard corporations), accelerated depreciation schemes, and exemptions from certain local enterprise taxes. These tax advantages are codified in Japan's Special Taxation Measures Law and continue to apply irrespective of the SME definition used in credit or industrial policy.

thresholds. In both periods, there is clear evidence of bunching near the eligibility cutoffs across all sectors, although some of the bunching occurs just above the cutoffs. In the service sector, where the employment threshold was raised from 50 to 100 employees, a strong new mode appears just below the higher threshold after 2010, while some firms continue to cluster below the original 50-employee cutoff. The retail sector similarly shows persistent clustering just below the 50-employee threshold.

5.2 Dynamic Effect of SME Policy Change in 1999

To quantify the effects of Japan's 1999 revision to the Basic Law on SMEs, I exploit variation in firm eligibility generated by the policy change. The empirical strategy focuses on identifying relative changes in firm outcomes—such as revenue, employment, paid-in capital, debt, and equity—for firms that became newly eligible for SME classification following the reform. These "newly eligible" firms are defined as those that exceeded the SME size threshold prior to the reform but fell below the expanded thresholds afterward. In addition to this treatment group, I define two control groups that may also be indirectly affected by the policy: firms that were always eligible (i.e., always small) and firms that were always ineligible (i.e., always large).

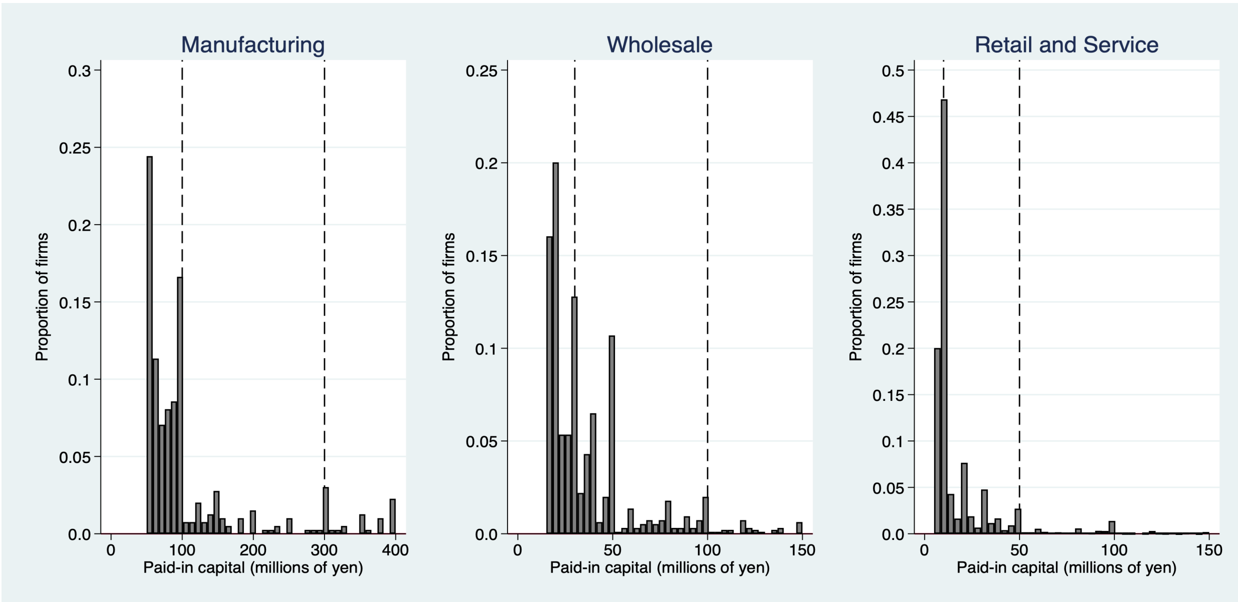
The main empirical specification follows an event-study difference-in-differences framework:

$$\ln(y_{ft}) = \sum_{t=1995}^{2010} \beta_t \cdot \text{NewEligible}_{ft} + \alpha_f + \gamma_{pt} + \delta_{it} + \varepsilon_{ft} \tag{19}$$

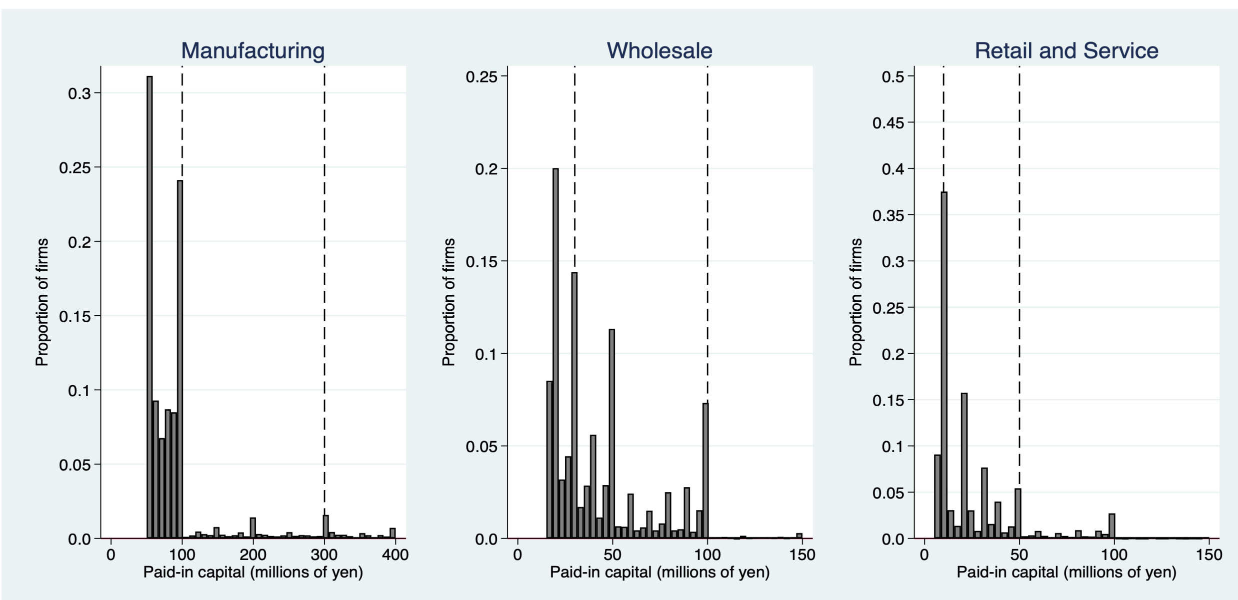
where $\ln(y_{ft})$ denotes the log of the outcome variable for firm f in year t, and NewEligible_{ft} is an indicator equal to one if firm f is in the newly eligible group in year t. The coefficient vector $\{\beta_t\}$ captures the differential change in the outcome of newly eligible firms relative to a control group in each year.

The identifying assumption is that in the absence of the policy reform, newly eligible firms would have followed parallel trends to the control group. In the baseline specification, the control group consists of firms that were always classified as small (large)—that is, those

Figure 5: Firm Bunching Around SME Capital Eligibility Threshold



(a) Before the 1999 SME Definition Reform



(b) After the 1999 SME Definition Reform

Note: This figure shows the distribution of firms by paid-in capital around the SME eligibility threshold. Panel (a) displays the firm size distribution before the 1999 reform, when the capital thresholds for SME classification were 100 million yen for manufacturing, 30 million yen for wholesale, and 10 million yen for both retail and service sectors. Panel (b) shows the distribution after the reform took effect in 2000, which raised the capital thresholds to 300 million yen for manufacturing, 100 million yen for wholesale, and 50 million yen for retail and service industries.

that were lower (higher) than both the pre- and post-reform SME thresholds throughout the sample period.

The specification includes firm fixed effects (α_f) to absorb all time-invariant firm characteristics, as well as prefecture-year fixed effects (γ_{pt}) to flexibly control for local economic shocks and region-specific trends, such as variation in credit conditions or local policy environments. Industry-year fixed effects (δ_{it}) are included to capture sector-level shocks, including those arising from international demand fluctuations or regulatory changes. To address serial correlation and heteroskedasticity in the error term, standard errors are clustered at both the firm and industry-year levels.

The data structure is an unbalanced panel, reflecting typical patterns of entry and exit among firms. The long panel and rich fixed effects allow me to nonparametrically trace out the dynamic treatment effects before and after the reform, and to test for pre-trends as a validity check of the identification strategy.

To enhance comparability around the SME eligibility threshold, I restrict the sample to firms within a defined size range prior to the 1999 policy change. Specifically, I exclude firms whose size exceeded twice the post-reform SME threshold or fell below half the pre-reform threshold. All subsequent observations for these firms are also dropped from the panel. However, firms that began within the eligible size range but later grew substantially are kept in the sample. This trimming procedure ensures that the newly eligible and control groups are drawn from a comparable region of the size distribution, thereby mitigating potential bias from compositional effects.

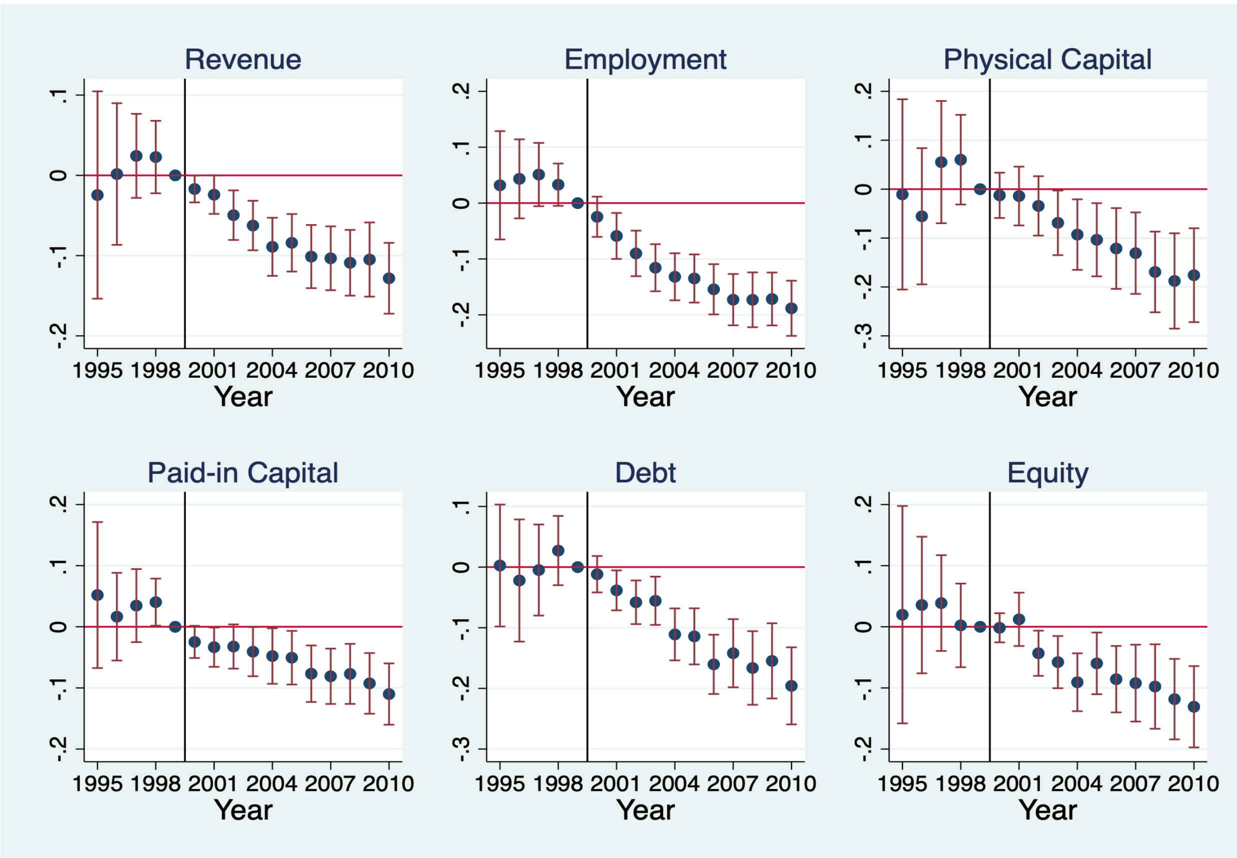
The coefficients of interest, β_t, are plotted in Figure 6 to visualize the evolution of treatment effects for newly eligible firms—those that gained SME status following the 1999 policy change—relative to firms that were always classified as SME. Following the policy change, the newly eligible firms exhibit persistent declines in all real outcomes: revenue, employment, and physical capital all show negative and statistically significant trends relative to the always-treated group. The magnitude of the decline is especially pronounced for employment and physical capital, indicating a contraction in firm scale among newly eligible firms. Financial indicators display a comparable pattern, with both debt and equity levels declining steadily following the reform, suggesting a marked slowdown in balance sheet expansion. Moreover, the observed declines in both real and financial indicators appear to be persistent rather than transitory.

Figure 7 compares the same group of newly eligible firms to those that were never eligible. The results show limited evidence of significant changes in real outcomes. Across revenue, employment, and physical capital, the estimated post-reform effects are statistically indistinguishable from zero. There is some indication of a modest decline in employment and revenue beginning in the mid-2000s. On the financial side, both debt and equity show weakly positive trends post-2000, but these effects are generally small in magnitude and not statistically significant. However, one notable exception is paid-in capital, which increased among the newly eligible group relative to the never-eligible firms. This suggests that some newly eligible firms raised external equity financing, potentially to take advantage of their new SME status, even at the cost of approaching the eligibility threshold. This pattern is consistent with firms seeking to expand cautiously within the confines of their new classification, balancing the benefits of growth with the risk of losing policy support.[13]

One possible interpretation of the contrasting trends observed across the two figures is that the SME size threshold itself acted as a growth barrier. Prior to the reform, firms in the always-treated group may have strategically constrained their growth to remain below the original cutoff and retain access to generous government-backed credit guarantees. The 1999 policy change effectively relaxed this constraint for them by raising the eligibility threshold, thereby allowing these firms to expand without jeopardizing access to subsidized credit. In contrast, firms that became newly eligible after the reform may have begun to face similar incentives to limit their scale in order to avoid crossing the new threshold. Nonetheless, the observed increase in paid-in capital among the newly eligible group suggests that some firms did choose to expand and raise external capital once they were granted SME status, perhaps anticipating that doing so would unlock subsidized lending or other support mechanisms without immediately breaching the new eligibility limit.

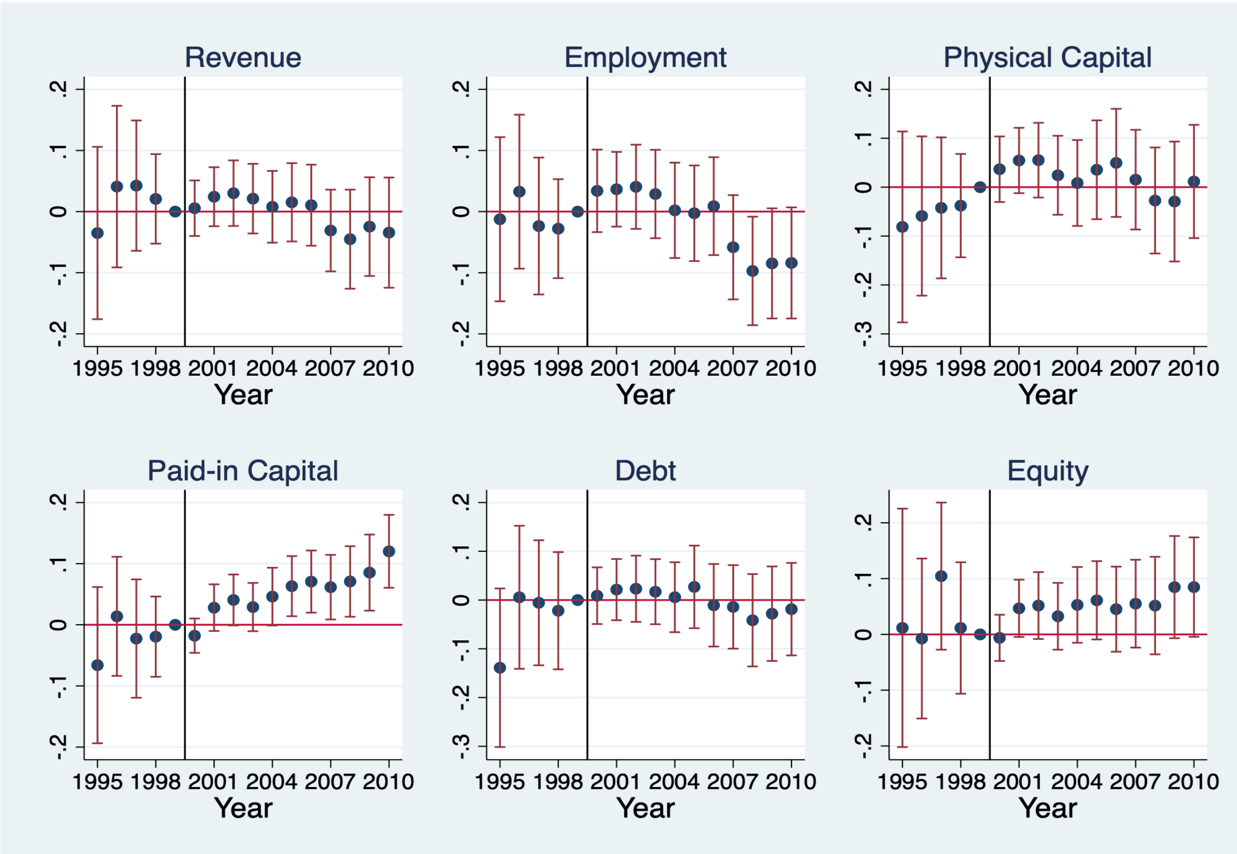
[13] Appendix Figure B2 shows that the post-reform expansion in economic performance is driven almost entirely by the always-eligible group. The fact that only the always-eligible firms show a clear break in trajectory reinforces the view that the 1999 reform relaxed a previously binding constraint for these firms, allowing them to grow while still retaining access to credit guarantees.

Figure 6: Dynamic Effects: Newly-Eligible vs. Always-Eligible Firms



Notes: This figure plots estimated event-study coefficients β_t from a difference-in-differences specification comparing firms that became newly eligible for SME classification following the 1999 policy change (treated group) to those that were always below the SME threshold and thus continuously eligible for SME treatment (control group). The outcome variables include revenue, employment, physical capital, paid-in capital, debt, and equity. The specification includes firm fixed effects, prefecture-year fixed effects, and industry-year fixed effects. Standard errors are clustered at the firm level and industry-year level. The treated group consists of 1,192 firms, and the control group includes 1,758 firms. To improve comparability near the eligibility threshold, the sample is restricted to firms with size larger than 0.5 times the pre-reform SME cutoff before 2000. The coefficients are normalized to zero in 1999, the year of the policy change.

Figure 7: Dynamic Effects: Newly-Eligible vs. Never-Eligible Firms



Notes: This figure plots estimated event-study coefficients β_t from a difference-in-differences specification comparing firms that became newly eligible for SME classification following the 1999 policy change (treated group) to firms that were always classified as large and thus never eligible (control group). The outcome variables include revenue, employment, physical capital, paid-in capital, debt, and equity. The specification includes firm fixed effects, prefecture-year fixed effects, and industry-year fixed effects. Standard errors are clustered at the firm level and industry-year level. The treated group consists of 1,436 firms, and the control group includes 948 firms. To improve comparability near the eligibility threshold, the sample is restricted to firms with size lower than 2 times the post-reform cutoff before 2000. The coefficients are normalized to zero in 1999, the year of the policy change.

Table 4: Direct Effect of SME Redefinition (Newly-Eligible vs. Never-Treated)

	Revenue (1)	Employment (2)	Physical Capital (3)	Paid-in Capital (4)	Debt (5)	Total Assets (6)
Post×NewEligible	-0.005	-0.007	0.049	0.068***	0.015	0.031
	(0.027)	(0.033)	(0.038)	(0.022)	(0.035)	(0.028)
Firm FE	yes	yes	yes	yes	yes	yes
Prefecture-Time FE	yes	yes	yes	yes	yes	yes
Industry-Time FE	yes	yes	yes	yes	yes	yes
Firms	2,386	2,386	2,383	2,386	2,386	2,386
Firm-Year Obs	22,147	22,147	22,125	22,147	22,147	22,147

Note: This table reports estimates from difference-in-differences regressions evaluating the impact of the 1999 SME Basic Law reform on firm outcomes. The dependent variables in columns (1) through (6) are the log of operating revenue, employment, physical capital, paid-in capital, debt, and total assets, respectively. The treatment group consists of firms that became newly eligible for SME classification after the reform, while the control group includes never-eligible firms. Firms with extreme values of paid-in capital or employment size (very large) are excluded from the sample. All regressions include firm fixed effects, prefecture-year fixed effects, and industry-year fixed effects. Standard errors are clustered at the firm and industry-year level. Standard errors are reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

5.3 Estimating the Direct Effect of SME Policy Change in 1999

To estimate the direct effects of the SME reclassification policy, I implement the following difference-in-differences specification:

$$\ln(y_{ft}) = \beta \text{Post} \times \text{NewEligible} + \alpha_f + \gamma_{pt} + \delta_{it} + \varepsilon_{ft} \tag{20}$$

Similar to the dynamic specification, to improve comparability around the thresholds, firms with extremely small or large values of paid-in capital and employment before the policy change are excluded from the estimation sample. All regressions include firm fixed effects, prefecture-year fixed effects, and industry-year fixed effects. Standard errors are clustered at the firm and industry-year levels.

Table 4 reports estimates comparing newly eligible firms to firms that were never classified as SMEs. Here, the effects are mostly statistically insignificant, with the exception of paid-in capital, which increases by 6.8% for newly eligible firms. This implies that the reform did not induce significant real expansion among marginal firms relative to larger peers, even though it granted them formal SME status.

Table 5 presents estimates comparing newly eligible firms to those that were always

Table 5: Direct Effect of SME Redefinition (Newly-Eligible vs. Always-Treated)

	Revenue (1)	Employment (2)	Physical Capital (3)	Paid-in Capital (4)	Debt (5)	Total Assets (6)
Post×NewEligible	-0.083***	-0.141***	-0.113***	-0.073***	-0.110***	-0.105***
	(0.017)	(0.018)	(0.035)	(0.018)	(0.023)	(0.018)
Firm FE	yes	yes	yes	yes	yes	yes
Prefecture-Time FE	yes	yes	yes	yes	yes	yes
Industry-Time FE	yes	yes	yes	yes	yes	yes
Firms	2,958	2,958	2,949	2,958	2,958	2,958
Firm-Year Obs	25,008	25,008	24,978	25,008	25,008	25,008

Note: This table reports estimates from difference-in-differences regressions evaluating the impact of the 1999 SME Basic Law reform on firm outcomes. The dependent variables in columns (1) through (6) are the log of operating revenue, employment, physical capital, paid-in capital, debt, and total assets, respectively. The treatment group consists of firms that became newly eligible for SME classification after the reform, while the control group includes always-eligible firms. Firms with extreme values of paid-in capital or employment size (very small) are excluded from the sample. All regressions include firm fixed effects, prefecture-year fixed effects, and industry-year fixed effects. Standard errors are clustered at the firm and industry-year level. Standard errors are reported in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

treated as SMEs. Across all outcomes, the coefficients on the interaction term $Post \times NewEligible$ are negative and statistically significant. Column (1) shows that revenue declined by 8.3% for newly eligible firms relative to the control group. Column (2) reveals an even larger contraction in employment, with a 14.1% drop. Physical capital, paid-in capital, debt, and total assets also decreased by 11.3%, 7.3%, 11.0%, and 10.5%, respectively (columns 3–6). These results indicate that always-eligible firms expanded significantly in both operational and financial dimensions after the SME cutoff change. The sharp increase in employment and assets among these always-eligible firms suggests that some of them have strategically downsized to remain within eligibility limits and retain access to subsidized debt.

6 Quantitative Implementation

This section describes in detail how I take the two–period model of Section 3 to the Japanese firm-level data and compute welfare under both the actual credit guarantee program and a set of counterfactual regimes. I proceed in three steps: (i) calibration of non-estimated parameters; (ii) identification of the finance wedge σ_λ via difference-in-differences; (iii) computation of welfare effects for each of the four statutory sectors.

6.1 Calibration

Table 6 summarizes the parameters that are either externally imposed or calibrated to match observed empirical moments. The capital share $\theta = 0.68$ is set near the median of micro-level estimates for Japanese manufacturing firms. The equity issuance cost parameter $c = 0.025$ is chosen such that the average equity premium (i.e., the difference between the cost of raising new equity and the cost of debt) in the 1995–1998 ORBIS sample is approximately 2.5% of the firm's capital stock.

The lump-sum subsidy rate $S = 0.006$ corresponds to the maximum statutory fee rebate under Japan's Safety-Net Credit Guarantee scheme (1.5% of the guaranteed principal), scaled by the average guarantee penetration rate observed among SMEs in the data (40%). The leverage cap $\bar{\lambda} = 2.2$ reflects the regulatory rule that total borrowing may not exceed 120% of paid-in capital.

The pre- and post-reform SME capital thresholds, $\overline{E}_0 = (100, 30, 10, 10)$ million yen and $\overline{E}_1 = (300, 100, 50, 50)$ million yen, are taken directly from the 1999 amendment to the SME Basic Act. Finally, the productivity distribution is approximated using a Pareto distribution fitted to the upper tail of firm-level TFP estimates in 1995–1998, yielding a tail index of $k = 2.4$. The lower bound of support is normalized to $\underline{\alpha} = 1$.

Table 6: Calibration of Parameters

Parameter	Value	Source or Calibration Target
θ	0.68	Median TFP elasticity from ORBIS (manufacturing)
c	0.025	Matches 2.5% equity premium (vs. debt) in ORBIS
S	0.006	Fee rebate × average SME guarantee rate
$\bar{\lambda}$	2.20	120% regulatory limit on loan-to-equity
$\overline{E}_0$	(100, 30, 10, 10)	SME Basic Act (pre-2000)
$\overline{E}_1$	(300, 100, 50, 50)	SME Basic Act (post-2000)
k	2.4	Fitted to top-tail firm TFP (1995–1998)
$\underline{\alpha}$	1	Normalization of Pareto support

I simulate a grid of $N = 50{,}000$ draws $\{\alpha_n\}_{n=1}^{N}$ from the Pareto$(\underline{\alpha}, k)$ distribution to approximate all model integrals. Entry thresholds, firm-level asset demand, and aggregate welfare objects are evaluated on this grid using Simpson's rule to ensure numerical precision.

6.2 Identifying the variable–cost subsidy σ_λ

Proposition 1 (Mapping from DID estimates to the structural wedge)**.** Let

$$\gamma \ := \ \frac{1}{1-\theta}\ \ln\!\Big(\frac{1}{\sigma_\lambda}\Big) \ > \ 0, \qquad \Delta^{DID}x := \big[x_{i1}-x_{i0}\big]-\big[x_{c1}-x_{c0}\big]$$

where i indexes *newly eligible firms* $\overline{E}_0 < E^*_{i0} \le \overline{E}_1$ and c indexes *always-large controls* $E^*_{c0} > \overline{E}_1$. Then

$$\Delta^{DID}\ln E \ = \ \gamma \qquad \Longrightarrow \qquad \sigma_\lambda \ = \ \exp\!\big[-(1-\theta)\,\widehat{\beta}_{\ln E}\big]$$

Proof sketch. Taking first differences removes any firm-specific fixed effect and the common term $\ln r_t$. For the newly eligible group the finance wedge falls from 1 to σ_λ, while it is constant at 1 for the controls, so the treatment-control difference in $\ln E$ equals γ. The full proof could be found in appendix A.1. □

Following proposition 1, I ran regression 20 using firm data for all sectors. The estimated coefficient is presented in Table 4, column 4 (0.068). And the calculated

$$\widehat{\sigma_\lambda} = \exp\big[-(1-\theta)\,\widehat{\beta}_{\ln E}\big] = \exp[-0.32\times 0.068] \approx 0.978.$$

6.3 Welfare computation

I compute welfare $W_{t,g} = Y_{t,g} - S\,M_{t,g}$, where $M_{t,g} = \Pr\{E^*_{t,g} \le \overline{E}_{t,g}\}$ is the mass of eligible firms in sector g. Table 7 reports the following percentages of pre–reform output $Y_{0,g}$: the welfare loss in the baseline (column 1), the welfare loss post–reform (column 2), and the gain from raising the cutoff (column 3).

In each sector the guarantee program imposes a substantial welfare loss of roughly 5% of output before 1999. The 2000 expansion of the SME ceilings recovers approximately 1% of output, reducing the residual loss to about 4%. These results highlight the large distortionary cost of size–dependent credit guarantees and confirm that broadening eligibility yields modest but positive net benefits.

Table 7: Welfare effects by sector (percent of pre–reform output $Y_{0,g}$)

Sector	Baseline loss $W_{0,g} - W_{0,g}^N$	Post–reform loss $W_{1,g} - W_{1,g}^N$	Reform gain $W_{1,g} - W_{0,g}$
Manufacturing	−5.4%	−4.4%	+1.1%
Wholesale	−5.2%	−4.0%	+1.2%
Retail	−5.0%	−3.5%	+1.5%
Services	−5.1%	−4.2%	+0.9%
Value–added average	−5.2%	−4.1%	+1.1%

7 Conclusion

This paper studies the allocative consequences of size-dependent credit guarantee policies, with a focus on Japan's Credit Guarantee Scheme. Exploiting a major 1999 policy reform that redefined SME eligibility, I show that newly eligible firms, relative to their always-eligible peers, systematically reduced their scale—both operational and financial—to retain access to subsidized credit. Using administrative data on public guarantee issuance between 2011 and 2022, I also document a robust inverse relationship between bank capitalization and reliance on government guarantees, suggesting that weak banks disproportionately lend under the program. These patterns point to a misalignment between policy design and efficient capital allocation, driven by unintended behavioral responses at both the firm and bank levels.

To interpret these findings, I develop a two-period general equilibrium model in which firms choose equity and scale under a leverage constraint. The model generates endogenous bunching in firm size. Calibrating the model to match estimated behavioral responses, I find that Japan's size-based guarantee program imposes a welfare loss of over 5% of output under the original regime. The 1999 reform, by relaxing eligibility thresholds, delivers a gain of approximately 1% of value added, but sizable distortions persist in the post-reform equilibrium. These results highlight the trade-offs inherent in broad-based credit support and highlight the need for more targeted policies that mitigate frictions without entrenching inefficiencies.

As a complementary exercise, I develop an extended general equilibrium model in the Appendix C that explores how optimal credit guarantee policies should be designed when banks are heterogeneous in capitalization and firms differ in default risk. This framework introduces endogenous bank sorting and general equilibrium credit market clearing. It highlights a key policy trade-off: relaxing eligibility thresholds may support marginal firms but can also encourage undercapitalized banks to lend excessively to riskier borrowers. The model shows that a guarantee scheme that conditions more tightly on bank capitalization—offering lower guarantees to well-capitalized banks—can improve credit allocation and maximize value added. The results underscore the importance of tailoring guarantee intensity to institutional quality and reinforce the empirical evidence of misallocation due to uniform guarantee policies.

Future research could deepen this analysis by extending the theoretical framework along several important dimensions. One promising direction is to embed a fully articulated banking sector into the size-dependent policy model, allowing for endogenous determination of bank balance sheet risk, deposit pricing, and regulatory constraints. This would enable richer analysis of how guarantee design interacts with bank incentives, particularly in contexts where capital regulation and monetary policy jointly influence lending behavior. Another avenue is to introduce firm dynamics—such as multi-period investment and exit decisions—into the bunching environment, which would capture long-run distortions in innovation and reallocation. These extensions would help build a more comprehensive theory of financial intermediation under targeted government support.

A Proof of Propositions

A.1 Proof of Proposition 1

Proof of Proposition 1. Fix a productivity type α and suppress it from the notation.

Step 1. Log–linear representation of optimal equity. When the leverage ceiling is slack the interior optimum for assets is $K_t^{\mathrm{FOC}} = (\theta/\tilde{\sigma}_t r_t)^{1/(1-\theta)}\alpha^{1/(1-\theta)}$, with $\tilde{\sigma}_t \in \{1, \sigma_\lambda\}$. Because every firm finances at the ceiling $K = \bar{\lambda}E$, optimal equity is

$$\ln E_t^* = \frac{1}{1-\theta}\Big[\ln\theta - \ln(\tilde{\sigma}_t r_t) - \ln\bar{\lambda}\Big] + \frac{1}{1-\theta}\ln\alpha. \tag{A.1}$$

Step 2. Log change for a newly eligible firm. For a treatment firm $\overline{E}_0 < E_0^* \le \overline{E}_1$ I have $\tilde{\sigma}_0 = 1$ and $\tilde{\sigma}_1 = \sigma_\lambda$, so

$$\begin{aligned}\Delta^{\mathrm{T}} &:= \ln E_1^* - \ln E_0^* \\ &= \frac{1}{1-\theta}\big[-\ln(\sigma_\lambda r_1) + \ln(r_0)\big]. \end{aligned} \tag{A.2}$$

Step 3. Log change for a control firm. For an always–large control $E_t^* > \overline{E}_1$ in both periods, $\tilde{\sigma}_0 = \tilde{\sigma}_1 = 1$, giving

$$\begin{aligned}\Delta^{\mathrm{C}} &:= \ln E_{c1}^* - \ln E_{c0}^* \\ &= \frac{1}{1-\theta}\big[-\ln r_1 + \ln r_0\big]. \end{aligned} \tag{A.3}$$

Step 4. Difference–in–differences. Subtracting control from treatment,

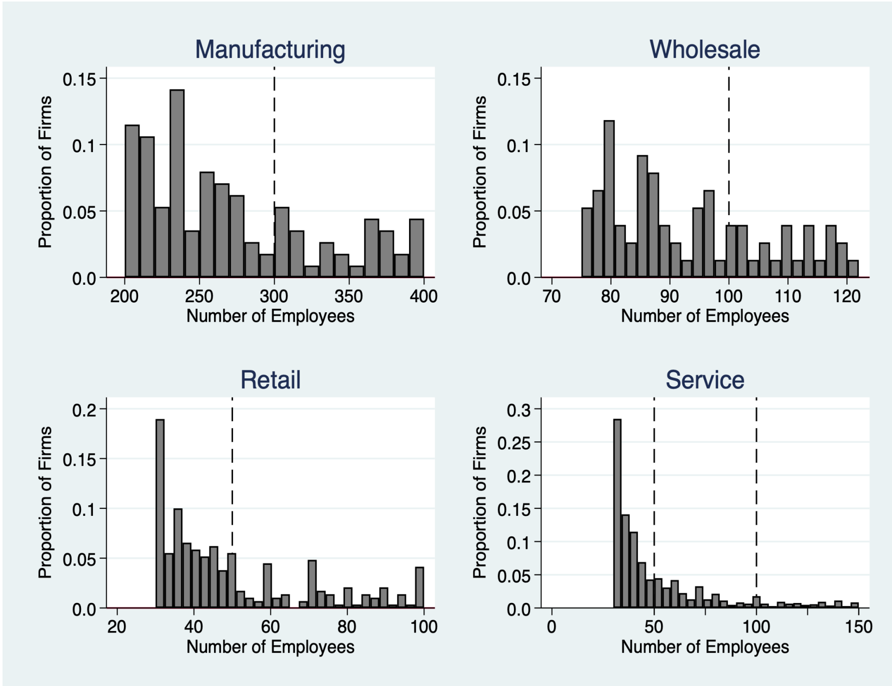
$$\Delta^{\mathrm{T}} - \Delta^{\mathrm{C}} = \frac{1}{1-\theta}\big[-\ln\sigma_\lambda\big] = \frac{1}{1-\theta}\ln\Big(\tfrac{1}{\sigma_\lambda}\Big) = \gamma.$$

Thus the DID coefficient on $\ln E$ equals γ even though the equilibrium interest rate r_t is unobserved.

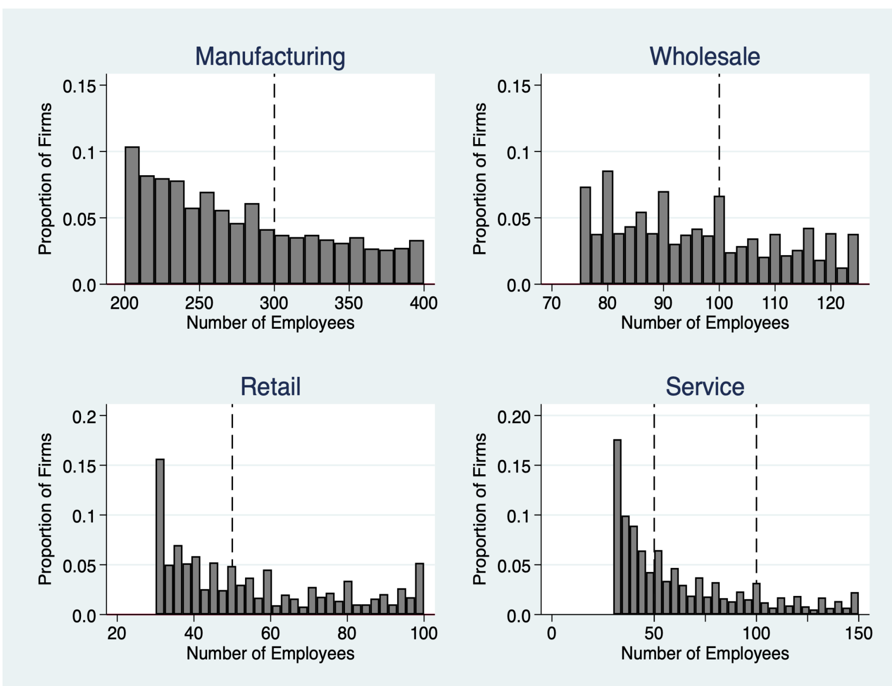
□

B Additional Tables and Figures

Figure B1: Firm Bunching Around SME Employment Eligibility Threshold



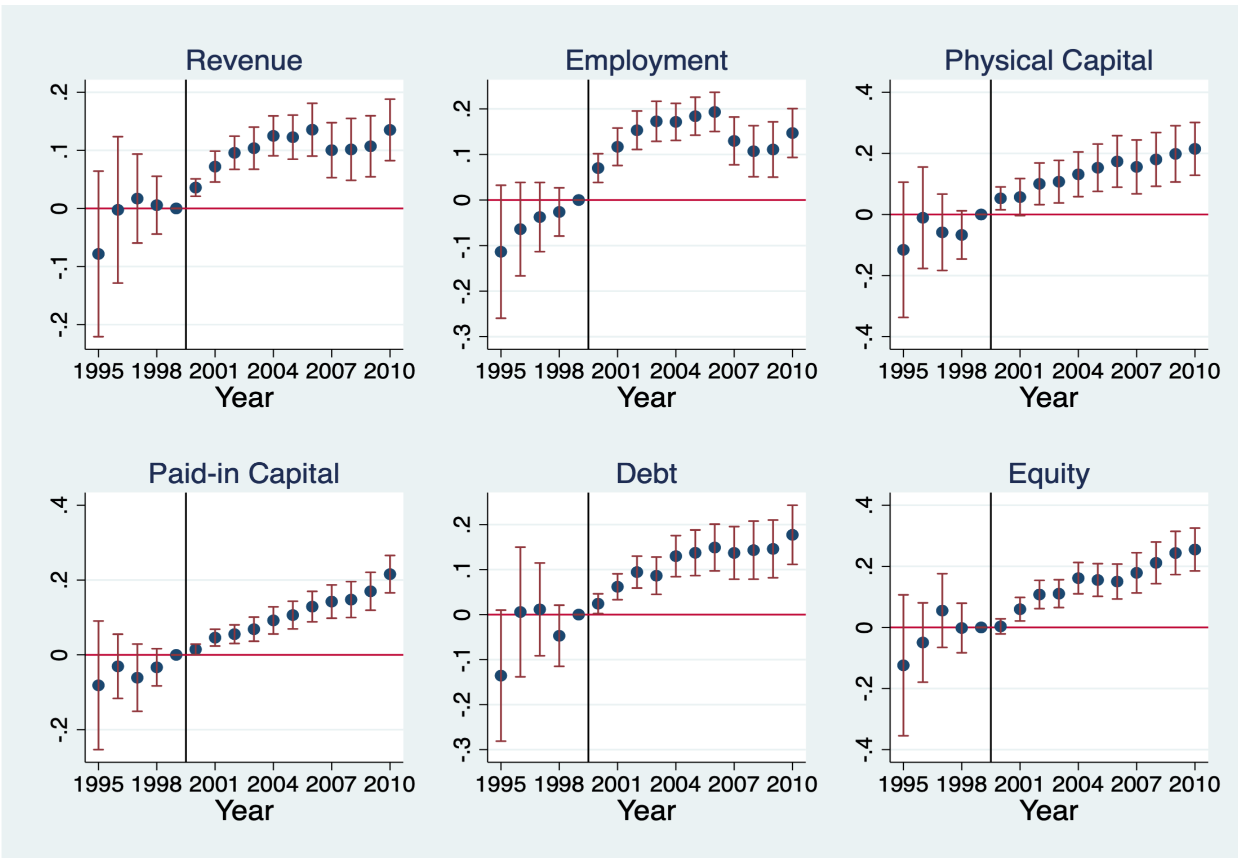
(a) Before the 1999 SME Definition Reform



(b) After the 1999 SME Definition Reform

Note: This figure shows the distribution of firms by employment around the SME eligibility threshold. Panel (a) displays the firm size distribution before the 1999 reform. Panel (b) shows the distribution after the reform took effect in 2000, which raised the employment thresholds only for the service industries.

Figure B2: Dynamic Effects: Always-Eligible vs. Never-Eligible Firms



Notes: This figure plots estimated event-study coefficients β_t from a difference-in-differences specification comparing firms that were always eligible for SME classification to those that were never eligible. The specification includes firm fixed effects, prefecture-year fixed effects, and industry-year fixed effects. Standard errors are clustered at the firm level and industry-year level. The coefficients are normalized to zero in 1999, the year of the policy change.

C A Model of Optimal Credit Guarantee Policy

This section introduces a general equilibrium model to analyze how government credit guarantees interact with firm heterogeneity, bank capital structure, and credit allocation. The purpose of the model is to quantify distortions arising from equity-dependent guarantees and identify the optimal credit guarantee policy.

C.1 Environment: Firms, Banks, and Government Policy

The economy comprises a continuum of incumbent firms, normalized to a mass of one. These firms differ in their default probabilities and productivity. Specifically, there are two firm types: healthy (h) firms and zombie (z) firms. Healthy firms constitute a fraction $(1-\lambda)$ of incumbents, while zombie firms account for the remaining fraction λ. Additionally, potential entrants with a mass of λ are all healthy firms.

Each firm requires financing of one monetary unit to implement a single, indivisible project. Projects yield returns contingent on success or failure. A type-i firm (with $i \in \{h, z\}$) successfully produces an output y_i with probability $(1-p_i)$, and defaults with probability p_i, where it produces zero output. All firms draw an idiosyncratic operating cost shock, ε, from a common distribution $F(\varepsilon)$.

Given these project characteristics, a firm of type i decides to operate if and only if its realized operating cost is below a threshold determined by its expected net revenue, which equals the difference between expected output and the loan repayment obligation, weighted by the probability of success. Specifically, firm i operates if:

$$\varepsilon \leq \varepsilon_i^* \equiv (1-p_i)(y_i - R_i),$$

where R_i is the loan rate charged by the bank to the firm. Consequently, the equilibrium measure of operating firms for each type is:

$$m_h = (1-\lambda+\lambda)F(\varepsilon_h^*) = F(\varepsilon_h^*), \quad m_z = \lambda F(\varepsilon_z^*).$$

Banks are characterized by their equity ratios $e \in [e_{\min}, e_{\max}]$, with the distribution of banks across equity ratios given by $\mu(e)$. Each bank has a normalized balance sheet size of one monetary unit and decides among three possible investment options: lending to healthy firms, lending to zombie firms, or investing in a safe asset yielding a risk-free return R_f. I assume competitive credit markets, implying that loan interest rates R_i are determined in general equilibrium and taken as given by both banks and firms. On the liability side, banks raise $1-e$ units from depositors, who must always be compensated at the risk-free rate R_f, regardless of the project's outcome.

The government sets two key policy instruments: the risk-free rate R_f and a bank-specific credit guarantee rate $\theta(e)$. In the Japanese context, I assume that R_f has already reached its effective lower bound, meaning the government cannot further reduce interest rates in response to negative economic shocks. I also assume the guarantee rate decreases with a bank's equity ratio e, formally expressed as $\theta'(e) < 0$, an assumption supported by the empirical findings.

C.2 Bank Optimization

Banks evaluate three investment options by maximizing their expected return on equity (ROE), given by:

$$\max_{i\in\{h,z,f\}} \mathrm{ROE}_i = \frac{(1-p_i)R_i + p_i\theta(e) - R_f(1-e)}{e}$$

When investing in the safe asset, banks' ROE equals the risk-free rate, $\mathrm{ROE}_f = R_f$.

Proposition 2. Consider a credit guarantee policy defined by $\theta(e) = \bar{\theta}(1-\kappa e)$, where $\kappa > 0$ governs the negative sensitivity of the guarantee rate to a bank's equity ratio e. Then, there exist two equity thresholds:

$$e^* = \frac{1}{\kappa}\left[1 - \frac{(1-p_z)R_z - (1-p_h)R_h}{\bar{\theta}(p_h - p_z)}\right], \quad e^{**} = \frac{1}{\kappa}\left[1 - \frac{R_f - (1-p_h)R_h}{p_h\bar{\theta}}\right],$$

which segment banks into three different equilibrium lending strategies:

$$\text{Bank investment choice} = \begin{cases} \text{lend to zombie firms,} & \text{if } e < e^*, \\ \text{lend to healthy firms,} & \text{if } e \in (e^*, e^{**}), \\ \text{invest in safe asset,} & \text{if } e > e^{**}. \end{cases}$$

The intuition underlying Proposition 2 is straightforward. Under an equity-sensitive guarantee policy, less-capitalized banks benefit disproportionately from generous guarantees, thereby incentivizing them to finance riskier, zombie firms. Conversely, well-capitalized banks receive less favorable guarantees and thus prefer safer investments or lending to healthier firms. This sorting mechanism illustrates how government guarantees can unintentionally encourage fragile banks to engage in riskier lending practices, exacerbating financial misallocation and inefficiencies.

C.3 General Equilibrium and Optimal Policy

General Equilibrium. A general equilibrium in this economy consists of loan rates (R_h, R_z), a government guarantee function $\theta(e)$, and the risk-free rate R_f satisfying the following conditions simultaneously:

i. *Bank Optimization:* Given loan rates (R_h, R_z), the guarantee schedule $\theta(e)$, and risk-free rate R_f, each bank characterized by equity ratio e chooses investment $i(e) \in \{h, z, f\}$ to maximize its expected return on equity:

$$i(e) = \arg\max_{i\in\{h,z,f\}} \frac{(1-p_i)R_i + p_i\theta(e) - R_f(1-e)}{e},$$

with the optimal choices inducing thresholds (e^*, e^{**}) that partition banks' lending behavior.

ii. *Firm Entry and Exit Conditions:* Given the equilibrium loan rates (R_h, R_z), each type-i firm operates if and only if its realized operating cost is below the profitability threshold:

$$\varepsilon \leq \varepsilon_i^* = (1 - p_i)(y_i - R_i), \quad i \in \{h, z\}.$$

Thus, equilibrium masses of operating firms are:

$$m_z = \lambda F(\varepsilon_z^*), \quad m_h = (1 - \lambda + \lambda) F(\varepsilon_h^*) = F(\varepsilon_h^*).$$

iii. *Loan Market Clearing Conditions:* Aggregate credit supply by banks to each type of firm equals the respective aggregate demand from operating firms. Formally, this requires:

$$\int_{e_{\min}}^{e^*} \mu(e)\, de = m_z, \quad \int_{e^*}^{e^{**}} \mu(e)\, de = m_h.$$

An equilibrium therefore simultaneously satisfies the bank optimization conditions, firm entry and exit thresholds, and market clearing equations, given the policy choices $(R_f, \theta(e))$ set by the government.

Total Value Added. Total output net of operating costs (i.e., total value added) in this economy is defined as the sum of expected output across all operating firms, minus their respective operating costs. Let Y denote total value added:

$$Y = \lambda \left[y_z F(\varepsilon_z^*) - \int_0^{\varepsilon_z^*} \varepsilon f(\varepsilon)\, d\varepsilon \right] + \left[y_h F(\varepsilon_h^*) - \int_0^{\varepsilon_h^*} \varepsilon f(\varepsilon)\, d\varepsilon \right].$$

The first term captures the contribution of zombie firms weighted by their measure λ, while the second term reflects the contribution of healthy firms, including both incumbents and entrants.

Optimal Credit Guarantee Policy. Given that the risk-free rate R_f is constrained by its effective lower bound, when facing negative shocks, the government cannot stimulate credit further by lowering interest rates. Instead, it chooses the guarantee schedule $\theta(e)$ to maximize total value added Y, while minimizing the fiscal cost of providing guarantees. Formally, the government solves:

$$\min_{\theta(e)} \int_{e_{\min}}^{e_{\max}} \theta(e)\, de \quad \text{subject to} \quad Y[\theta(e)] = \sup_{\theta'(e)} Y[\theta'(e)].$$

This problem characterizes the optimal trade-off between allocative efficiency and fiscal discipline. The government aims to implement a guarantee policy that achieves the highest possible aggregate output net of costs, while committing the least amount of public resources.

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