Personal Guarantees on Bank Loans and SMEs' Risk-taking

Takeo Hoshi
Graduate School of Economics, The University of Tokyo

Yoko Shibuya
Fuqua School of Business, Duke University

This paper examines two types of loan contracts designed to mitigate the moral hazard problem in small business lending: loans with personal guarantees and loans with monitoring. We build a theoretical model to compare these contracts to traditional loan agreements, showing that both effectively reduce moral hazard and enhance credit availability, but through different mechanisms. Personal guarantees create a financial burden for company managers in the event of business failure, while bank monitoring reduces the personal benefits associated with poor investment choices. Consequently, banks offer lower interest rates for loans backed by personal guarantees due to the decreased risk of default. However, personal guarantees can discourage managers from pursuing profitable but risky investments. Leveraging a Japanese policy reform that encouraged banks to transition from personal guarantees to monitoring, we confirm the model predictions. Specifically, interest rates for monitored loans are higher than those for loans with personal guarantees, and receiving monitored loans is associated with increased risk-taking and improved firm performance.

Key words: Banks, Moral hazard, Personal guarantees, Bank monitoring, Risk-taking, Small and medium-sized enterprise, Japan

---

Acknowledgement

The paper began as a study conducted by Hoshi, as a member of the Policy Evaluation Study Group at the SME Unit of the Japan Finance Corporation (JFC). We are grateful to Kosuke Aoki, Taiji Furusawa, John Grigsby, Daiji Kawaguchi, Sagiri Kitao, Nobuhiro Kiyotaki, Tadanobu Nemoto, Masahiro Odaka, Yoshiaki Ogura, Kei Takahashi, Hirofumi Uchida, Iichiro Uesugi, Nobuyoshi Yamori, and other seminar participants at Princeton University, the University of Tokyo, and JFC study group for their valuable comments and suggestions. At the preliminary stage of the study, Hoshi collaborated with Sabrina Howell and Ayako Yasuda. Hoshi acknowledges their insights and efforts that helped to start the investigation. An early version of the paper was included as a chapter in Shibuya's Ph.D. dissertation. We thank Shibuya's thesis advisors, Kyle Bagwell and Pete Klenow, for their helpful comments. All remaining errors are ours.

1. Introduction

Small and medium-sized enterprises (SMEs) play a crucial role in economic activity. Across OECD countries, SMEs account for around 99% of all firms, are a major source of employment, and generate 50% to 60% of value added on average (OECD 2024). However, many

of these firms face significant challenges in securing financing due to information asymmetry (Robb and Robinson 2014). While collateral requirements can help mitigate these challenges, many SMEs lack the tangible assets needed to provide collateral. As a result, in many countries, lenders typically adopt one of two strategies to address this problem: requiring SME managers to personally guarantee loan repayment in the event of default, or implementing bank monitoring mechanisms to oversee borrower firms.

Despite the critical importance of SME financing for both financial stability and economic growth, there is a lack of systematic studies examining the determinants and consequences of these loan arrangements. In this paper, we develop a theoretical model to analyze the impact of two distinct types of SME loan contracts on various factors: loan pricing, the types of firms that gain access to credit, borrowers' preferences for these loan types, and the strategic risk-taking decisions firms make under different loan arrangements. We test the predictions of our model using detailed loan-level data from Japan, exploiting the 2014 policy reform that shifted the focus from personal guarantees to greater reliance on bank monitoring.

Our model features moral hazard frictions between banks and firm managers regarding investment and risk-taking decisions. Managers face a choice between pursuing good or poor projects. While poor projects yield lower returns for the firm, they offer private benefits to the managers. Additionally, managers can opt for riskier investments, which increase the potential for both high returns and failure compared to more moderate investments.

We consider three types of loan contracts: basic loans, personal guarantee loans, and loans with bank monitoring. Basic loans, which we use as a baseline for comparison, restrict access to financing for some firms due to moral hazard issues surrounding investment decisions. Personal guarantee loans, where managers personally commit to repaying the loan if the project fails, reduce the incentives to choose poor investment projects, thus improving access to financing. Finally, loans with bank monitoring help reduce moral hazard by limiting the private benefits managers can derive from poor projects. This, in turn, enhances loan availability by curbing incentives to invest in suboptimal projects.

While both personal guarantees and bank monitoring mitigate moral hazard and enhance credit availability, there are important differences between the two. Loans with bank monitoring are typically associated with a higher likelihood of default, prompting banks to charge higher interest rates compared to personal guarantee loans. Furthermore, personal

guarantees may discourage managers from taking firm performance-enhancing risks by increasing their personal financial exposure, whereas bank monitoring does not create the same disincentive for risk-taking.

We also investigate the conditions under which managers may prefer loans with bank monitoring over those with personal guarantees. While the former eliminates personal financial risk in the event of project failure, it often comes with higher interest rates than loans with personal guarantees. Our model predicts that managers are more likely to choose loans with bank monitoring when their firms face a lower probability of project success or when they have a smaller personal stake in the firm.

We evaluate our model's predictions using data from the Japan Finance Corporation (JFC), the largest government financial institution in Japan focused on SME lending. Our analysis centers on the 2014 banking policy reform. Before this reform, the Japanese SME lending market was predominantly characterized by loans with personal guarantees, with over 80% of SME loans carrying such guarantees. The 2014 reform strongly encouraged financial institutions to shift towards offering loans with bank monitoring, moving away from personal guarantees. Following the reform, the JFC allowed all loan applicants to choose between loans with personal guarantees and those with bank monitoring, leading to approximately 40% of JFC loans during this period being issued with bank monitoring.

First, we examine the interest rates associated with loans with bank monitoring compared to those secured by personal guarantees. Our findings support the model's predictions: loans with monitoring carry higher interest rates than loans backed by personal guarantees. Moreover, the interest surcharge on loans with monitoring is more pronounced for firms with poorer credit ratings, which is consistent with our theoretical framework.

Next, we analyze the influence of different loan types on firms' risk-taking behaviors and performance. We find that firms with loans under bank monitoring are more likely to default compared to those with personal guarantee loans, suggesting increased risk-taking, which aligns with our model's implications. However, firms with monitoring loans also exhibit higher performance, conditional on survival. Thus, the higher risk-taking associated with these loans appears to yield positive outcomes overall.

Finally, we compare the characteristics of firms that opted for loans with monitoring to those that chose loans with personal guarantees. Our analysis reveals that firms with better credit ratings and managers with a smaller ownership stake in the firm are more

likely to choose loans with monitoring. This finding diverges from our model's predictions, leading us to explore several extensions to the model, which we discuss in a later section.

Our findings contribute to the literature on the determinants of heterogeneous loan arrangements, with a particular focus on SME loan contracts. The choice of specific loan arrangements is influenced by factors on both the lender and borrower sides. On the lender side, while much of the literature has explored the factors driving banks' collateral requirements (Berger and Udell 1990, 1995, Boot and Thakor 1994, Boot 2000), fewer studies examine the factors that lead banks to require personal guarantees for SME loans, such as the length of the bank-borrower relationship (Ono and Uesugi 2009) and bank capital regulations (Mayordomo et al. 2021). On the borrower side, much of the literature has focused on how the value of collateral influences firms' decisions between public debt and bank debt (Hoshi et al. 1993, Cantillo and Wright 2000, Park 2000, Lin 2016). Our contribution lies in providing both theoretical and empirical insights into the determinants of SME loan arrangements from the perspectives of both lenders and borrowers. We demonstrate how moral hazard between banks and SME managers leads banks to require personal guarantees or implement bank monitoring, how these loan arrangements result in different pricing outcomes, and how managers' preferences are shaped between the two loan arrangements.

In addition, by exploring the consequences of heterogeneous loan arrangements on managers' strategic choices, we contribute to the literature examining the relationship between managers' personal financial risk and firm strategies. Previous research has primarily focused on litigation risk as a form of personal financial risk and how varying degrees of liability protection influence firm strategies. While some studies suggest that lower financial risk exacerbates agency problems, leading to sub-optimal choices by managers (Zou et al. 2008, Lin et al. 2011, 2013, 2019, Aguir et al. 2014, Appel 2019), more recent work highlights the positive role of liability protection in fostering innovation investments (Lin et al. 2021, Guan et al. 2021). We extend this body of literature by demonstrating that transitioning to limited liability and reduced personal financial risks for SME managers—via bank-monitored loans instead of personally guaranteed loans—encourages managers to take higher-risk strategies. This results in a higher likelihood of default but also leads to improved firm performance conditional on survival.[1]

[1] Few studies address how unlimited liability through personal guarantees affects firm performance; Mayordomo et al. (2021) finds that firms providing personal guarantees have a lower default likelihood, but this does not impact firm performance conditional on survival.

The remainder of the paper is organized as follows. Section 2 provides the institutional context and details the 2014 Japanese policy reform. Section 3 presents the theoretical model and summarizes its empirical predictions. Section 4 describes the data and presents the empirical results. Section 5 discusses the limitations of our model and potential extensions, and Section 6 concludes the paper.

2. Institutional Background

This section outlines the institutional framework surrounding personal guarantees and their implications for banks, companies, and managers. It also includes a description of the policy reform around 2014 that impacted the use of guarantees in SME lending in Japan.

2.1. Personal guarantees and their implications

Signing personal guarantees on business loans places direct liability on guarantors, typically company managers, making them personally responsible for loan repayment in the event of business failure. Unlike collateral, which is limited to the company's tangible assets, personal guarantees represent claims against the guarantor's current and future wealth, including personal properties such as houses, cars, and future wages. Without personal guarantees, a manager's liability is limited to their ownership stake, but these guarantees impose unlimited liability. This financial risk incentivizes managers to exert greater effort to prevent loan defaults, thereby reducing moral hazard between banks and managers.

The prevalence of personal guarantees in SME lending is significant in Japan. In 2014, over 80% of SME loans in Japan involved personal guarantees.[2] This practice is also common globally; a 2020 Small Business Credit Survey by the Federal Reserve found that 59% of small businesses in the United States used personal guarantees to secure funding, with similar trends in Europe, including France, Italy, Spain, and the United Kingdom (Schmalz et al. 2017, Rodano et al. 2011, Mayordomo et al. 2021, Bahaj et al. 2020).

While personal guarantees can mitigate moral hazard and facilitate SME lending, they also impose considerable financial and psychological burdens on CEOs. These burdens are often viewed as obstacles to necessary corporate risk-taking for productivity growth among Japanese SMEs, which have struggled with sluggish productivity for the past 30 years (Colacelli and Hong 2019). As a result, the Japanese government seeks to reduce reliance on personal guarantees in SME lending to encourage essential corporate risk-taking.

[2] For more information on the prevalence of personal guarantees in SME loans in Japan, see `https://www.fsa.go.jp/policy/hoshou_jirei/index.html`.

2.2. Japanese policy reform in 2014

In December 2013, the Japan Bankers Association and the Japan Chamber of Commerce introduced the Guidelines for Personal Guarantees Provided by Business Managers.[3] These guidelines strongly recommend that banks refrain from requiring personal guarantees from SME CEOs if the following criteria are met: (1) a clear separation of company assets from personal assets, (2) a robust financial foundation, and (3) timely disclosure of accounting information to the banks.[4] The rationale behind these guidelines is that when SMEs meet these requirements, financial institutions can more effectively monitor their business conditions, thus reducing the need for personal guarantees to ensure loan repayment.[5]

The guidelines took effect on February 1, 2014. Since they were guidelines rather than mandatory requirements, most private banks did not immediately stop requiring personal guarantees. However, the change was significant for the SME Unit of the JFC, which serves as our data source. Figure 1 illustrates the monthly proportion of new JFC SME loans issued without personal guarantees. Before the guidelines, fewer than 10% of loans were issued without them. Following the implementation of the guidelines in February 2014, this proportion surged to over 30% and gradually increased to 50% by March 2016. Between February 2014 and March 2016, approximately 40% of new loans were issued without personal guarantees, while the remainder still required them.

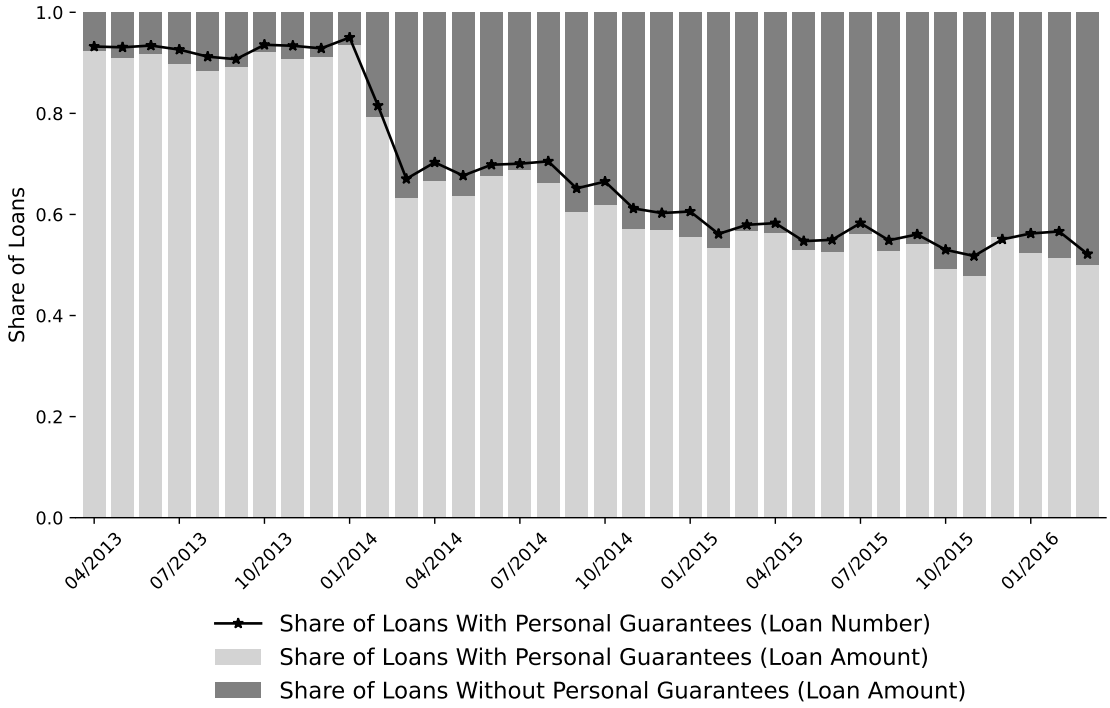
Between February 2014 and March 2016, all companies applying for new loans from the SME Unit had the option to borrow without personal guarantees but with monitoring, provided they met the conditions outlined in the guidelines. The JFC offered various interest rates based on the loan contract. Some borrowers chose loans without personal guarantees, while others opted for traditional loans that required them, depending on their preferences and the interest rates available.

[3] The guidelines (in Japanese) are available on the FSA website: `https://www.fsa.go.jp/news/25/ginkou/20131209-1.html`.

[4] The guidelines also outline procedures for renegotiating or removing existing guarantees. However, their practical impact has been limited. For example, in fiscal year 2015, personal guarantees were dissolved in only 207 cases by private financial institutions and 61 cases by government-owned institutions. For details, see `https://www.fsa.go.jp/policy/hoshou_jirei/index.html`.

[5] The costs associated with these requirements may vary among SMEs and their managers. Compliance with requirement (1) is typically more costly for owner-managed firms, while requirements (2) and (3) impose higher costs on firms with weaker financial foundations and accounting systems. In Section 3, we discuss the heterogeneous costs of monitoring across firms.

Figure 1: The Use of Personal Guarantees Over Time: Loan Amount and Number of Loans



Note: This graph illustrates the monthly share of newly issued loans with/withotu personal guarantees by the JFC SME Unit from April 2013 to March 2016. The bar charts represent the share of loans based on amount: the light gray area indicates loans with personal guarantees, while the gray area shows loans without personal guarantees. The line plot depicts the share of loans with personal guarantees based on the number of loans.

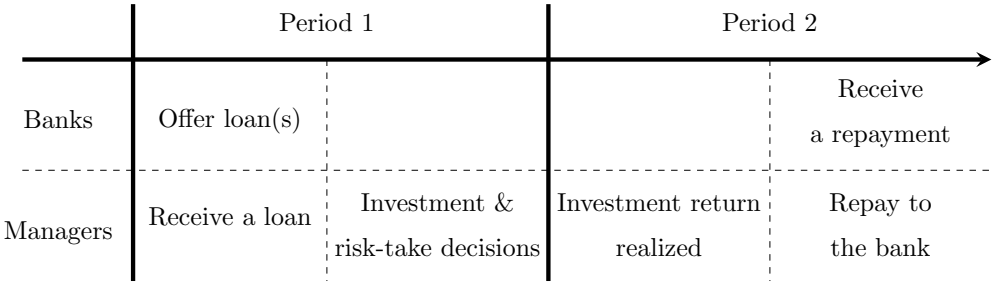
3. Model

3.1. Setting

The model consists of two types of agents: firms (with managers as decision-makers) and banks. Figure 2 illustrates the model's timing over two periods. In period 1, banks offer loan contracts to managers, who decide which contract to accept and which investment project to pursue, choosing between good and poor investments and deciding whether to take on additional risks. In period 2, investment returns are realized, and claims are settled. Both managers and banks are assumed to be risk-neutral.

There is a continuum of managers, each matched to a firm. In period 1, each manager faces two investment opportunities (good and poor) with stochastic returns, requiring an investment cost $I > 0$. Firms raise funds from banks, as they have no cash on hand. In period 2, investments yield returns of XR (great success, $X > 1$), R (moderate success, $R \geq I$), or 0 (failure). The probabilities of great and moderate success for good investments are

Figure 2: Model timing



$p \in [0, 0.5]$, with failure probability $1 - 2p$. For poor investments, the success probabilities are p_L, with failure probability $1 - 2p_L$, where $p \geq p_L$. When pursuing a poor investment, the manager receives a private benefit of $B > 0$.

We assume that financing poor investment projects is not financially viable. Specifically, if banks anticipate that firms will choose a poor investment project, they would have to charge interest rates that exceed the investment returns from great or moderate success. Thus, if banks expect managers to invest in a poor project, they will not extend financing.

For both good and poor investments, managers receive a share $w \in (0, 1)$ of the company's returns after repaying the bank, which we can interpret as the financial stake the manager has in the company. If no project is undertaken, the company generates zero profit, and the manager receives no return. We assume that only one project is selected per company.

Each company i (matched to manager i) has a specific success probability p_i for good investments, while poor investment success probabilities are constant across companies at p_L. Managers differ in their stakes in company profits, denoted $w_i \in (0, 1)$, drawn from a joint distribution $F(p, w)$. The common parameters X, R, I, and p_L, as well as the heterogeneous parameters (p_i, w_i), are publicly observable.[6]

Upon investing, each manager i may choose to take a risk, increasing the probabilities of both great success and failure by $\alpha > 0$. For a good investment, the probabilities shift to $p_i + \alpha$, $p_i - 2\alpha$, and $1 - 2p_i + \alpha$ for great success, moderate success, and failure, respectively. The same risk-taking mechanism applies to poor investments.[7] For simplicity, we assume that risk-taking incurs no costs. To ensure that each investment outcome (great

[6] We assume that (p_i, w_i) are observable to banks, and therefore do not address the issue of adverse selection in our framework. The problem of adverse selection has been widely explored in the literature (Rothschild and Stiglitz 1978, Stiglitz and Weiss 1981, Diamond 1984, Wang and Williamson 1993), particularly with respect to small business financing in developing countries (for a review, see Beck et al. 2008).

[7] This aligns with the empirical literature on risk-taking and investment volatility (Coles et al. 2006, Weber et al. 2013, Lian et al. 2019).

success, moderate success, and failure) retains a positive probability, we impose the following parameter restriction: $2\alpha < p_L < \frac{1}{2}$. Table 1 summarizes the return probabilities for good investments, with poor investment probabilities replacing p_i with p_L.

Table 1: Outcomes of Good Investment Project

Outcome	Great success	Moderate success	Failure
Return	XR	R	0
Probability (no risk)	p_i	p_i	$1-2p_i$
Probability (risk)	$p_i+\alpha$	$p_i-2\alpha$	$1-2p_i+\alpha$

Risk-taking opportunities can increase or decrease expected investment returns. Whether risk-taking increases returns depends on X, which measures the excess return from great success relative to moderate success. Since risk-taking raises the probabilities of both great success and failure, the excess return from great success must be large enough to improve the investment return:

$$\underbrace{(p_i+\alpha)XR+(p_i-2\alpha)R}_{\text{investment return with risk}} \quad \geq \quad \underbrace{p_iXR+p_iR}_{\text{return without risk}} \implies X \geq 2.$$

Thus, for $X \geq 2$, risk-taking increases returns, while for $X < 2$, it decreases them. Even when $X < 2$, managers may still take risks, as their returns differ from the overall investment returns. In our discussion below, we assume $X \geq 2$ as it aligns with the Japanese context. However, all qualitative statements remain valid even if $X < 2$.

A continuum of banks operates in a perfectly competitive lending market. For simplicity, we assume banks finance operations entirely through deposits, with a zero required return on deposits. This leads banks to set loan prices that result in zero profits, given the assumptions of perfect competition and a zero required return.[8]

At the beginning of period 1, banks offer loan contracts to company i. For each loan type, banks determine the repayment amount, which is equivalent to setting the interest rate, as the investment cost I is homogeneous across companies. While banks observe company i's project success probability p_i and manager i's stake w_i, they cannot control the manager's investment choice or risk-taking, creating a moral hazard between banks and managers.

[8] Relaxing the assumption of a zero required rate of return does not alter any qualitative outcomes.

3.2. Three Types of Loan Contracts

We define manager i's expected value from a loan and a *poor* project as v_i^{Type}, where $Type$ refers to the loan type: Basic (BA), Personal Guarantees (PG), or Bank Monitoring (BM). For a *good* project, the expected value is V_i^{Type}. When taking a risk, manager i's expected values for a good (poor) project are denoted $\hat{V}_i^{Type}$ ($\hat{v}_i^{Type}$).

3.2.1. Basic Loan Contract A basic loan contract specifies a repayment amount D_i^{BA}. If the project succeeds (great or moderate), the company repays D_i^{BA}. There is no repayment obligation if the project fails.

Manager i's expected returns from poor and good projects, without risk-taking, are:

$$v_i^{BA} = w_i \left\{ p_L(XR - D_i^{BA}) + p_L(R - D_i^{BA}) \right\} + B, \tag{1}$$

$$V_i^{BA} = w_i \left\{ p_i(XR - D_i^{BA}) + p_i(R - D_i^{BA}) \right\}. \tag{2}$$

Managers face a trade-off between good and poor projects: good projects have higher success probabilities, allowing managers to earn a fraction w of the profits, while poor projects offer a private benefit B.

With risk-taking, the expected values become:

$$\hat{v}_i^{BA} = w_i \left\{ (p_L + \alpha)(XR - D_i^{BA}) + (p_L - 2\alpha)(R - D_i^{BA}) \right\} + B, \tag{3}$$

$$\hat{V}_i^{BA} = w_i \left\{ (p_i + \alpha)(XR - D_i^{BA}) + (p_i - 2\alpha)(R - D_i^{BA}) \right\}. \tag{4}$$

3.2.2. Loan with Personal Guarantees A loan contract with personal guarantees specifies a repayment amount D_i^{PG}. If the project succeeds (great or moderate), the company repays D_i^{PG} from its investment returns. If the project fails, manager i must repay D_i^{PG} using their personal wealth, assuming sufficient personal assets to meet the obligation.

Manager i's expected values with a personal guaranteed loan without risk-taking are:

$$v_i^{PG} = w_i \left\{ p_L(XR - D_i^{PG}) + p_L(R - D_i^{PG}) \right\} - (1 - 2p_L)D_i^{PG} + B, \tag{5}$$

$$V_i^{PG} = w_i \left\{ p_i(XR - D_i^{PG}) + p_i(R - D_i^{PG}) \right\} - (1 - 2p_i)D_i^{PG}. \tag{6}$$

The first terms in Eqs. (5) and (6) represent manager i's expected returns from project successes. The second terms are expected repayments in case of failure, where the manager must repay the full loan from personal wealth, regardless of their stake in the company.

Manager i's expected values with risk-taking are:

$$\hat{v}_i^{PG} = w_i \left\{ (p_L + \alpha)(XR - D_i^{PG}) + (p_L - 2\alpha)(R - D_i^{PG}) \right\} - (1 - 2p_L + \alpha) D_i^{PG} + B, \quad (7)$$

$$\hat{V}_i^{PG} = w_i \left\{ (p_i + \alpha)(XR - D_i^{PG}) + (p_i - 2\alpha)(R - D_i^{PG}) \right\} - (1 - 2p_i + \alpha) D_i^{PG}. \quad (8)$$

Risk-taking affects the expected values through both project success and failure, as reflected in the final terms on the right-hand sides of Eqs. (7) and (8).

3.2.3. Loan with bank monitoring Banks incur costs to monitor borrowers. Specifically, they invest a cost $c > 0$ before extending a loan with monitoring to establish a monitoring framework. Once incurred, the personal benefit for the manager from selecting a poor project decreases to $b \in (0, B)$, reflecting managers' reduced incentives to deviate from optimal decisions due to the bank's monitoring. In order for bank monitoring to be effective in reducing moral hazard, we assume that $B - b \geq \frac{2cw_i(p_i - p_L)}{2p_i - \alpha}$, i.e., the reduction in personal benefit, $B - b$, is large enough.

Manager i's expected values from a loan with bank monitoring, without risk-taking, are:

$$v_i^{BM} = w_i \left\{ p_L(XR - D_i^{BM}) + p_L(R - D_i^{BM}) \right\} + b, \quad (9)$$

$$V_i^{BM} = w_i \left\{ p_i(XR - D_i^{BM}) + p_i(R - D_i^{BM}) \right\}. \quad (10)$$

Similarly, manager i's expected returns with risk-taking are:

$$\hat{v}_i^{BM} = w_i \left\{ (p_L + \alpha)(XR - D_i^{BM}) + (p_L - 2\alpha)(R - D_i^{BM}) \right\} + b, \quad (11)$$

$$\hat{V}_i^{BM} = w_i \left\{ (p_i + \alpha)(XR - D_i^{BM}) + (p_i - 2\alpha)(R - D_i^{BM}) \right\}. \quad (12)$$

3.3. Equilibrium loan contracts

Due to the moral hazard friction between banks and managers regarding investment choices and risk-taking, the equilibrium outcome is such that credit is only extended to managers who satisfy two incentive compatibility constraints. First, managers must satisfy the incentive compatibility constraint for selecting a good investment project. Given our assumption that poor investment projects are not financially viable, banks will not extend credit to managers who have an incentive to choose a poor project at the prevailing interest rate. As a result, banks set the interest rate with the expectation that managers will select a good investment project, and the manager's best strategy must be to choose a good project at that interest rate.

Second, managers must meet the incentive compatibility constraint for risk-taking. Unlike the investment choice, both good investment projects—those with and without risk-taking—are financially viable. Therefore, the incentive compatibility condition dictates that if the bank expects the manager to take (or avoid) risk at a given interest rate, it should be optimal for the manager to do so. In other words, the manager's decision regarding risk-taking must align with the bank's expectations at the offered interest rate.

The loan repayment amount for each loan type and firm is determined by the zero-profit condition for banks in equilibrium. This condition implies that the equilibrium repayment amount is set at a level where the expected repayment from firms (or managers, in the case of personally guaranteed loans) exactly equals the cost of financing for the bank.

3.4. Results

We analyze the model and derive its predictions in three steps. First, we examine a scenario where banks offer only basic loan contracts, highlighting the limited credit access for certain firms. Next, we introduce loans with personal guarantees and loans with bank monitoring, demonstrating how these two arrangements address the shortcomings of basic loans through two different mechanisms. Finally, we compare personal guarantees and bank monitoring, drawing testable empirical predictions regarding loan pricing, manager preference, and risk-taking incentives.

3.4.1. Limited credit availability under basic loans Assume that banks offer only basic loan contracts to firms, where the bank's decision is to determine the loan repayment required in the event of a successful project outcome. Managers choose the type of investment (either good or poor) and whether to take risks with the investment. For the loan contract to be in equilibrium, it must provide managers with the incentives to invest in a good project; otherwise, banks will withhold financing. Additionally, the incentives for risk-taking must be aligned between the banks and the managers.

The following lemma outlines the equilibrium loan contract, the availability of credit, and the managers' risk-taking decisions.

LEMMA 1. *Given company i's success probability and managerial stake (p_i, w_i), the basic loan contract specifies the repayment amount as*

$$D_i^{BA} = \frac{I}{2p_i - \alpha}. \tag{Repayment:BA}$$

Managers who satisfy the following IC constraint regarding investment type will receive financing:

$$w_i(p_i - p_L)\left((X+1)R - 2D_i^{BA}\right) \geq B. \tag{IC:BA}$$

All managers who receive basic loans are incentivized to take risks.

The proof of this lemma and other proofs are in the Appendix.

The intuition behind Lemma 1 is as follows. First, under basic loan contracts, the IC constraint regarding risk-taking is only satisfied in regions where managers are willing to take risks. Banks expect that all managers prefer risk-taking and, accordingly, offer interest rates. With the offered interest rates, it is indeed optimal for managers to take risks. These interest rates, which incorporate managers' incentives to take risks, are characterized in (Repayment:BA). The interest rate reflects the fact that managers will take risks, and the probability of repayment is lower in risk-taking scenarios, reduced by a factor of α. Moreover, the interest rate is higher for companies with lower success probabilities. Finally, the IC constraint that ensures investment in a good project is satisfied when (IC:BA) holds. Since banks cannot finance firms with managers who have incentives to invest in poor projects, those managers who do not satisfy (IC:BA) will not receive financing. The IC constraint is more likely to be satisfied by managers with high values of (p_i, w_i).

Why do managers with low (p_i, w_i) fail to satisfy the IC constraint? The IC constraint ensures that the manager's personal return is higher when choosing a good investment project. However, managers with lower p_i have a lower expected return when choosing the good investment project due to a higher probability of project failure, and as a result, they may prefer to take the private benefit B from choosing a poor project. Similarly, managers with low w_i cannot satisfy the IC constraint because they receive a smaller portion of the company's profits. Even if they choose the good investment project, their personal return is smaller. In other words, the private benefit of choosing the poor project is relatively larger for these managers.

As we have seen, basic loans provide limited credit availability to managers due to moral hazard related to investment choices. In the following subsections, we explore how personal guarantees and bank monitoring address this problem through two distinct mechanisms.

3.4.2. Enhancing credit availability with personal guarantees and bank monitoring

Basic loans and personal guarantees. Suppose that banks offer two types of loans to managers: basic loans and loans with personal guarantees. The key difference between these loan types is that, with loans backed by personal guarantees, managers are personally liable for repayment if the company's project fails to generate sufficient returns. How does this shift in repayment responsibility influence loan pricing, credit availability, and risk-taking incentives? If both loan types are available, which contract would managers prefer? The following proposition provides a summary of the answers to these questions.

PROPOSITION 1. *Given company i's success probability and managerial stake (p_i, w_i), the following relationships hold between basic loans and loans with personal guarantees.*

(i) The repayment amount is higher under basic loans, i.e., $D_i^{BA} > D_i^{PG}$ for any $p_i \in [2\alpha, \frac{1}{2})$, where D_i^{PG} is given by

$$D_i^{PG} = I \tag{Repayment:PG}$$

(ii) Credit availability is greater under loans with personal guarantees, i.e., (IC:PG) *is more relaxed than* (IC:BA) *where* (IC:PG) *is given by*

$$w_i(p_i - p_L)\{(X+1)R - 2D_i^{PG}\} + 2(p_i - p_L)D_i^{PG} \geq B, \tag{IC:PG}$$

(iii) Manager i is more likely to engage in risk-taking under basic loans. Specifically, manager i always takes risks under basic loans, whereas under loans with personal guarantees, manager i will only take risks if $X \geq 2 + \frac{I}{R}\frac{1-w_i}{w_i}$.

(iv) Manager i prefers basic loans, i.e., manager i's expected return is higher under basic loans. Specifically,

$$w_i\{p_iR(X+1) + (X-2)\alpha R - (2p_i - \alpha)D_i^{BA}\}, \tag{Return:BA}$$

$$\begin{cases} w_i\{p_i(X+1)R - 2p_iD_i^{PG}\} - (1-2p_i)D_i^{PG} & \text{for } X < 2 + \frac{I}{R}\frac{1-w_i}{w_i}, \\ w_i\{p_iR(X+1) + (X-2)\alpha R - (2p_i-\alpha)D_i^{PG}\} - (1-2p_i+\alpha)D_i^{PG} & \text{otherwise}, \end{cases} \tag{Return:PG}$$

and (Return:BA) $\geq$ (Return:PG) *for any $p_i \in [2\alpha, \frac{1}{2})$ and $w_i \in (0,1)$.*

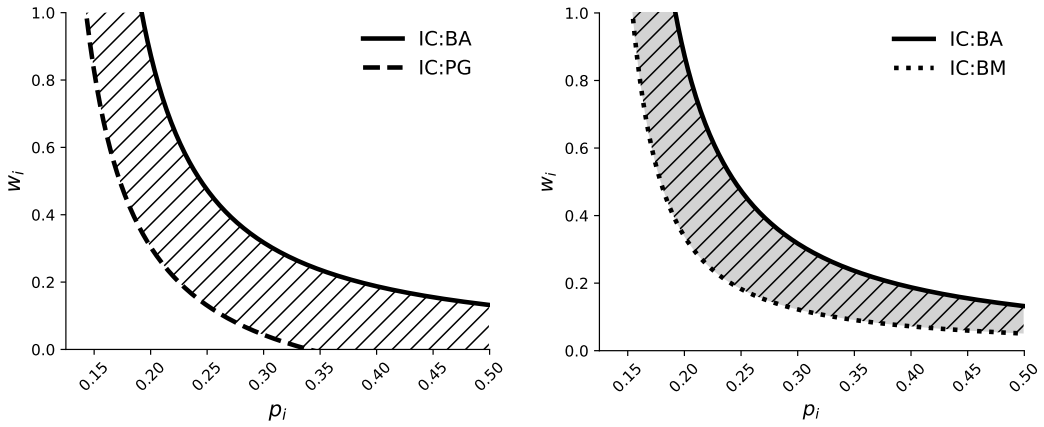
When loans carry personal guarantees, managers face the risk of personally repaying the loan if the project fails. From the banks' perspective, even if a project fails, they can recover their funds from the managers. As a result, banks face zero risk of loan default and do not charge positive interest rates in a perfectly competitive lending market.[9] Therefore, interest rates are always higher under basic loans.

[9] In reality, even loans with personal guarantees may carry positive interest rates due to the possibility that the guarantor cannot repay the loan (e.g., in cases of filing personal bankruptcy). For simplicity, our model assumes that each manager possesses sufficient personal wealth to cover the loan repayment.

IC constraints regarding investment types are more relaxed when loans include personal guarantees. Figure 3a illustrates the IC constraints for basic loans versus those with personal guarantees, with project success probability (p_i) on the x-axis and managerial stake (w_i) on the y-axis. The solid and dashed lines represent the IC constraints for basic loans and personal guarantees, respectively, as defined in (IC:BA) and (IC:PG). IC constraints are satisfied for managers in the area above these lines; thus, the shaded region indicates managers who only satisfy IC constraints when loans are backed by personal guarantees.

As discussed previously, for basic loans, IC constraints are met only in the high p_i and high w_i regions (top right region of Figure 3a). When loans include personal guarantees, IC constraints expand into the lower p_i and w_i regions for several reasons. First, the repayment amounts are lower when loans carry personal guarantees (see case (i) of Proposition 1), enhancing the manager's expected personal return from choosing good investment projects, which have a higher likelihood of success. Second, in the case of project failure, managers must use their personal wealth to repay loans with personal guarantees, further motivating them to invest in good projects with a higher probability of success. This requirement for personal repayment is independent of the managerial stake w_i, thereby diminishing the incentive for managers to invest in poor projects, even for managers with low managerial stakes. Consequently, IC constraints become satisfied even in very low w_i region.

Figure 3: Comparing IC Constraints



(a) BA and PG **(b)** BA and BM

Next, consider the risk-taking incentives for managers when borrowing each type of loan. Basic loans do not impose any repayment obligation in the event of project failure, so as

long as the risk-taking opportunities enhance the expected investment return—specifically, when $X \geq 2$—managers who borrow basic loans are incentivized to take risks. In contrast, when managers face personal repayment obligations in case of project failure, they tend to avoid risk even when $X \geq 2$, as outlined in case (iv) of Proposition 1. Since risk-taking increases personal financial risk by raising the probability of project failure, the excess return on great success (X) must be high enough to offset the potential downside risk. This threshold value of X is higher for managers with a lower managerial stake in the company (i.e., lower w_i) because they have a higher weight on personal wealth over firm profits and are therefore less likely to take risks.

Lastly, consider a manager who has a choice between basic loans and loans with personal guarantees. According to case (iii) of Proposition 1, managers always prefer basic loans over those with personal guarantees. There is a trade-off involved in using personal guarantees. On one hand, the repayment amount in the event of project success is lower for loans with personal guarantees, leading to higher personal returns for managers. On the other hand, the personal repayment obligation in case of project failure applies only to loans secured by personal guarantees. Overall, the latter effect consistently outweighs the former, resulting in higher expected personal returns for managers with basic loans.

In summary, personal guarantees reduce moral hazard and increase credit availability by imposing unlimited liability on managers. This aligns the incentives of banks and managers with respect to investment choices. However, the unlimited liability associated with personal guarantees can also deter managers from taking certain risks that could enhance firm performance.

Basic loans and loans with bank monitoring. Bank monitoring acts as an alternative method for mitigating moral hazard. While personal guarantees increase the manager's financial risk when selecting a poor investment, bank monitoring directly curtails the private benefits a manager can derive from such decisions. However, monitoring comes with costs, as managers must incur initial expenses before they receive monitoring. The following proposition compares basic loans with loans with bank monitoring as a counterpart of Proposition 1.

PROPOSITION 2. *Given company i's success probability and managerial stake (p_i, w_i), the following relationships hold between basic loans and loans with bank monitoring.*

(i) The repayment amount is higher for loans with bank monitoring, i.e., $D_i^{BM} > D_i^{BA}$ for any $p_i \in [2\alpha, \frac{1}{2})$, where D_i^{BM} is given by

$$D_i^{BM} = \tfrac{I+c}{2p_i-\alpha}. \qquad \text{(Repayment:BM)}$$

(ii) Credit availability is greater under loans with monitoring, i.e., (IC:BM) *is more relaxed than* (IC:BA)*, where* (IC:BM) *is given by*

$$w_i(p_i - p_L)\{(X+1)R - 2D_i^{BM}\} \geq b, \tag{IC:BM}$$

(iii) Manager i's risk-taking incentives are identical between the two loans. Specifically, manager i always takes risks under basic loans and loans with monitoring.

(iv) Manager i prefers basic loans, i.e., manager i's expected return is higher under basic loans. Specifically,

$$w_i\{p_iR(X+1) + (X-2)\alpha R - (2p_i - \alpha)D_i^{BM}\}, \tag{Return:BM}$$

and (Return:BA) $\geq$ (Return:BM) *for any* $p_i \in [2\alpha, \frac{1}{2})$ *and* $w_i \in (0,1)$.

Loans with bank monitoring do not require personal guarantees, meaning that banks expect repayment only when projects achieve great or moderate success, similar to basic loans. As a result, the zero-profit conditions for both basic loans and loans with bank monitoring are the same. Consequently, the repayment amounts for the two types of loan contracts are identical, as formalized in case (i) of Proposition 2.

Bank monitoring reduces moral hazard, as discussed in case (ii) of Proposition 2. Compared to basic loans, the IC constraint is more relaxed for loans with monitoring because bank monitoring reduces the private benefits of selecting poor investments, thereby reducing managers' incentives to prefer poor projects over good ones. Figure 3b illustrates the IC constraints for basic loans and those with bank monitoring. The gray dashed area highlights managers whose IC constraints are satisfied only under loans with bank monitoring.

Due to the different mechanisms for reducing moral hazard between personal guarantees and monitoring, Figure 3a and Figure 3b appear slightly different. Personal guarantees expand the IC constraint into very low w_i regions (bottom right of Figure 3a). In contrast, bank monitoring does not extend the IC constraint into these very low w_i areas (bottom right of Figure 3b). Although bank monitoring reduces the personal benefit of choosing a poor investment from B to b, managers with very low stakes in the company may still find poor investment projects attractive, as their expected personal returns from company profits remain minimal even when selecting good projects.

Next, regarding managers' risk-taking incentives, both basic loans and loans with monitoring have same impacts (see case (iv) of Proposition 2). Neither type of loan imposes

a repayment obligation in the event of project failure. Therefore, as long as the risk-taking opportunities increase the expected investment return—specifically when $X \geq 2$—managers with either basic or monitored loans are incentivized to take risks.

Finally, consider manager's preference between basic loans and loans with monitoring. From case (i) of Proposition 2, repayment amounts are the same between the two loans. Both loans do not carry personal guarantees. Only difference in manager's expected return between the two loans is the presence of cost of receiving bank monitoring. Since the cost $c(p_i, w_i)$ is non-negative, if managers have a choice between the two loans, they always prefer basic loans over loans with bank monitoring, as stated in case (iii) of Proposition 2.

3.4.3. Model Predictions: Comparing Personal Guarantees and Bank Monitoring In the previous subsections, we showed that both personal guarantees and bank monitoring enhance credit availability for managers who otherwise cannot secure loans. The two loan arrangements reduce moral hazard through different mechanisms, affecting repayment amounts, loan preferences, and risk-taking incentives, as summarized in Table 2. We now derive testable predictions on loan pricing, risk-taking, and loan preferences, focusing on the comparison between loans with personal guarantees and those with bank monitoring, noting that both types of loans coexisted following the 2014 policy reform in Japan.

Table 2: Model Result Summary

Statement number	**Repayment amount**	**Credit availability**	**Risk-taking**	**Loan preference**
Proposition 1	BA $\geq$ PG	BA $\leq$ PG	BA $\geq$ PG	BA $\geq$ PG
Proposition 2	BA $\leq$ BM	BA $\leq$ BM	BA $=$ BM	BA $\geq$ BM

First, consider the repayment amounts for loans with personal guarantees versus those with bank monitoring. Personal guarantees reduce the risk of loan default, while bank-monitored loans carry the same default risk as basic loans. However, due to the extra monitoring costs, bank-monitored loans typically have higher repayment amounts. The simple observation from the first column of Table 2 generates the following prediction.

Prediction 1 *Interest rates for loans with bank monitoring exceed those for loans with personal guarantees, with the interest surcharge on loans with bank monitoring larger for firms with lower project success probabilities.*

The interest surcharge, defined as the difference between loans with monitoring and personal guarantees, is derived from comparing D_i^{PG} and D_i^{BM}, as shown in (Repayment:PG) and (Repayment:BM).

Next, we compare managers' risk-taking incentives under personal guarantees and bank monitoring. As indicated in Table 2, personal guarantees discourage risk-taking since managers bear personal financial consequences if the project fails. In contrast, bank monitoring does not reduce managers' incentives to take risks.

Prediction 2 *Managers borrowing with bank monitoring are more likely to take risks than those borrowing with personal guarantees.*

Finally, suppose that both loan types are available to managers. Making predictions regrading manager's loan preference between loans with personal guarantees and loans with bank monitoring is not straightforward as the last column of Table 2 shows that managers prefer basic loans over loans with personal guarantees or loans with bank monitoring. The following summarizes which manager is likely to prefer loans with bank monitoring.

COROLLARY 1. *Manager i prefers loans with bank monitoring over those with personal guarantees if the following condition holds:*

$$\begin{cases} w_i(2p_i-\alpha)(D_i^{BM}-D_i^{PG}) \leq (1-2p_i+\alpha)D_i^{PG} & \text{for } X \geq \frac{I}{R}\frac{1-w_i}{w_i}, \\ 2p_i w_i(D_i^{BM}-D_i^{PG}) - w_i\alpha((X-2)R+D_i^{BM}) \leq (1-2p_i)D_i^{PG} & \text{otherwise.} \end{cases} \tag{13}$$

This condition is more likely to be satisfied for managers with higher p_i and lower w_i.

The left-hand side of Eq. (13) represents the additional repayment in the event of project success under bank monitoring, which reduces the manager's expected personal return in proportion to their managerial stake. The right-hand side captures the personal repayment obligation in the event of project failure under personal guarantees. Managers will prefer bank-monitored loans if the extra interest payment is smaller than the repayment under personal guarantees, with the preference depending on the project's success probability and the manager's stake in the company.

Prediction 3 *Suppose that both loans with bank monitoring and loans with personal guarantees are available. Managers with lower project success probabilities and smaller managerial stakes are more likely to prefer loans with bank monitoring.*

Managers of firms with lower project success probabilities face smaller repayments in bank-monitored loans, while managers with smaller stakes in the company are less affected by the additional costs of bank monitoring. In contrast, the repayment under personal guarantees is independent of the manager's stake. Hence, such managers are more likely to prefer loans with bank monitoring.

4. Empirical Analysis

4.1. Data

We utilize an anonymized version of proprietary data from the JFC SME Unit to assess the model's empirical predictions.[10] The dataset includes both loan-level and firm-level information. The loan-level data includes a firm identifier, loan amount, contract date, maturity, interest rate, borrowing purpose (loan program), and additional attributes, such as whether the loan is secured by a personal guarantee.

The firm-level data consists of five categories: accounting, credit rating, collateral, enterprise, and managerial information. The accounting data features the firm's financial statements, which we use to derive performance measures such as profits and sales.

Credit rating information is also collected annually, with the JFC evaluating each borrower's credit rating at the end of the fiscal year on a scale from 1 to 12, where lower numbers indicate better creditworthiness.

Collateral data details the values of assets that can be pledged for loans, broken down into real estate, land, and other assets. This includes which portions of these assets are already pledged and which are available for future collateral. We account for the value of collateral available for future use in our estimations, as the presence of collateral can significantly influence the choice of personal guarantees, which our model does not capture.

The enterprise data provides key business information, including industry classification, establishment date, and employee count. We identify a firm's primary business at the four-digit level of the Japan Standard Industry Classification (JSIC) to control for industry fixed effects in our estimations. The establishment year is used to calculate firm age, and we control for firm size based on the number of employees.

Finally, the managerial data includes details about the firm's management, such as the manager's age and ownership stake in the company. For consistency with the model section,

[10] The definition of SMEs varies by industry. For instance, in the manufacturing sector, SMEs are defined as companies with fewer than 300 employees or equity below 300 million yen (approximately 2.5 million USD). For further details on the definition of SMEs at the JFC, please visit `https://www.jfc.go.jp/n/finance/search/pdf/chusho_chouki.pdf`.

we refer to company CEOs as "managers." Therefore, in the empirical analysis, managerial ownership denotes CEO ownership, and manager age refers to CEO age.

We combine the loan- and firm-level data through unique firm identifiers. We restrict our sample to firms borrowed from the JFC SME Unit between February 2014 and March 2016. Our sample includes 24,183 Japanese firms borrowed from the JFC SME Unit between February 2014 and March 2016, which can be connected to necessary firm-level information. Table 3 summarizes the basic statistics of key variables. In March 2016, the average total JFC outstanding loans were 216 million JPY (≈ 1.7 million USD), among which 32.5% of loans were issued with bank monitoring (without personal guarantees).

Our sample firms are small and medium-sized. The median and average number of employees are 33 and 60, respectively. Firms vary in their profitability—the median profit-sales ratio calculated using net income is 2%, while the profit-sales ratio for the top 10% of firms is 10%. The distribution of credit rating is right-skewed, with the median and mean credit rating scores of 3.4 and 3.0, respectively. Firms also vary in their size of pledgeable collateral, and the median value of pledgeable collateral assets as of March 2016 is 137 million JPY. Finally, many of our sample firms are owner-managed—the median managerial ownership is 33%. Table OA.2 in the Supplementary Information Section gives a correlation matrix of these variables.

Table 4 presents the distribution of firm characteristics based on the share of loans with bank monitoring as of March 2016. Firms are categorized into four groups by loan share: (1) share $= 0$, (2) share $\in (0, 0.5)$, (3) share $\in [0.5, 1)$, and (4) share $= 1$. Half of the firms are in the first group, with no loans under bank monitoring, while the rest are distributed across the other three categories. Credit ratings improve (lower scores) and managerial ownership decreases as the share of loans with bank monitoring increases. However, no clear trends are observed for performance or size variables, such as profit-sales ratio, employee count, and collateral value. Additionally, no significant correlations are found between firm or manager age and the share of loans with bank monitoring.

Our sample firms are drawn from a wide range of industries and locations in Japan. The top three industries in terms of the number of firms in our sample are manufacturing, construction, and transport and postal service. Our sample firms are concentrated in big cities such as Tokyo and Osaka. Average firm characteristics, including share of loans with bank monitoring, credit rating, and managerial ownership, vary across industries and

Table 3: Summary Statistics

Variable	Obs.	Mean	SD	10%	50%	90%
Level of oustanding loans (million JPY)	24183	216.0	292.8	164.6	106.7	551.8
Share of outstanding loans with monitoring (without personal guarantees)	24183	0.325	0.395	0.000	0.000	1.000
Rating (scale of 1 to 12)	24183	3.4	2.0	1.0	3.0	6.0
Ownership	24183	0.384	0.321	0.000	0.330	0.900
Number of employees	24183	60.4	107.6	4.0	33.0	137.0
Profit-sales ratio	23901	0.027	0.089	-0.022	0.020	0.099
Pledgeable collateral (million JPY)	24171	137.2	211.4	0.0	54.8	390.9
Manager age	24183	58.1	11.3	43.0	58.0	73.0
Firm age	22079	41.8	19.5	14.0	44.0	66.0

Notes: This table provides summary statistics for the main firm-level variables used in the econometric analysis. The unit of observation is the firm. *Level of outstanding loans* is the total outstanding JFC loans for firms in our sample. *Share of outstanding loans with bank monitoring (without personal guarantees)* is each firm's share of outstanding JFC loans with bank monitoring. *Rating* is JFC's internal credit rating score for the company on a scale of 1 to 12, where a lower number indicates a better rating. *Ownership* is the company share owned by the manager. *Profit-sales ratio* is calculated as the net income over total sales. *Number of employees* is the total number of employees. *Pledgeable collateral* is the value of collateral that are not yet pledged and can be used for future loans. *Manager age* is the manager's age in years. *Firm age* is the number of years since the firm was established. All the variables are measured as of March 2016.

Table 4: Distribution of Firm Characteristics by Share of Loans with Bank Monitoring

Share of loans with bank monitoring (without personal guarantees)	0	0 - 0.5	0.5 - 1	1
Number of firms	12163	4152	4120	3748
Portion of outstanding loans issued	0.436	0.306	0.191	0.068
Average firm characteristics				
Rating	3.9	3.1	2.7	2.8
Ownership	0.414	0.361	0.354	0.347
Profit-sales ratio	0.021	0.035	0.034	0.033
Employment	48.3	80.5	75.1	61.2
Pledgeable collateral (million JPY)	117.1	238.4	155.8	70.2
Manager age	57.9	58.7	58.4	57.9
Firm age	40.1	45.9	44.4	39.7

Notes: This table provides distribution of firm characteristics across firms with different share of JFC loans with bank monitoring (without personal guarantees) as of March 2016. Other variables follow the definitions in Table 3. All the variables are measured as of March 2016.

locations. The detailed distribution of firm characteristics across industries and prefectures is available in Tables OA.3 and OA.4 in the Supplementary Information Section. We control industry- and prefecture-specific patterns by including fixed effects in our estimation.

4.2. Results

We present the results that test each of the four empirical predictions from the model. Each test requires distinct empirical specifications, which we outline in the corresponding subsections.

4.2.1. Loan pricing We estimate the following loan-level regression to examine the relationship between the use of personal guarantees and loan interest rates:

$$\begin{aligned} Interest_{l,f,i,r} =& \alpha_1 BM_{l,f,i,r} + \alpha_2 (BM_{l,f,i,r} \times Rating_{f,i,r}) + \alpha_3 Rating_{f,i,r} \\ &+ \alpha_4 Control_{f,i,r} + \phi_i + \varphi_r + \epsilon_{l,f,i,r}, \end{aligned} \tag{14}$$

where the subscripts l, f, i, and r denote loan, firm, JSIC 4-digit industry, and prefecture, respectively. The dependent variable, $Interest_{l,f,i,r}$, represents the interest rate on the loan. The primary independent variable, $BM_{l,f,i,r}$, is a dummy variable that equals one if the loan is bank monitoring-based and zero if the loan carries personal guarantee. The variable $Rating_{f,i,r}$ indicates the credit rating score of firm f as of March 2016. We also include control variables (firm and manager ages, collateral asset value, and the number of employment) and industry and prefecture fixed effects, ϕ_i and φ_r, respectively.

If Prediction 1 is true, loans without a personal guarantee will have higher interest rates, and the interest surcharge (i.e., the difference in interest rates between loans with personal guarantees and loans with bank monitoring) will be greater for firms with lower credit ratings (i.e., higher credit rating scores). Therefore, we expect the coefficients α_1 and α_2 to be positive.

Table 5 presents the results of estimating regression (14). Results in columns 1 and 2 indicate that loans with bank monitoring are associated with higher interest rates, even after controlling for credit rating, consistent with Prediction 1. We control for credit rating by including dummies, using $Rating = 1$ as the base category. In column 2, the coefficient on BM is estimated at 330 and is statistically significant, suggesting that loans with bank monitoring carry interest rates that are 330 basis points higher than those with personal guarantees, controlling for credit ratings and other variables.

Column 3 of Table 5 reports the results of regression (14) with an interaction term between BM and $Rating$. Compared to the base interaction term $(BM = 1) \times (Rating = 1)$, the coefficients on the other interaction terms are positive and increase with credit

rating scores. This indicates that the relationship between loans with bank monitoring and interest rates is stronger for firms with higher credit ratings (i.e., poorer ratings), further supporting Prediction 1.

The signs of the coefficients on control variables align with expectations. Interest rates are lower for firms with higher values of pledgeable collateral assets. The negative coefficients for firm age and number of employees suggest that interest rates also decrease for older and larger firms. Finally, equipment loans, as opposed to working capital loans, are associated with lower interest rates.

4.2.2. Risk-taking We estimate the following regression to examine whether loans with personal guarantees or bank monitoring affect risk-taking:

$$\begin{aligned} Performance_{f,i,r} =& \alpha_1 ShareBM_{f,i,r} + \alpha_2 Rating_{f,i,r} + \alpha_3 Ownership_{f,i,r} \\ &+ \alpha_4 Control_{f,i,r} + \phi_i + \varphi_r + \epsilon_{f,i,r}, \end{aligned} \tag{15}$$

Here, $Performance_{f,i,r}$ represents various firm performance measures after March 2016. Since we cannot directly observe risk-taking, we use firm performance as a proxy. The first measure is $Default_{f,i,r}$, a dummy variable equal to one if a firm defaults on loans between March 2016 and March 2020. We expect a higher likelihood of default for firms with bank-monitored loans, suggesting increased risk-taking. The second measure, $\Delta Profit\text{-}sales\ Ratio_{f,i,r}$, captures the change in the profit-to-sales ratio from March 2016, with different time lags. If loans with bank monitoring promote performance-enhancing risk-taking, we expect an improvement in the profit-to-sales ratio for these firms. We also examine investment in intangible assets to assess different types of riskier investments.

Table 6 shows the results from estimating regression (15). Column 1 uses default likelihood as the dependent variable, while columns 2 to 5 examine the change in the profit-to-sales ratio with time lags of 1 to 4 years. The coefficient on $ShaerBM$ is 0.030 and statistically significant, suggesting that firms with all loans under bank monitoring have a 3 percentage point higher likelihood of loan default than firms with loans issued with personal guarantees. This supports Prediction 2, increased risk-taking for firms with bank-monitored loans.

Columns 2 to 5 further show that, conditional on firm survival, firms with a higher share of bank-monitored loans experience a greater improvement in the profit-to-sales ratio,

Table 5: Loan pricing and personal guarantees

	Dependent Variable: Interest rate		
Independent Variable	(1)	(2)	(3)
BM	19.13	330.1	50.34
	(7.865)	(7.715)	(17.61)
× Rating = 1			
× Rating = 2			-14.02
			(22.11)
× Rating = 3			142.4
			(23.25)
× Rating = 4			610.7
			(32.02)
× Rating ≥ 5			1017.0
			(24.19)
Rating = 1			
Rating = 2		77.65	62.54
		(11.10)	(18.15)
Rating = 3		328.3	180.2
		(12.09)	(17.28)
Rating = 4		596.2	344.5
		(14.92)	(19.21)
Rating ≥ 5		1131.9	818.7
		(12.04)	(16.64)
Collateral	-417.9	-379.2	-346.5
	(7.763)	(6.971)	(6.830)
Equipment	-366.7	-217.6	-228.7
	(9.156)	(8.335)	(8.128)
ln(Firm Age)	-17.40	-9.693	-8.761
	(3.298)	(2.954)	(2.879)
log(Employment)	-32.98	-12.57	-6.291
	(3.476)	(3.117)	(3.041)
Observations	56795	56795	56795
R^2	0.155	0.323	0.357

Standard errors in parentheses

Notes: This table presents the result of analyzing how loan interest rates are related to the use of personal guarantees. The sample of loans include loans issued between February 2014 and March 2016. The dependent variable is the loan interest rate in the unit of basis point. Independent variable BM is a dummy variable that equals one if the loan is with bank monitoring and zero otherwise. All other variables are defined in Table OA.5. The unit of analysis is at the loan level. Industry and prefecture fixed effects are included in all specifications.

regardless of the time lag. This suggests that risk-taking associated with bank-monitored loans contributed to improved firm performance.

We also analyzed whether loans with bank monitoring led to more investment in intangible assets, which are considered risky because they cannot be used as collateral (Coles et al. 2006, King and Wen 2011). The results, presented in Table OA.6 and Table OA.7, show no clear relationship between the change in the intangible asset ratio and the share of loans with bank monitoring, regardless of controls for credit rating or managerial ownership. This suggests that while loans with bank monitoring may have induced risk-taking in terms of project choice, they did not lead to increased investment in intangible assets.

4.2.3. Loan Preference We estimate the following firm-level regression to examine the choice of loan arrangements after the implementation of the guidelines:

$$ShareBM_{f,i,r} = \alpha_1 Rating_{f,i,r} + \alpha_2 Ownership_{f,i,r} + \alpha_3 Control_{f,i,r} + \phi_i + \varphi_r + \epsilon_{f,i,r}. \quad (16)$$

The definitions of the variables follow the previous ones. Between February 2014 and March 2016, the JFC offered all loan applicants the same options—loans with personal guarantees or loans with bank monitoring—allowing us to investigate how firm preferences depend on credit ratings and managerial ownership.

If Prediction 3 holds, firms with poorer credit ratings and lower managerial ownership should prefer loans with bank monitoring. Thus, we expect $\alpha_1 > 0$ and $\alpha_2 < 0$.

Table 7 presents the results of estimating regression (16) to analyze characteristics of firms that chose loans with bank monitoring. The results in columns 1-3 suggest that firms with lower credit ratings (i.e., better credit ratings) are more likely to choose loans with bank monitoring. This finding contradicts model predictions, which suggest that firms with better credit ratings should prefer loans with personal guarantees when both options are available. We discuss potential reasons for this discrepancy in Section 5.

Columns 1-3 also show that firms with lower managerial ownership are more likely to choose loans with bank monitoring, which aligns with model predictions. The financial burden of personal guarantees is greater for managers with lower company stakes, as they receive a smaller portion of profits from successful investments, while the burden remains the same if the investment fails.

The coefficient on the number of employees is positive, while the coefficient on the value of available collateral is negative, suggesting that larger firms with lower collateral value are more likely to choose loans with bank monitoring. Additionally, younger firms are more likely to choose loans with bank monitoring.

Table 6: Firm Risk-taking and Loan Types

	Dependent Variable				
	Default	**Δ_t Profit-sales Ratio**			
Independent Variable	(1)	(2) $t=1$	(3) $t=2$	(4) $t=3$	(5) $t=4$
ShareBM	0.0300	0.00253	0.00274	0.00254	0.00213
	(0.00551)	(0.00146)	(0.00153)	(0.00160)	(0.00184)
Rating $=1$					
Rating $=2$	0.0181	-0.00913	-0.00845	-0.00750	-0.00751
	(0.00631)	(0.00167)	(0.00175)	(0.00183)	(0.00210)
Rating $=3$	0.0389	-0.0105	-0.0104	-0.0121	-0.0152
	(0.00683)	(0.00182)	(0.00189)	(0.00199)	(0.00228)
Rating $=4$	0.0799	-0.0131	-0.0136	-0.0121	-0.0121
	(0.00852)	(0.00227)	(0.00236)	(0.00248)	(0.00285)
Rating ≥ 5	0.260	-0.0163	-0.0168	-0.0193	-0.0185
	(0.00661)	(0.00179)	(0.00187)	(0.00196)	(0.00225)
Ownership	0.0196	0.00177	-0.000358	0.00157	-0.00294
	(0.00654)	(0.00174)	(0.00182)	(0.00191)	(0.00219)
ln(Firm Age)	-0.0302	0.000584	-0.000807	-0.00265	-0.00288
	(0.00385)	(0.00105)	(0.00109)	(0.00115)	(0.00132)
ln(Collateral)	-0.00444	0.00220	0.00226	0.00222	0.00240
	(0.000939)	(0.000249)	(0.000259)	(0.000272)	(0.000312)
ln(Employment)	-0.000592	-0.000719	-0.00169	-0.00150	0.000236
	(0.00210)	(0.000560)	(0.000585)	(0.000615)	(0.000705)
Profit-sales Ratio		-0.625	-0.650	-0.689	-0.699
		(0.00677)	(0.00709)	(0.00751)	(0.00866)
Observations	21626	21382	21339	21332	21271
R^2	0.188	0.348	0.350	0.347	0.330

Notes: This table presents combined results from analyzing how the choice of loans affects firms' risk-taking behaviors and performance. The dependent variable for the first two columns is the default likelihood, while the last four columns use Δ_2 and Δ_4 Profit-sales Ratios, representing the change in profit-sales ratio between March 2018 and March 2020. All independent variables are defined in Table OA.5. The unit of analysis is at the firm level.

Table 7: Choice of Loans with Bank Monitoring

	Dependent variable: ShareBM		
Independent variable	**(1)**	**(2)**	**(3)**
Rating = 1			
Rating = 2	-0.0761		-0.0761
	(0.00790)		(0.00789)
Rating = 3	-0.266		-0.264
	(0.00836)		(0.00836)
Rating = 4	-0.349		-0.347
	(0.0104)		(0.0104)
Rating ≥ 5	-0.331		-0.327
	(0.00794)		(0.00795)
Ownership		-0.0923	-0.0603
		(0.00859)	(0.00815)
ln(Firm Age)	-0.0101	-0.00426	-0.0132
	(0.00477)	(0.00506)	(0.00478)
ln(Pledgeable Collateral)	-0.0317	-0.0251	-0.0320
	(0.00115)	(0.00121)	(0.00115)
ln(Employment)	0.0354	0.0361	0.0332
	(0.00260)	(0.00276)	(0.00261)
Observations	21963	21963	21963
R^2	0.197	0.103	0.199

Standard errors in parentheses

Notes: This table presents the result of the analysis of the choice of loan arrangements. The dependent variable is a share of JFC loans with bank monitoring as of March 2016. The sample of firms are the firms that borrowed at least once from the JFC between February 2014 and March 2016. All independent variables are defined in Table OA.5. The unit of analysis is at the firm level. Industry and prefecture fixed effects are included in all specifications.

5. Discussion

In the previous section, we highlighted a discrepancy between Prediction 3 and our empirical findings. Specifically, the model predicts that firms with lower success probabilities prefer loans with bank monitoring over loans with personal guarantees, while our data shows that firms with higher success probabilities (i.e., better credit ratings) are actually more likely to prefer loans with bank monitoring. In this section, we explore several extensions to the model that may better align it with these empirical observations.

First, in our baseline model, we assume that the monitoring cost c incurred by banks is constant across all firms. However, it is plausible that monitoring costs vary depending on a firm's characteristics, particularly its success probability. If monitoring costs are higher for firms with lower success probabilities, we would expect those firms to face even higher interest rates under bank monitoring. In this case, firms with lower success probabilities might prefer loans with personal guarantees, as these loans typically carry lower interest rates, which better aligns with our empirical findings.

Second, our model assumes that project success probabilities vary only at the firm level. However, in reality, each firm may have different success probabilities for individual projects. If these project-level success probabilities are private information to the firm, while banks only observe the average success probability at the firm level, firms with poor credit ratings could still have individual projects with above-average success probabilities. In such cases, these firms may find the interest rates under bank monitoring too high for certain projects and, instead, opt for loans with personal guarantees. This adjustment to the model could help explain discrepancies between our model and empirical data.

Finally, our model assumes that managers have sufficient personal wealth to repay banks with certainty under personal guarantees in the event of project failure. In practice, however, banks may not be able to recover the full loan amount if managers lack the necessary personal wealth or file for personal bankruptcy. For instance, managers of firms with a lower probability of project success may have less personal wealth and may be more likely to file for bankruptcy following a loan default. This could reduce the financial burden associated with personal guarantees, making them a more appealing option, which aligns with our empirical observations. However, it is also plausible that banks would increase interest rates on loans with personal guarantees for firms with lower success probabilities, anticipating a lower recovery rate. This, in turn, could diminish managers' incentives to prefer loans with personal guarantees.

6. Conclusion

Personal guarantees and bank monitoring are two common mechanisms used to reduce moral hazard in SME lending, but they operate in fundamentally different ways. We develop a theoretical model to analyze the trade-offs between these loan types and validate our predictions using detailed Japanese loan data. Both mechanisms address moral hazard, but they affect managers' incentives and the overall risk profile of loans in distinct ways.

Loans with personal guarantees reduce moral hazard by holding managers personally responsible for repayment in the event of project failure, which lowers the likelihood of loan default and enables banks to charge lower interest rates. However, they can discourage managers from pursuing higher-risk, higher-return investments. In contrast, bank monitoring mitigates moral hazard by limiting the private benefits managers gain from suboptimal investments. The bank monitoring loans exhibit a higher likelihood of loan default and, consequently, higher interest rates. Unlike personal guarantees, bank monitoring preserves managers' incentives to take on higher-risk investments with the potential for greater returns, which could lead to improved firm performance.

This paper provides both managerial and policy implications. For managers, the decision regarding loan contract terms, including whether to offer personal guarantees, is not solely a financial consideration. While using personal guarantees can secure lower interest rates, it may also limit future investment opportunities by influencing managers' incentives. From a policy perspective, fostering economic growth while ensuring financial stability requires a careful balance between enhancing loan availability and managing the risk-taking incentives of managers.

References

Aguir I, Burns N, Mansi SA, Wald JK (2014) Liability protection, director compensation, and incentives. *Journal of Financial Intermediation* 23(4):570–589.

Appel I (2019) Governance by litigation. *Available at SSRN 2532278* .

Bahaj S, Foulis A, Pinter G (2020) Home values and firm behavior. *American Economic Review* 110(7):2225–2270.

Beck T, Demirgüç-Kunt A, Maksimovic V (2008) Financing patterns around the world: Are small firms different? *Journal of financial economics* 89(3):467–487.

Berger AN, Udell GF (1990) Collateral, loan quality and bank risk. *Journal of Monetary Economics* 25(1):21–42.

Berger AN, Udell GF (1995) Relationship lending and lines of credit in small firm finance. *Journal of Business* 351–381.

Boot AW (2000) Relationship banking: What do we know? *Journal of Financial Intermediation* .

Boot AW, Thakor AV (1994) Moral hazard and secured lending in an infinitely repeated credit market game. *International economic review* 899–920.

Cantillo M, Wright J (2000) How do firms choose their lenders? an empirical investigation. *The Review of Financial Studies* 13(1):155–189.

Colacelli M, Hong MGH (2019) *Productivity drag from small and medium-sized enterprises in Japan* (International Monetary Fund).

Coles JL, Daniel ND, Naveen L (2006) Managerial incentives and risk-taking. *Journal of Financial Economics* 79(2):431–468.

Diamond DW (1984) Financial intermediation and delegated monitoring. *The review of economic studies* 51(3):393–414.

Guan Y, Zhang L, Zheng L, Zou H (2021) Managerial liability and corporate innovation: Evidence from a legal shock. *Journal of Corporate Finance* 69:102022.

Hoshi T, Kashyap AK, Scharfstein DS (1993) The choice between public and private debt: An analysis of post-deregulation corporate financing in japan.

King THD, Wen MM (2011) Shareholder governance, bondholder governance, and managerial risk-taking. *Journal of Banking & Finance* 35(3):512–531.

Lian C, Ma Y, Wang C (2019) Low interest rates and risk-taking: Evidence from individual investment decisions. *Review of Financial Studies* 32(6):2107–2148.

Lin C, Liu S, Manso G (2021) Shareholder litigation and corporate innovation. *Management Science* 67(6):3346–3367.

Lin C, Officer MS, Schmid T, Zou H (2019) Is skin in the game a game changer? evidence from mandatory changes of d&o insurance policies. *Journal of Accounting and Economics* 68(1):101225.

Lin C, Officer MS, Wang R, Zou H (2013) Directors' and officers' liability insurance and loan spreads. *Journal of Financial Economics* 110(1):37–60.

Lin C, Officer MS, Zou H (2011) Directors' and officers' liability insurance and acquisition outcomes. *Journal of Financial Economics* 102(3):507–525.

Lin L (2016) Collateral and the choice between bank debt and public debt. *Management Science* 62(1):111–127.

Mayordomo S, Moreno A, Ongena S, Rodriguez-Moreno M (2021) Bank capital requirements, loan guarantees and firm performance. *Journal of Financial Intermediation* 45:100825.

OECD (2024) SMEs and entrepreneurship. URL `https://www.oecd.org/en/topics/policy-issues/smes-and-entrepreneurship.html`, Accessed on Novembeer 20th, 2024.

Ono A, Uesugi I (2009) Role of collateral and personal guarantees in relationship lending: Evidence from japan's sme loan market. *Journal of Money, Credit and Banking* 41(5):935–960.

Park C (2000) Monitoring and structure of debt contracts. *The Journal of finance* 55(5):2157–2195.

Robb AM, Robinson DT (2014) The capital structure decisions of new firms. *Review of Financial Studies* 27(1):153–179.

Rodano G, Serrano-Velarde NAB, Tarantino E (2011) The causal effect of bankruptcy law on the cost of finance. *Available at SSRN 1967485* .

Rothschild M, Stiglitz J (1978) Equilibrium in competitive insurance markets: An essay on the economics of imperfect information. *Uncertainty in economics*, 257–280 (Elsevier).

Schmalz MC, Sraer DA, Thesmar D (2017) Housing collateral and entrepreneurship. *Journal of Finance* 72(1):99–132.

Stiglitz JE, Weiss A (1981) Credit rationing in markets with imperfect information. *American Economic Review* 71(3):393–410.

Wang C, Williamson SD (1993) Adverse selection in credit markets with costly screening. *Department of Economics, University of Iowa* .

Weber M, Weber EU, Nosić A (2013) Who takes risks when and why: Determinants of changes in investor risk taking. *Review of Finance* 17(3):847–883.

Zou H, Wong S, Shum C, Xiong J, Yan J (2008) Controlling-minority shareholder incentive conflicts and directors' and officers' liability insurance: Evidence from china. *Journal of Banking & Finance* 32(12):2636–2645.

Appendix A: Proofs

Proof of Lemma 1. First, we show that managers have incentives to take risks regardless of the repayment amount D_i^{BA} under basic loans. Manager i's expected return under basic loans when investing in a good project with risk-taking is higher than that of investing without risk-taking if

$$\hat{V}_i^{BA} \geq V_i^{BA} \quad \Longleftrightarrow \quad w_i\alpha\left\{(X-2)R + D_i^{BA}\right\} \geq 0,$$

where the expressions for $\hat{V}_i^{BA}$ and V_i^{BA} are given by Eqs. (2) and (4). This inequality always holds because $X \geq 2$ by assumption and $D_i^{BA} \geq 0$ by the definition of the repayment amount. The same inequality holds under poor investment projects. Therefore, managers always prefer taking risks under basic loans.

Second, having observed that managers prefer taking risks regardless of the repayment amount, it follows that the IC constraint regarding risk-taking is satisfied when banks expect managers to take risks and offer interest rates accordingly. Combined with the assumption that banks only finance if they expect managers to invest in a good investment project, the banks' zero-profit condition that determines the equilibrium repayment amount is given by

$$(p_i + \alpha)D_i^{BA} + (p_i - 2\alpha)D_i^{BA} = I \quad \Longleftrightarrow \quad D_i^{BA} = \tfrac{I}{2p_i - \alpha}.$$

The left-hand side of the first equation shows the expected repayment amount under great and moderate project success, and the right-hand side represents the initial financing cost.

Finally, for this loan contract to be an equilibrium, the IC constraint regarding the investment type must be satisfied. Since banks only finance good investment projects, with the offered interest rate D_i^{BA}, the manager's optimal choice will be to invest in the good project. The IC constraint is given by

$$\hat{V}_i^{BA} \geq \hat{v}_i^{BA} \quad \Longleftrightarrow \quad w_i(p_i - p_L)\left\{(X+1)R - 2D_i^{BA}\right\} \geq B,$$

where the expression for $\hat{v}_i^{BA}$ comes from Eq. (3). Managers who do not satisfy this IC constraint will not receive financing. ■

Proof of Proposition 1. Proof of (i): We show that banks' zero-profit conditions that determine the repayment amount under loans with personal guarantees do not depend on whether managers have incentives to take risks. With risk-taking, the zero-profit condition is given by

$$(2p_i - \alpha)D_i^{PG} + (1 - 2p_i + \alpha)D_i^{PG} = I \quad \Longleftrightarrow \quad D_i^{PG} = I.$$

The first term in the equation represents the expected repayment from the company's revenue under project success, while the second term represents the expected repayment from the managers' personal wealth under project failure. Without risk-taking, the zero-profit condition is given by

$$(2p_i)D_i^{PG} + (1 - 2p_i)D_i^{PG} = I \quad \Longleftrightarrow \quad D_i^{PG} = I.$$

Both cases yield the same repayment amount I. Therefore, regardless of whether banks expect managers to take risks or not, the repayment amount charged by the bank is the same. By comparing D_i^{PG} and D_i^{BA} given by (Repayment:BA), $D_i^{BA} > D_i^{PG}$ for any $p_i \in [2\alpha, \frac{1}{2})$.

Proof of (iii): Managers' expected return when taking a risk and investing in a good project exceeds the expected return when not taking a risk and investing in a good project if

$$\begin{aligned}\hat{V}_i^{PG} \geq V_i^{PG} &\Longleftrightarrow w_i\left\{\alpha(X-2)R + \alpha D_i^{PG}\right\} - \alpha D_i^{PG} \geq 0 \\ &\Longleftrightarrow X \geq 2 + \tfrac{I}{R} \cdot \tfrac{1-w_i}{w_i}.\end{aligned}$$

We used $D_i^{PG} = I$ to derive the last inequality from the second one. From Lemma 1, we know that all managers who receive basic loans prefer risk-taking. However, with personal guarantees, managers with $X \geq 2 + \frac{I}{R} \cdot \frac{1-w_i}{w_i}$ prefer risk-taking, while others do not. Therefore, manager i is more likely to engage in risk-taking under basic loans.

Proof of (ii): The IC constraint that ensures managers have the proper incentives to invest in a good investment project under loans with personal guarantees is given by:

$$\begin{aligned}&\hat{V}_i^{PG} \geq \hat{v}_i^{PG} \Longleftrightarrow w_i(p_i - p_L)\left\{(X+1)R - 2D_i^{PG}\right\} + 2(p_i - p_L)D_i^{PG} \geq B \quad \text{if } X \geq 2 + \tfrac{I}{R} \cdot \tfrac{1-w_i}{w_i}, \\ &V_i^{PG} \geq v_i^{PG} \Longleftrightarrow w_i(p_i - p_L)\left\{(X+1)R - 2D_i^{PG}\right\} + 2(p_i - p_L)D_i^{PG} \geq B \quad \text{otherwise .}\end{aligned}$$

The first line represents the IC constraint for managers with incentives to take risks, while the second line corresponds to the IC constraint for managers with no such incentives. By comparing (IC:PG) and (IC:BA),

it is evident that the left-hand side of the IC constraint is always larger under personal guarantees. This implies that the IC constraint is more relaxed when personal guarantees are in place.

Proof of (iv): Consider first the case where $X \geq 2 + \frac{I}{R} \cdot \frac{1-w_i}{w_i}$, in which case managers have incentives to take risks under both loan types. Manager i's expected return under basic loans exceeds that under loans with personal guarantees if

$$\hat{V}_i^{BA} \geq \hat{V}_i^{PG} \Longleftrightarrow (1-w_i)(1-2p_i+\alpha) \geq 0.$$

This inequality always holds because $w_i \in [0,1]$ and $p_i \leq \frac{1+\alpha}{2}$. Next, consider the case where $X < 2 + \frac{I}{R} \cdot \frac{1-w_i}{w_i}$, in which case managers have incentives to take risks under basic loans but do not have incentives to take risks under loans with personal guarantees. Manager i's expected return under basic loans exceeds that under loans with personal guarantees if

$$\hat{V}_i^{BA} \geq V_i^{PG} \Longleftrightarrow (1-w_i)(1-2p_i)I + w_i\alpha(X-2)R.$$

This inequality always holds because $w_i \in [0,1]$, $p_i \leq \frac{1}{2}$, and $X \geq 2$. Therefore, manager i's expected return is always higher under basic loans. ■

Proof of Proposition 2. Proof of (iii): Under bank monitoring, managers have incentives to take risks regardless of the repayment amount D_i^{BM}. Manager i's expected return under loans with bank monitoring when investing in a good project with risk-taking is higher than that of investing without risk-taking if

$$\hat{V}_i^{BM} \geq V_i^{BM} \quad \Longleftrightarrow \quad w_i\alpha\left\{(X-2)R + D_i^{BM}\right\} \geq 0,$$

where the expressions for $\hat{V}_i^{BM}$ and V_i^{BM} are given by Eqs. (10) and (11). This inequality always holds because $X \geq 2$ by assumption and $D_i^{BM} \geq 0$ by the definition of the repayment amount. The same inequality holds under poor investment projects. Combined with the results from Lemma 1, manager i's risk-taking incentives are identical between basic loans and loans with bank monitoring.

Proof of (i): Banks' zero profit condition that determines loan repayment D_i^{BM} under the assumption that managers prefer risk-taking regardless of the repayment amount is given by

$$(2p_i - \alpha)D_i^{BM} = I + c \quad \Longleftrightarrow \quad D_i^{BM} = \frac{I+c}{2p_i - \alpha}.$$

By comparing this expression for D_i^{BM} with the expression for D_i^{BA} given by (Repayment:BA), we observe that $D_i^{BM} > D_i^{BA}$ for any $p_i \in [2\alpha, \frac{1}{2})$.

Proof of (ii): The IC constraint that ensures managers have the proper incentives to invest in a good investment project under loans with bank monitoring is given by:

$$\hat{V}_i^{BM} \geq \hat{v}_i^{BM} \quad \Longleftrightarrow \quad w_i(p_i - p_L)\left\{(X+1)R - 2D_i^{BM}\right\} \geq b.$$

The IC constraint in (IC:BM) is more relaxed than the one in (IC:BA) if the following inequality holds:

$$\frac{(B-b)(2p_i-\alpha)}{2w_i(p_i-p_L)} \geq c.$$

This inequality always holds by assumption. Therefore, credit availability is always greater under loans with bank monitoring.

Proof of (iv): Manager i's expected return under basic loans exceeds that under loans with monitoring if

$$\hat{V}_i^{BA} \geq \hat{V}_i^{BM} \Longleftrightarrow w_i c \geq 0.$$

This inequality always holds because $w_i \in [0,1]$, $p_i \leq \frac{1}{2}$, and $c > 2$. Therefore, manager i's expected return is always higher under basic loans. ■

Proof of Corollary 1. Consider first the case where $X \geq 2 + \frac{I}{R} \cdot \frac{1-w_i}{w_i}$, in which case managers have incentives to take risks under both loan types. Manager i's expected return under bank monitoring exceeds that under loans with personal guarantees if

$$\begin{aligned}\hat{V}_i^{BM} \geq \hat{V}_i^{PG} &\Longleftrightarrow (1-2p_i+\alpha)D_i^{PG} \geq w_i(2p_i-\alpha)(D_i^{BM} - D_i^{PG}) \\ &\Longleftrightarrow (1-w_i)(1-2p_i+\alpha)I \geq w_i c.\end{aligned}$$

The left-hand side of the inequality decreases as p_i and w_i increase, while the right-hand side increases as w_i increases. Therefore, the inequality is more likely to be satisfied for lower values of (p_i, w_i).

Next, consider the case where $X < 2 + \frac{I}{R} \cdot \frac{1-w_i}{w_i}$, in which case managers have incentives to take risks under loans with bank monitoring but do not have incentives to take risks under loans with personal guarantees. Manager i's expected return under loans with bank monitoring exceeds that under loans with personal guarantees if

$$\begin{aligned}\hat{V}_i^{BM} \geq \hat{V}_i^{PG} &\iff (1-2p_i)D_i^{PG} \geq p_i w_i (D_i^{BM} - D_i^{PG}) - w_i \alpha \left((X-2)R + D_i^{BM}\right) \\ &\iff w_i(X-2)R + (1-w_i)(1-2p_i) \geq w_i c.\end{aligned}$$

Again, the left-hand side of the inequality decreases as p_i and w_i increase, while the right-hand side increases as w_i increases. Therefore, the inequality is more likely to be satisfied for lower values of (p_i, w_i). ■

Online Appendix
Appendix OA.1: Additional Tables

Table OA.1: Model variable and parameter definition

Parameter/variable	Definition
V_i^{Type}	Manager i's expected value when receiving a loan and investing in a good project. $Type$ refers to one of the three loan types—Basic (BA), personal guarantees (PG), and bank monitoring (BM).
v_i^{Type}	Manager i's expected value when receiving a loan and investing in a bad project. $Type$ refers to one of the three loan types—Basic (BA), personal guarantees (PG), and bank monitoring (BM).
$\hat{V}_i^{Type}$	Manager i's expected value when receiving a loan, investing in a good project, and taking a risk. $Type$ refers to one of the three loan types—Basic (BA), personal guarantees (PG), and bank monitoring (BM).
$\hat{v}_i^{Type}$	Manager i's expected value when receiving a loan, investing in a bad project, and taking a risk. $Type$ refers to one of the three loan types—Basic (BA), personal guarantees (PG), and bank monitoring (BM).
D_i^{Type}	Company i's repayment amount when receiving a loan. $Type$ refers to one of the three loan types—Basic (BA), personal guarantees (PG), and bank monitoring (BM).
w_i	Manager i's stake in company i's profits.
p_i	Company i's project success probability (great or moderate success) when investing in a good investment project.
p_L	Project success probability (great or moderate success) when investing in a bad investment project.
B	Private benefit for managers when choosing a bad investment project.
b	Private benefit for managers when choosing a bad investment project and receiving bank monitoring.
$c(p_i, w_i)$	Manager i's cost of receiving bank monitoring.
I	Initial investment costs.
R	Return on investment under moderate success.
XR	Return on investment under great success.
α	The increase in probabilities of great success and failure under risk-taking.

Table OA.2: Correlation Matrix of Major Variables

	Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ShareBM	(1)	1.000	-0.244	-0.082	0.056	0.069	-0.052	0.003	0.021
Rating	(2)	-0.244	1.000	0.134	-0.245	-0.070	-0.153	-0.030	-0.133
Ownership	(3)	-0.082	0.134	1.000	0.022	-0.111	-0.108	-0.023	-0.239
Profit-sales ratio	(4)	0.056	-0.245	0.022	1.000	-0.015	0.108	0.026	0.020
Employment	(5)	0.069	-0.070	-0.111	-0.015	1.000	0.215	0.013	0.159
Pledgeable collateral	(6)	-0.052	-0.153	-0.108	0.108	0.215	1.000	0.051	0.217
Manager age	(7)	0.003	-0.030	-0.023	0.026	0.013	0.051	1.000	0.143
Firm age	(8)	0.021	-0.133	-0.239	0.020	0.159	0.217	0.143	1.000

Notes: This table shows the correlation matrix of main independent variables used in our regressions. All variables are defined in Table OA.5 in Supplementary Information.

Table OA.3: Firm Characteristics across Industries

Industry	Obs.	ShareBM	Rating	Ownership	First-time	Profit-sales ratio	Employment	Collateral	Manager age	Firm age
Accommodations	906	0.275	3.7	0.475	0.270	0.028	81.4	145.7	55.4	33.1
Agriculture, fisheries & forestry	19	0.073	4.4	0.500	0.789	-0.021	11.9	119.9	58.2	34.2
Construction	1893	0.243	4.2	0.429	0.320	0.036	37.3	75.6	56.6	39.5
Education	149	0.328	3.8	0.412	0.228	0.010	73.9	122.6	57.8	31.2
Electricity, gas, heat & water	403	0.275	3.6	0.401	0.454	-0.007	45.0	142.3	57.6	30.5
Finance & insurance	10	0.296	3.0	0.387	0.600	0.006	15.2	31.0	54.7	13.1
Information & communications	509	0.458	4.0	0.401	0.336	0.012	57.4	26.6	54.4	24.2
Personal services & entertainment	415	0.293	3.6	0.452	0.301	0.026	67.9	141.5	56.1	32.6
Manufacturing	10213	0.355	3.0	0.348	0.167	0.024	70.5	162.6	58.7	46.7
Medical & healthcare	108	0.275	3.9	0.433	0.398	0.003	70.5	97.5	58.3	29.5
Mining	40	0.423	3.4	0.492	0.275	0.047	23.2	65.1	62.4	40.1
Real estate	1415	0.288	3.1	0.432	0.361	0.118	15.7	210.1	59.2	34.7
Scientific research	378	0.416	3.5	0.423	0.352	0.037	41.4	55.3	56.3	29.9
Service	752	0.357	3.1	0.425	0.318	0.032	61.1	86.4	57.2	33.8
Transport & postal services	1740	0.311	3.0	0.365	0.237	0.025	95.8	177.2	58.760	44.7
Wholesale & retail	5233	0.306	3.7	0.394	0.242	0.014	47.6	100.7	58.2	41.1

Note: The table presents the distribution of firm characteristics by industry. In the JFC data, firms are classified into four-digit JSIC codes, which we aggregate into 16 broader divisions for ease of presentation. All variables are defined in Table OA.5 and measured as of March 2016.

Table OA.4: Firm Characteristics by Prefecture

Prefecture	Obs.	ShareBM	Rating	Ownership	First-time	Profit-sales ratio	Employment	Collateral	Manger age	Firm age
Hokkaido	929	0.298	3.5	0.384	0.251	0.020	45.9	106.4	58.6	41.9
Aomori	229	0.296	3.5	0.324	0.231	0.022	69.2	88.7	59.5	41.1
Iwate	230	0.326	3.8	0.351	0.239	0.026	61.5	112.0	59.3	38.6
Miyagi	488	0.340	3.8	0.410	0.252	0.028	53.8	127.6	58.0	37.0
Akita	206	0.336	2.9	0.340	0.204	0.023	69.7	116.3	60.3	38.4
Yamagata	279	0.325	3.7	0.326	0.204	0.024	61.1	126.4	58.9	45.1
Fukushima	305	0.398	2.9	0.384	0.239	0.027	62.6	107.3	58.1	41.7
Ibaraki	290	0.230	3.3	0.385	0.234	0.026	57.4	141.0	59.0	39.5
Tochigi	279	0.249	3.5	0.447	0.344	0.019	48.1	157.1	59.1	39.6
Gunma	383	0.325	3.5	0.402	0.311	0.026	58.7	165.5	57.5	41.5
Saitama	741	0.335	3.4	0.399	0.182	0.031	66.1	131.9	58.2	42.2
Chiba	348	0.298	3.2	0.408	0.276	0.036	52.9	163.6	57.6	41.3
Tokyo	4324	0.359	3.5	0.386	0.204	0.029	64.6	142.2	57.8	42.5
Kanagawa	918	0.337	3.6	0.403	0.264	0.025	64.9	129.2	58.5	41.3
Niigata	603	0.327	3.2	0.349	0.172	0.031	56.3	117.2	59.0	42.9
Toyama	355	0.359	3.4	0.348	0.220	0.025	55.8	129.4	60.2	41.8
Ishikawa	321	0.388	3.2	0.362	0.277	0.030	59.6	131.8	59.1	41.4
Fukui	259	0.356	3.6	0.320	0.228	0.027	61.3	104.1	57.5	42.1
Yamanashi	181	0.335	3.0	0.392	0.199	0.030	50.7	151.0	57.6	41.1
Nagano	411	0.377	2.6	0.296	0.219	0.035	68.2	133.8	60.0	46.1
Gifu	232	0.300	3.6	0.333	0.267	0.020	57.7	129.9	57.3	42.5
Shizuoka	609	0.325	3.3	0.341	0.248	0.033	80.3	169.9	58.3	43.4
Aichi	1177	0.331	3.5	0.372	0.261	0.024	67.0	151.1	57.0	43.4
Mie	233	0.329	3.4	0.396	0.206	0.030	59.2	125.6	57.6	42.3
Shiga	145	0.313	3.1	0.376	0.159	0.025	71.0	165.8	57.6	42.1
Kyoto	305	0.317	3.6	0.403	0.256	0.035	67.3	124.8	58.1	41.4
Osaka	3307	0.333	3.3	0.411	0.226	0.032	56.1	142.0	57.9	42.3
Hyogo	1002	0.371	3.3	0.390	0.255	0.031	61.4	144.7	57.5	41.9
Nara	207	0.321	3.0	0.392	0.188	0.032	57.9	159.5	56.6	40.4
Wakayama	187	0.296	3.4	0.358	0.278	0.013	46.0	113.3	57.6	43.5
Tottori	150	0.309	3.6	0.348	0.267	0.027	57.5	125.9	58.4	42.6
Shimane	183	0.303	3.3	0.381	0.251	0.024	45.2	108.0	59.9	43.7
Okayama	419	0.330	3.1	0.380	0.217	0.029	75.0	139.6	59.1	43.2
Hiroshima	487	0.272	3.5	0.361	0.224	0.023	75.7	154.0	56.9	44.2
Yamaguchi	375	0.290	3.5	0.372	0.152	0.030	52.0	108.9	58.2	44.2
Tokushima	140	0.214	3.8	0.358	0.221	0.018	66.0	163.5	59.0	42.2
Kagawa	243	0.290	3.5	0.386	0.255	0.028	60.0	140.9	59.2	43.8
Ehime	267	0.247	3.2	0.341	0.232	0.032	53.8	181.4	58.5	45.0
Kochi	150	0.226	3.6	0.365	0.180	0.029	54.0	172.8	60.5	45.9
Fukuoka	924	0.298	3.7	0.421	0.326	0.024	55.2	130.3	57.9	36.6
Saga	185	0.313	3.2	0.381	0.259	0.021	55.4	135.7	57.8	40.9
Nagasaki	221	0.344	3.1	0.399	0.294	0.023	49.3	130.8	59.2	41.9
Kumamoto	288	0.209	3.6	0.431	0.306	0.017	45.4	131.2	59.1	35.5
Oita	225	0.248	3.8	0.400	0.298	0.007	50.4	116.7	56.5	37.7
Miyazaki	207	0.235	3.5	0.402	0.251	0.016	49.9	139.2	59.3	38.0
Kagoshima	236	0.210	3.8	0.349	0.246	0.028	63.7	135.6	57.9	40.8

Note: The table presents the distribution of firm characteristics by prefecture. All variables are defined in Table OA.5 and measured as of March 2016.

Table OA.5: Variable Definitions

Name	Definition
ShareBM	Share of JFC loans with bank monitoring (without personal guarantees) measured as of March 2016.
Ownership	Company share owned by the CEO as of March 2016.
Rating	A firm's credit rating score as of March 2016 on a scale of 1 to 12. The smaller the credit rating score, the better the credit rating.
ln(Manager Age)	Natural log of (CEO age) as of March 2016.
ln(Firm Age)	Natural log of (firm age as of March 2016 + 1). A firm's age is calculated using the firm's establishment year.
ln(Employment)	Natural log of (a firm's total employment+1) as of March 2016.
ln(Pledgeable Collateral)	Natural log of (a firm's total collateral available + 1) as of March 2016.
Default	A dummy variable that equals one if a firm defaults on loans between March 2016 and March 2020 and equals zero otherwise.
Profit-sales Ratio	A firm's net income divided by total sales as of March 2016.
Δ_i Profit-sales Ratio	A change in a firm's profit-sales ratio between March 2016 and March of year $2016+i$ $(i=1,2)$.
Intan-asset Ratio	A firm's intangible asset divided by total asset as of March 2016.
Δ_i Intan-asset Ratio	A change in a firm's intangible asset ratio between March 2016 and March of year $2016+i$ $(i=1,2)$.

Table OA.6: Intangible Asset Ratio and Choice of Loans (1 to 2 year lag)

	Dependent Variable: Δ_1Intan-asset Ratio			**Dependent Variable: Δ_2Intan-asset Ratio**		
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Share BM	0.000919	0.000302	0.000359	0.000835	-0.000455	-0.000349
	(0.00103)	(0.00106)	(0.00106)	(0.00115)	(0.00119)	(0.00119)
Rating		-0.000497	-0.000515		-0.00104	-0.00108
		(0.000213)	(0.000214)		(0.000239)	(0.000240)
Ownership			0.00139			0.00264
			(0.00128)			(0.00144)
Intan-asset Ratio	-0.160	-0.160	-0.160	-0.203	-0.202	-0.202
	(0.00373)	(0.00373)	(0.00373)	(0.00420)	(0.00420)	(0.00420)
ln(Employment)	0.00108	0.00105	0.00109	0.00125	0.00119	0.00127
	(0.000363)	(0.000363)	(0.000365)	(0.000408)	(0.000408)	(0.000410)
ln(Manager Age)	-0.00633	-0.00630	-0.00634	-0.00798	-0.00792	-0.00800
	(0.00198)	(0.00198)	(0.00198)	(0.00223)	(0.00223)	(0.00223)
ln(Pledgeable Collateral)	0.000111	0.0000427	0.0000530	0.000427	0.000284	0.000304
	(0.000180)	(0.000182)	(0.000182)	(0.000202)	(0.000205)	(0.000205)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23636	23636	23636	23616	23616	23616
R^2	0.117	0.117	0.117	0.133	0.134	0.134

Standard errors in parentheses

Notes: This table presents the result of analyzing how the choice of loans with personal guarantees and with bank monitoring (without personal guarantees) affects firms' risk-taking behaviors and resulting investment choices. Columns (1)-(3) use Δ_1 Intan-asset Ratio, a change in the share of intangible asset ratio between March 2017 and March 2016, as a dependent variable. Columns (4)-(6) use Δ_2 Intan-asset Ratio, a change in intangible asset ratio between March 2018 and March 2016, as a dependent variable. All independent variables are defined in Table OA.5. The unit of analysis is at the firm level.

Table OA.7: Intangible Asset Ratio and Choice of Loans (3 to 4 year lag)

	Dependent Variable: Δ_3Intan-asset Ratio			**Dependent Variable: Δ_4Intan-asset Ratio**		
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Share BM	0.00125	-0.000606	-0.000418	0.00214	0.0000656	0.000291
	(0.00125)	(0.00129)	(0.00129)	(0.00134)	(0.00138)	(0.00138)
Rating		-0.00150	-0.00156		-0.00168	-0.00175
		(0.000260)	(0.000261)		(0.000277)	(0.000278)
Ownership			0.00450			0.00547
			(0.00157)			(0.00167)
Intan-asset Ratio	-0.219	-0.218	-0.217	-0.298	-0.297	-0.296
	(0.00456)	(0.00456)	(0.00457)	(0.00486)	(0.00486)	(0.00486)
ln(Employment)	0.00158	0.00149	0.00163	0.00247	0.00238	0.00254
	(0.000443)	(0.000443)	(0.000445)	(0.000473)	(0.000473)	(0.000475)
ln(Pledgeable Collateral)	0.000146	-0.0000604	-0.0000265	-0.0000938	-0.000324	-0.000283
	(0.000220)	(0.000222)	(0.000223)	(0.000234)	(0.000237)	(0.000238)
ln(Manager Age)	-0.0100	-0.00992	-0.0101	-0.0108	-0.0107	-0.0109
	(0.00242)	(0.00242)	(0.00242)	(0.00259)	(0.00258)	(0.00258)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Prefecture FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23487	23487	23487	23595	23595	23595
R^2	0.132	0.133	0.134	0.181	0.183	0.183

Standard errors in parentheses

Notes: This table presents the result of analyzing how the choice of loans with personal guarantees and with bank monitoring (without personal guarantees) affects firms' risk-taking behaviors and resulting investment choices. Columns (1)-(3) use Δ_3 Intan-asset Ratio, a change in the share of intangible asset ratio between March 2019 and March 2016, as a dependent variable. Columns (4)-(6) use Δ_4 Intan-asset Ratio, a change in intangible asset ratio between March 2020 and March 2016, as a dependent variable. All independent variables are defined in Table OA.5. The unit of analysis is at the firm level.