Moral Hazard Models Do Explain the Use of Personal Guarantees

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Abstract

Existing studies, e.g., Berger and Udell (1995) and Brick and Palia (2007), find that personal guarantees have no (or even positive) relation with loan spreads. While this result can be closely replicated, it is due to considering firms with already unlimited liability and restricting the sample to credit lines. Re-examining all loan contracts in limited liability firms, we find that loan spreads decline with personal guarantees. This negative relation almost doubles when borrower risk is controlled for. Spreads also decline with guarantor wealth, especially when the loan amount is high relative to guarantor wealth. Consistent with moral hazard models, our results provide fresh insight into the role that owner wealth plays in the features of loan contracts.

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Personal guarantees provide an owner-guarantor with strong incentives that benefit lenders, because the guarantor can lose everything in the case that his/her firm defaults. Yet, the limited number of empirical studies on personal guarantees offers evidence inconsistent with the fundamental predictions of models based on moral hazard. Moral hazard models predict that, first, riskier firms will pledge assets; and second, corporate loan rates on loans with pledged assets will be lower than interest rates on similar loans without pledged assets (see Boot et al. (1991)). Panel A, Table 2 provides an overview of eight studies on personal guarantees. All studies, except Mayordomo et al. (2021), fail to find a relation between the riskiness of corporate borrowers and the pledging of owners' personal assets. More importantly, these studies report an insignificant or (even) positive effect of personal guarantees on loan interest rates (see, e.g., Berger and Udell 1995; Brick and Palia 2007).

We argue that the empirical approach in previous studies biases their results against the predictions of moral hazard models. To investigate, we begin with a replication exercise (Panel B, Table 2). Following previous studies, the sample includes *both* limited and unlimited liability firms and focuses on credit line borrowing from the 2003 Survey of Small Business Finances (henceforth, the SSBF survey).[2] Consistent with existing studies, we find that the borrowing risk of firms is unrelated to the likelihood of pledging personal guarantees, and that personal guarantees are unrelated to loan interest rates.

We then show that a refined empirical approach, with adjustments to sample selection criteria and measures of borrowing risk, yields different results. Our approach diverges from the existing literature in four important ways. First, we focus exclusively on limited liability corporations, as personal guarantees are less relevant and potentially redundant when the owner's liability is already unlimited. Specifically, we exclude sole proprietorships and partnerships because their owners lack liability protection. We expect that including sole proprietorships and partnerships biases the analysis against detecting the role of personal guarantees.

Second, we include all corporate loans in our analysis, as pledging outside wealth is expected to mitigate moral hazard in both transactional and relationship loans. Previous studies that focus exclusively on credit lines reduce sample size and amplify the noise associated with cash flow

[2] While the survey was discontinued after 2003, it remains an important source of data for small businesses (see, e.g., Benmelech, Kumar, and Rajan 2023). More importantly, no other publicly available U.S. database provides data on personal guarantees for replication purposes (see Table 2).

shocks that are often absorbed by credit lines. More importantly, the analysis of credit lines may introduce a selection effect, where personal guarantees are required to obtain or maintain credit facilities during challenging times, leading to higher observed interest rates when personal guarantees are present (Brown et al., 2021). Limiting the sample to credit lines, therefore, could bias the analysis against finding results consistent with personal guarantees mitigating moral hazard.

Third, we explicitly control for corporate borrowing risk using financial ratios and the Dun & Bradstreet (D&B) rank credit score, which tracks the firm's past payments made to both creditors and suppliers. Failing to control for borrowing risk may bias the analysis against moral hazard predictions because personal guarantees and loan rates are both endogenous and subject to selection effects where riskier loans require personal guarantees. Fourth, we control for owners' personal attributes, particularly net wealth, as this is crucial in determining the value of personal guarantees and thus their effectiveness in mitigating moral hazard. Including borrowing characteristics, alongside owner attributes and the characteristics of the banking relationship, provides a more accurate analysis of personal guarantees by addressing endogeneity and selection issues. However, we do not claim causal relationships given the cross-sectional SSBF survey data we analyze.

Narrowing the analysis to limited liability firms, we find that the use of personal guarantees is related to borrower characteristics, the borrower-lender relationship, and owner attributes. Specifically, the use of personal guarantees decreases with a firm's size and credit quality score, suggesting that riskier firms are required to provide guarantees when other financing options are limited. Although we find little correlation between the length of the lending relationship and the use of personal guarantees, their use does increase with the number of banks that a firm does business with, suggesting that lenders may be more cautious with clients who borrow from multiple sources, or that banks optimally reduce monitoring efforts when holding a smaller share of a firm's debt. Both possibilities could make personal guarantees more attractive. Additionally, personal guarantees are negatively related to the education level of owner-managers, which could reflect perceptions of the owner's ability to repay, or possibly even a negative relation between education and the propensity for risk-taking behavior (Jung (1995)).

Shifting our focus to loan spreads, we find that either restricting the sample to limited liability firms or expanding it to include all types of loans, uncovers a statistically significant negative

relationship between personal guarantees and loan spreads. Further, the negative effect of personal guarantees nearly doubles to 59 basis points after controlling for corporate borrowing risk with the D&B credit score. This is consistent with selection effects in which riskier borrowers are required to pledge personal guarantees. Selection effects complicate the analysis because tests focusing on rates with and without guarantees are likely to suffer from endogeneity and a selection bias that can induce a positive relation between guarantees and loan rates (see, e.g., Berger and Udell 1995; Brick and Palia 2007). Our findings suggest that the first three changes to the empirical approach discussed above are crucial for accurately analyzing models based on moral hazard.

Our approach also uncovers a strong relationship between owner wealth and loan spreads, comparable in magnitude to the effect of firm size in our sample of small U.S. firms. Our regressions indicate that a 10% increase in an owner's personal wealth reduces the loan spread by 35 basis points, while the same percentage change in firm assets leads to a 37 basis point reduction. The wealth relationship is more pronounced when owners provide a personal guarantee, particularly when the loan amount is substantial relative to the owner's wealth. These findings are new and further suggest that personal guarantees play a critical role in mitigating moral hazard.

Further, we find that owner wealth is negatively related to loan maturity and show that this relation is concentrated in loans that include a personal guarantee. Loan maturity is approximately 22 months shorter for every $0.2 million increase in the owner wealth (equivalent to a 10% increase above the sample average), relative to loans that do not include a personal guarantee. This aligns with a moral hazard explanation wherein lenders prefer frequent reassessments of the wealth pledged under a personal guarantee. An interaction between owner wealth and personal guarantees is also observed when we examine loan amounts. A $0.2 million increase in guarantor wealth is associated with an increase in loan amount that is $1.44 million higher than in loans without a guarantee. These findings offer additional insight into the role of an owner's personal wealth in securing financing for small businesses, where owner wealth is high relative to firm assets, underscoring the importance of personal guarantees.

Our study makes important contributions to the literature. Several studies document the importance of firm assets as collateral in loan pricing. For example, Benmelech and Bergman (2009) find that an interquartile increase in their asset redeployability measure is associated with a 58-62 basis point lower credit spread, Berger et al. (2016) document that deposits, bank guarantees, and corporate securities that are highly liquid, reduce loan spreads by 60 basis points,

and Benmelech et al. (2022) find that secured debt has lower spreads in the range of 35 to 72 basis points. Our finding that personal guarantees are associated with a 59 basis point lower spread complements these studies by showing that owner outside wealth can be equally important to other forms of collateral in smaller firms.

Additionally, our research adds to the literature that illustrates how pledging of firm assets can mitigate moral hazard issues, such as underinvestment and asset substitution (e.g., Smith and Warner (1979); Stulz and Johnson (1985)). We complement these foundational studies by showing that personal guarantees can serve as an effective alternative to the pledging of internal assets of smaller firms. Our results suggest that personal guarantees may be especially valuable in emerging economies, where they may be able to mitigate self-dealing practices in both private and public firms (La Porta et al. (2003)).

1. Theories and Hypotheses

Theories of collateral highlight its role in alleviating frictions related to adverse selection and moral hazard. When borrowers possess superior ex-ante information about the quality of their investments, pledging assets can help resolve adverse selection problems. High-quality firms are more likely to pledge assets when raising debt because they have a lower risk of losing those assets, whereas low-quality firms tend to borrow without securing their debt. Consequently, high-quality borrowers can secure better interest rates compared to their low-quality counterparts (Bester 1985; Chan and Kanatas 1985; Besanko and Thakor 1987a, b).

In moral hazard models, pledged assets help curb an owner-manager's incentives to take on excessive risk (often termed asset substitution) or to reduce effort (Berger and Udell 1990; Boot et al. 1991). These models suggest that riskier borrowers are required to pledge assets when raising capital, which, in turn, lowers their relative cost of debt by mitigating moral hazard.

Our study focuses on personal guarantees as a specific form of asset pledging. We hypothesize that personal guarantees are particularly effective in addressing moral hazard in our setting for several reasons. First, the outside wealth of owners is substantial relative to the asset values in small firms, which are the focus of our study. Second, this outside wealth is imperfectly correlated with the firm's business risk, offering lenders a diversification benefit and providing additional incentives for borrowers to reduce moral hazard problems. Third, personal guarantees are legally enforceable. The substantial personal cost of legal proceedings, which includes reputational costs,

to small business owners reinforces the incentives tied to personal guarantees. Because personal guarantees are well-suited to mitigate the key concerns in moral hazard models (i.e., risks of asset substitution, shirking, and strategic default), we propose the following hypotheses.

H1: The use of personal guarantees is positively related to firm credit risk.

H2: Loan spreads are negatively related to the use of personal guarantees.

To test the first hypothesis (H1), we measure a firm's credit risk by its *D&B credit score* which is based on the firm's payment history with its lenders and suppliers. As discussed below, this score is readily available in our dataset and is a valuable indicator of credit quality. In addition, we incorporate three types of control variables that may also affect a firm's borrowing risk. The first set of controls relates to firm characteristics. We include *total loans* / *total assets, payables* / *total assets,* and *unused loans* / *total assets* to measure a firm's overall borrowing capacity, and *profit* / *total assets* to measure its repayment ability. Following Berger and Udell (1995) and Giannetti et al. (2011), we also include *firm size* and *fixed assets* / *total assets* to measure firm assets that can potentially be pledged as collateral. Last, we include an indicator variable for firms that primarily sell services or differentiated products because Giannetti et al. (2011) show that these firms have exceptionally low collateral and liquidation values, and because these firms comprise more than half of the small firms in our dataset, as detailed below.

Second, we control for personal attributes of owners that tend to be correlated with the borrowing risk of small firms. Berger and Udell (1998), for example, illustrate that outside financiers put considerable weight on the financial position and reputation of owners. Thus, we include *owner wealth* and *owner experience* as measures of financial health and reputation, respectively. These variables may mitigate a borrowing firm's credit risk. We also include *owner education* as a measure of earnings potential and reputation, and possibly the propensity to engage in risk-taking behavior (Jung 2015).

Third, we include variables that account for the firm's banking relationship, capturing softer information that may not be reflected in other variables. Following Boot and Thakor (1994), Berger and Udell (1995), and Carletti (2004), we include *firm age*, the *length of banking relationship* in years, and the total *number of banks* from which a firm borrows.

To test our second hypothesis (H2), we define loan spread as the difference between the interest rate on the most recent loan and its maturity-matched treasury yield following Gurkaynak et al. (2007). We also add two loan-level control variables (in addition to the firm level variables above), loan maturity and loan amount, following Benmelech et al. (2022).

Our next hypothesis focuses on the relationship between loan spreads, owner wealth, and personal guarantees. Berger and Udell (1998) highlight the importance lenders place on the financial position of small firms' owners, suggesting that loan spreads decrease with owners' outside wealth. We expect this relation to be more pronounced when owners have pledged wealth in the form of a personal guarantee. This interaction effect is consistent with personal guarantees being more valuable when backed by greater owner wealth (Avery et al. 1998) and thus more effective in mitigating moral hazard. This leads to our third hypothesis.

H3: **(a)** Loan spreads are negatively related to owner outside wealth, **(b)** especially in the presence of a personal guarantee.

We also consider the relationship between personal guarantees and loan maturities. Corporate lending models suggest that loans backed by pledged assets, including personal guarantees, heighten a lender's incentive to monitor these assets (Rajan and Winton 1995; Park 2000). Personal guarantees are more effective as collateral when their value can be periodically verified, especially when substantial wealth is required to back these guarantees. Shorter maturities facilitate this verification during loan renewals. Selection effects may also arise because riskier loans, which typically have shorter maturities, are more likely to require personal guarantees backed by owner wealth. This adds to the negative relation expected between personal guarantees and loan maturity. In addition to the lender's preference for short-term loans, risk-averse guarantors may have the same preference to limit their exposure to business risk and allow future renegotiation on better terms. This effect of risk aversion is also expected to be more important at a higher level of guarantor outside wealth. Therefore, we have our fourth hypothesis as:

H4: **(a)** Loans with personal guarantees exhibit shorter maturities, **(b)** especially when guarantor wealth is high.

Lastly, we expect guarantees to be related to loan amounts. Capital structure theories suggest that a firm's debt capacity increases with the value of its collateral (Williamson 1988; Harris and Raviv 1990; Shleifer and Vishny 1992). Given the close connection between personal and business finances in small businesses, we predict that personal guarantees will enhance the debt capacity of small firms. This leads to the following hypothesis.

H5: **(a)** Loan amounts are positively related to the use of personal guarantees, **(b)** especially when guarantor wealth is high.

Hypothesis 5 is consistent with several empirical studies documenting a positive relation between collateral and debt capacity. For example, Gan (2007) documents that firms with collateral losses due to an unexpected land market collapse in Japan end up securing a smaller amount of bank credit, and Benmelech and Bergman (2009) find that loan-to-value ratios increase with their measure of asset redeployability. However, we know of no existing study that evaluates the relation between entrepreneurs' personal assets and their firm's loan amounts.

2. Data and Descriptive Statistics

We gather data from the 2003 Survey of Small Business Finances, which was conducted during the period June 2004 to January 2005 by the Federal Reserve Board and the National Opinion Research Center at the University of Chicago. Small businesses are defined as non-financial, non-farm enterprises employing fewer than 500 people. These firms are important to the U.S. economy; they account for 99.9% of all firms, create about 62% of jobs, and contribute 44% of economic activity (Kobe and Schwinn 2018; Small Business Administration 2019).

The 2003 SSBF survey consists of 4,268 nationally representative firms that include sole proprietorships, partnerships, S corporations, and C corporations. Because we analyze the use of personal guarantees in limited liability legal entities, our final sample comprises 946 C corporations. The SSBF survey data provides cross-sectional information on firms that go beyond financial statements. This data has been analyzed to study the use of trade credit (Petersen and Rajan 1997; Giannetti et al. 2011), borrower-lender relationships (Berger and Udell, 1995), agency problems between shareholders and managers (Ang et al. 2000), and racial discrimination in lending (Cavalluzzo and Wolken 2005).

Table 1 presents summary statistics for our variables grouped into the four categories discussed above. *Personal guarantee* is this study's main variable of interest. This variable switches on if the firm-owner provided guarantee based on his/her real estate, any specific asset, or overall wealth for the firm's credit lines, mortgage loans, equipment loans, motor vehicle loans, etc. The summary statistics illustrate that personal guarantee is frequently used to secure loans in small, limited liability firms. Specifically, 552 out of 946 firms (or 58.4%) use personal guarantees in our sample. This is larger than the frequency reported in Avery et al. (1995) and Berger and Udell (1995), suggesting that this type of collateral has become more common since the late 1980s.

Borrower characteristics are summarized next. *Firm size*, expressed in millions of dollars, refers to a firm's total assets, *fixed assets* / *total assets* is the fixed assets ratio that is based on all non-current assets, and *profit* / *total assets* is profit-on-asset based on income after all expenses and taxes. The average (median) firm has approximately $4.4 ($1) million of total assets, of which only 34.1% (30%) are fixed, reflecting that small firms have limited fixed assets to use as collateral. The average (median) firm is profitable with a 21.8% (5.5%) profit-on-asset ratio.

The Dun & Bradstreet credit score from the 2003 SSBF survey warrants a more detailed discussion. Dun & Bradstreet assigns scores on a scale of 1-100, with 100 being the best possible PAYDEX score, which reflects a firm's credit history and payment records. Dun & Bradstreet divides this score into three risk categories: 0-49 indicate a high risk, 50-79 indicate a moderate risk, and 80-100 indicate a low risk of late payment. In the 2003 SSBF survey, the PAYDEX scores are transformed into rank credit scores that range between 1 and 6. A *D&B credit score* of 1-3 corresponds to PAYDEX scores between 0-50, 4 corresponds to 51-75, 5 corresponds to 76-90, and 6 corresponds to 91-100. The average (median) firm's *D&B credit score* is 4.1 (4), suggesting moderate borrowing risk of late payment in small firms.

Total loans / *total assets* and *payables* / *total assets* are presented next. *Total loans* is the combined amount of outstanding principal of loans, mortgages, notes, bonds, and capital leases, and *payables* is the amount of money the firm owes to other businesses for supplies and services. Our small, limited liability companies are highly levered. The average (median) sum of these two variables is 86.4% (32.4%) of total assets. Untapped credit can affect firms' financial risk and is also included. *Unused credit* is the difference between the bank credit limit and the amount drawn. Average untapped credit is 21.6% of total assets.

Service or diff. products is an indicator variable that equals 1 if the firm supplies services or sell differentiated products. These firms are relatively difficult to liquidate and lack physical assets to pledge. Following Rauch (1999) and Giannetti et al. 2011, service firms are those operating in industries such as water/air transportation, communications, and electric, gas, sanitary services, whereas firms selling differentiated products operate in industries such as furniture, printing, machinery, and electrical and electronic equipment (see the appendix in Giannetti et al. 2011 for a detailed list of industries). About 60% of our small firms operate in these industries.

We employ three variables to measure the borrower-lender relationship. *Length of banking relation* measures the total length of banking relation in months, *number of banks* refers to the total number of financial institutions a firm deals with, and *firm age* is the natural logarithm of the number of years a firm has existed under the current ownership (Berger and Udell (1995)). The typical firm in our sample banks with 3 financial institutions, the median length of banking relationship is 10 years, and median firm age is 20 years.

We also measure three owner attributes. *Owner education* is the weighted average education level of owners. This variable can range from 1 to 7 based on education degrees, with 5 as trade school/vocational program, 6 as college degree, and 7 as post-graduate degrees. *Owner experience* is the weighted average business experience of owners in years. Finally, *owner wealth* measures the total net worth of the principal owner after excluding his/her primary home and the value of his/her firm ownership. Hence, this variable refers to the owner's outside wealth. We find that the average (median) small business owner is a trade school/vocational program (college) graduate with about 24 (25) years of experience and $4.5 ($0.6) million outside wealth. It is notable that owner outside wealth is significant relative to the size of owners' firm, almost equal for the average firm.

Finally, we employ three loan-level variables. First is loan spread. The average (median) spread in our sample is 330 (319) basis points. This is somewhat higher than those reported in Benmelech et al. (2022), who study DealScan loan data where 85% of loan facilities are secured. In our SSBF survey data, 64.6% of most recent loans have personal guarantees. Thus, the higher spread in our sample may reflect the inability of firms to provide pledgeable assets or higher business risks unique to smaller firms. The average (median) *loan maturity* is 36.8 (12) months, which is shorter than the length of loans from the DealScan database (Benmelech et al. 2022), possibly because the majority of small firms are granted loans with 12 months of maturity. The

average (median) *loan amount* is $1.34 (0.25) million, which is significant relative to the average (median) firm size of $4.42 ($0.98) million.

3. Results

3.1 Replication

In Panel B of Table 2, we replicate the general findings in the existing literature by including both limited and unlimited liability firms and focusing on loans categorized as credit lines. Our regressions include the controls discussed above. We model the likelihood of personal guarantees at the firm level in column 1, controlling for borrower characteristics, the borrower-lender relationship, and owner attributes. We model the effect of personal guarantees on loan spreads in column 2, controlling for borrower characteristics, the borrower-lender relationship, owner attributes, and loan terms (amount and maturity).

The results in column 1 show no significant relation between D&B credit score and the likelihood of personal guarantees, and the results in column 2 show no significant relation between personal guarantees and loan spreads. These results are generally consistent with the studies summarized in Panel A of Table 2. Berger and Udel (1995) use the same SSBF dataset and find an insignificant relation between personal guarantees and loan spreads. Brick and Palia (2007) also employ the SSBF dataset and find that personal guarantees are either insignificantly or positively related to loan spread. They use an instrumental variables approach. Their instrumenting stage uses CEO attributes and several measures of borrowing risk (i.e., debt, profitability, and cash ratios) to model personal guarantees and uncovers no significant relation between borrowing risk and the use of personal guarantees. Using data from a Finnish bank, Peltoniemi and Vieru (2013) find a positive relation between personal guarantees and loan spread, and no significant relation between borrowing risk and the use of personal guarantees. They use banks' internal risk rating classifications to measure borrowing risk. Ono and Uesugi (2009) employ Japanese survey data and find no significant relation between borrowing risk and the likelihood of personal guarantees. They employ a credit score commonly employed by Japanese financial institutions to measure borrowing risk for small and medium firms in Japan.

While the results of the replication exercise in Panel B do not align with the predictions of moral hazard models concerning personal guarantees, the samples include firms with unlimited liability and are limited to credit lines, which may introduce a bias against finding supportive

evidence. To address this, in the rest of the paper we include all types of loans and restrict the sample to firms with limited liability to re-evaluate the predictions of moral hazard models.

3.2 Univariate Analysis

Table 3 presents univariate comparisons of limited liability firms with personal guarantees versus without personal guarantees. Firms that use personal guarantees have, on average, $2.4 million less in assets that could be used as collateral. They also have worse D&B credit scores that put them close to the high-risk category. In addition, they have a substantially higher total loan ratio (78.4% versus 43.4% of assets) which, along with higher payables (28.5% versus 14.2% of assets) and lower profitability (16.8% versus 28.9% of assets), suggests substantial financial risk and repayment risk. Consistent with the models based on moral hazard, these findings suggest that risky firms are likely to use owners' personal guarantees to help raise capital when alternate financing options are limited.

Univariate comparisons also reveal that firms with personal guarantees have lending relationships with approximately four financial institutions, while other firms have relationships with less than three. Owners who provide personal guarantees are significantly less wealthy, such that owner outside wealth is a lower fraction of assets in these firms, despite their smaller firm size.

3.3 Multivariate Analysis

3.3.1 Use of Personal Guarantee

We begin with an empirical analysis of limited liability firms' use of personal guarantees. We estimate the likelihood of personal guarantee use with the following logit regression model

(1) $Prob(Personal\ guarantee_i = 1) = \alpha + \beta_1.(Borrower\ characteristics_i) + \beta_2.(Borrower\text{-}lender\ relation_i) + \beta_3.(Owner\ attributes_i) + \varepsilon_i,$

where $personal\ guarantee_i$ is an indicator variable that equals 1 if the business owner pledged personal assets to secure any existing loan as reported in the 2003 SSBF survey. *Borrower characteristics*, *borrow-lender relation*, and *owner attributes* are the vectors of characteristics

described in the previous section. The subscript *i* refers to firm. As the SSBF data is collected at a point in time, our analysis is limited to cross-sectional analysis.

Table 4 reports the logit estimates. The first three models separately examine the role of borrower risk, banking relationships and owner attributes, respectively. The fourth model includes all three categories. The last column reports the marginal effects of the logit regression in Model 4. We focus our discussion on the full specification in Model 4.

We find that the likelihood of a personal guarantee declines with firm size and credit quality, whereas it rises with unused credit ratios. The magnitudes are economically meaningful. Specifically, a 10% increase in D&B credit score is associated with a 24% reduction in the likelihood of personal guarantee use, whereas a similar 10% increase in firm size above the sample average is associated with a 12% reduction in the likelihood. The statistically significant positive coefficient of unused credit suggests that lenders may be willing to approve larger loan amounts in the presence of owner personal guarantees. These results, particularly the significant D&B credit score, are consistent with our first hypothesis (H1) that borrower risk is positively related to the use of personal guarantee. The reason that credit score is significant here, but not in the replication exercise in column 1 of Panel B, Table 2, is the differing sample selection criteria, specifically the exclusion of unlimited liability firms which are included in Panel B, Table 2.

Another notable difference when focusing on limited liability firms is that *length of banking relation* is no longer significant**.** Instead, *number of banks* is positive and statistically significant. A possible reason is that spreading a firm's borrowing across a larger number of banks reduces the optimal level of monitoring or the amount of soft information acquired through banking relationships, so that individual banks require personal guarantees as substitutes, particularly in small informationally opaque firms with limited internal assets to pledge.

The coefficient of *owner education* is negative and statistically significant. Economically, four to six years of additional education (about 45% increase above the sample average) appears to eliminate the use of personal guarantees. This is consistent with education serving as a substitute for personal guarantees, or the possibility that more educated owners are less inclined toward excessive risk-taking (Jung (1995)). It is also consistent with a selection effect wherein better educated owners have better projects, reducing the need for personal guarantees. Other control variables exhibit little success in explaining the likelihood of personal guarantees.

In untabulated robustness tests, we repeat all of the analysis with industry fixed effects, where industries are classified into nine broad categories as reported in the 2003 SSBF survey. In another test, we control for the banking market concentration at the Metropolitan Statistical Areas (MSA) level. The results reported in Tables 4 continue to hold.

3.3.2 Personal Guarantee and Loan Spread

To analyze the relationship between personal guarantees and loan spreads, we estimate the following OLS regression using all types of loans to limited liability firms

(2) $Loan\ spread_i = \alpha + \beta.(Personal\ guarantee_i) + \gamma_1.(Borrower\ characteristics_i) + \gamma_2.(Borrower\text{-}lender\ relation_i) + \gamma_3.(Owner\ attributes_i) + \varepsilon_i$.

Firm *i*'s loan spread is computed using the most recent loan reported in the SSBF survey. For firm *i*, $loan\ spread_i$ is measured in basis points by taking the difference between the interest rate on the most recent loan and its maturity-matched treasury yield following Gurkaynak et al. (2007). This requires the availability of information on interest rates and maturity, which results in a sample of 544 loan contracts.

In equation (2), the key variable of interest is $personal\ guarantee_i$, which takes the value of 1 if the owner of the firm provided a guarantee based on his/her personal wealth on the most recent loan. To isolate the effect of this variable, we control for borrower characteristics, borrower-lender relation, owner attributes, loan maturity, and loan amount. Under the second hypothesis (H2), the coefficient of $personal\ guarantee_i$ (β) is expected to be negative as pledging outside assets of the owner mitigates moral hazard problems.

Table 5 presents the regression results. Model 1 extends the sample in column 2 of Panel B, Table 2 to include all loan contracts rather than just credit lines. Models 2-6 include all loans and further exclude unlimited liability firms. Thus, they differ from the spread regressions in Panel B of Table 2 in that they restrict the sample to limited liability firms and they include all loans. Models 3-5 add control variables related to borrower characteristics, borrower-lender relationship, and owner attributes one by one. In Model 6, we consider all variables jointly, including the loan characteristics *amount* and *maturity*. This step-by-step exercise helps us determine the empirical

methodologies required to uncover the negative relation between personal guarantee and loan spread.

The main result is that the coefficient of *personal guarantee*$_i$ is negative and statistically significant in all models. In contrast, *personal guarantee*$_i$ is not significant in column 2 of Panel B, Table 2, where unlimited liability firms are included and the loan sample is restricted to credit facilities. Model 1, which relaxes this restriction, illustrates that including all loan contracts in the sample selection criteria uncovers the negative relation between personal guarantee and loan spread. The negative correlation is slightly stronger (i.e., more negative) in Model 2, suggesting that the type of firms included during sample selection is also important in reducing estimation bias. While the bias appears relatively modest when moving from Model 1 to 2, it increases substantially with control variables. For example, in an unreported regression using Model 6 but including unlimited liability firms, the coefficient of *personal guarantee*$_i$ is -39.528, as compared to its coefficient of -56.386 reported in Table 6.

The selection effect in collateral pricing warrants discussion here. Because risky firms are required to pledge assets, the analysis of loan rates with pledged assets and loan rates without pledged assets tends to find higher rates for loans with pledged assets (see, e.g., Berger and Udell 1995; John et al. 2003). This could explain why earlier studies analyzing firms' inside collateral do not find the negative relation we find in Models 1 and 2, where loan spread is regressed on personal guarantee without any control variables. Selection effects may be less pronounced in the SSBF data (compared to Dealscan, for example, which includes credit lines, bank term loans, institutional term loans, etc.), possibly because some firms are unable to pledge assets due to their smaller size or limited owner wealth. It is also possible that moral hazard effects are more pronounced in our data.

Model 3 highlights the importance of controlling for borrower risk characteristics. The negative correlation between personal guarantee and loan spread approximately doubles to 59 basis points when borrowing risk is controlled for. This is again consistent with selection effects whereby loans to riskier projects are required to include a personal guarantee**.** Models 4 and 5 reveal that controlling for relationship banking and owner attributes is also important, but less so than controlling for risk characteristics. Model 6 shows that personal guarantees are associated with spreads that are 56 basis points lower than loans without guarantees once all controls are included. Overall, the results provide fresh evidence consistent with moral hazard models

underlying the second hypothesis (H2) that loan spreads decline with the use of personal guarantees.

Model 6 also shows that outside *owner wealth* is negatively related to loan spread. This supports the first half of our third hypothesis (H3a), that spreads decrease with outsider owner wealth. Notably, the economic impact of owner wealth is comparable to that of firm size. For example, a 10% increase in *firm size* is related to a 37 basis point reduction in loan spread, whereas a 10% increase in *owner wealth* is related to a 35 basis point reduction in loan spread. These results suggest that owner personal wealth is nearly as important as firm size in small business lending. We know of no existing study that estimates the importance of owner outside wealth on corporate loan pricing.

Credit quality and owner business experience are also negatively and significantly related to loan spread, consistent with credit risk and owner business acumen playing a role in loan pricing for small businesses. The coefficient of loan *amount* is negative but not economically significant, whereas the coefficient of loan *maturity* is negative and statistically significant, consistent with a negative relation between risk and maturity. Other control variables, except the fixed assets ratio, are not statistically significant. The coefficient of the fixed assets ratio is positive, which is inconsistent with the idea that loan spread should reduce for firms with more pledgeable physical assets. A possible explanation is that the fixed assets ratio and firm size are determined jointly.

In untabulated regressions, we consider a subsample analysis based on borrowers' risk of late payments. We find that personal guarantees are negatively related to loan spreads in the sample of firms with moderate to low risk of late payments (i.e., *D&B credit score* of 4 and more). On the other hand, personal guarantees are not related to loan spreads when firms have high risk of late payment. Possible reasons are that personal guarantees are more effective when firms have significant leverage but modest probabilities of default, or that selection effects are less pronounced in loans where the likelihood of default is low. We also consider owners' personal bankruptcy in the last seven years or delinquent obligations in the last three years. Because only 0.2% (7.6%) of owners were declared bankrupt (had delinquent obligations), we do not analyze them formally in regression analysis.

3.3.3. Loan Spread and Guarantor Wealth

In Table 5, loan spreads are found to be inversely related to both the use of personal guarantees and the owners' outside wealth, which aligns with hypotheses H2 and H3(a). To gain further insight, we focus on the interaction between personal guarantees and owner wealth. Hypothesis H3(b) predicts that lenders are likely to charge lower interest rates when personal guarantees are provided by owners with higher outside wealth, as this increases the likelihood that lenders can recover a greater portion of their loans in the event of default.

Table 6 presents regression results with the interaction term included. The main variable of interest is *personal guarantee*$_i$ × *personal wealth*$_i$. The coefficients of the control variables are similar to Table 5 and therefore, we do not report them to save space. In Model 1, where the sample is all limited liability firms, the coefficient estimate of *personal guarantee*$_i$ is -39.27, which is 17 basis points lower than the estimate in Model 6 of Table 5 and not statistically significant. However, the coefficient of the interaction term is negative and statistically significant at the 10% level. This is consistent with hypothesis H3(b), suggesting that the personal wealth of owners who have provided a personal guarantee (i.e., "guarantor wealth") plays a significant role in the pricing of such loans. The result is economically meaningful: A 10% increase in guarantors' personal wealth above the sample average, which is slightly below $0.2 million, is associated with a 120 basis point reduction in loan spread, relative to loans without a personal guarantee. Because the average (median) loan amount with personal guarantees is $0.66 (0.23) million in our sample, a 10% increase in guarantor wealth is economically significant for lenders. These findings suggest that lenders charge lower interest rates when they have substantial recourse against the owners' personal wealth if the loan is not repaid.

It is important to recognize that, in equilibrium, many important factors, including project risk, personal guarantees, and investor wealth, are endogenous and thus interact with one another. The cross-sectional nature of the SSBF dataset limits our ability to address the identification problem that arises as personal guarantees and guarantor wealth are not randomly assigned in loan contracts. Selection effects may inflate the interest rates on risky loans with personal guarantees backed by significant personal wealth. For instance, owners with sufficient personal wealth to offer guarantees may also be inclined to approve high-risk projects. The positive relation implied by this selection effect may offset the negative relation between loan rates and guarantees, consistent with moral hazard models, especially when guarantor wealth is high. This selection effect suggests that

the moral hazard relation we are investigating could be even stronger than what is reported in Model 1 of Table 6.

To investigate the severity of such selection effects, we divide our sample based on the median value of the *loan amount* / *personal wealth* ratio. When the loan amount is small relative to owner wealth, the selection effect above, wherein wealthy borrowers both approve riskier projects and offer personal guarantees, is expected to be more pronounced. In contrast, moral hazard problems (i.e., the risk that the borrower will engage in suboptimal behavior because they do not bear the full consequences) are mitigated, implying a muted role for personal guarantees. When the loan amount is high relative to owner wealth, however, the selection effect is muted while the role for guarantees to mitigate moral hazard strengthens. Thus, we expect selection effects to be relatively important in the subsample with below median *loan amount* / *personal wealth* and moral hazard effects to be relatively important in the subsample with above median *loan amount* / *personal wealth*.

The subsample results are presented in Models 2 and 3 of Table 6. For the low *loan amount* / *personal wealth* ratio subsample in Model 2, we find that the coefficient of $personal\ guarantee_i \times personal\ wealth_i$ is statistically indistinguishable from zero. For the high *loan amount* / *personal wealth* ratio subsample in Model 3, the coefficient is negative and statistically significant. This mirrors what was observed in the whole sample (Model 1), except that the coefficient is amplified. This suggests that selection effects might still be influencing the results in the whole sample, highlighting the complexity of the relationship between personal guarantees and loan spreads.

3.3.4 Personal Guarantee, Loan Maturity, and Loan Amount

Next, we investigate the relation between personal guarantees and other loan terms, specifically maturity and amount, using a variation of regression equation (2) by replacing $loan\ spread_i$ with $loan\ maturity_i$ and $loan\ amount_i$. $Loan\ maturity_i$ refers to the original number of months over which the loan is repaid and $loan\ amount_i$ is the total amount of credit granted on the most recent loan, as reported in the 2003 SSBF survey. All independent variables follow from equation (2).

Table 7 presents regression results. The first four columns (models) focus on loan maturity and the last four on loan amount. All regressions include personal guarantee and the control variables above. In Model 1, we find that the coefficient of $personal\ guarantee_i$ is statistically insignificant

and positive. This is inconsistent with hypothesis H4(a), in which the coefficient of personal guarantee is expected to be negative. In Model 2, we include interaction effects with owners' personal wealth to test H4(b). The coefficient of *personal guarantee*$_i$ × *personal wealth*$_i$ is negative and statistically significant at the 5% level. This supports H4(b), consistent with a stronger incentive to monitor the owner's outside wealth through loan renewals when that wealth is high. It is also consistent with a selection effect wherein riskier loans have shorter maturities and require a personal guarantee, especially when owners have high wealth.

Model 1 also reports the direct (un-interacted) relationship between owner wealth and loan maturity. The coefficient of *personal wealth*$_i$ is negative and statistically significant, but its magnitude is relatively modest. The negative interaction term in Model 2 implies that the negative relationship between owner wealth and loan maturity is more pronounced for loans that include a personal guarantee. With a personal guarantee, loan maturity is reduced by approximately 22 months for every $0.2 million increase in owner wealth (a 10% increase above the sample average), relative to the same increase in wealth when loans do not include a personal guarantee. This result further suggests that personal guarantees play a role in determining loan terms.

Models 3 and 4 split the sample based on the *loan amount* / *personal wealth* ratio to investigate selection versus moral hazard effects. Here, however, the subsample analysis does not yield statistically significant results, so we cannot distinguish selection or moral hazard effects with confidence.

The next four columns focus on loan amounts. Hypothesis H5(a) predicts a positive relation between loan amount and personal guarantee. Model 5 shows that the coefficient is negative and statistically insignificant, failing to support hypothesis H5(a). In Model 6, however, the interaction effect between *personal guarantee*$_i$ and *personal wealth*$_i$ is positive and statistically significant at the 1% level. This is consistent with H5(b) and suggests that debt capacity is positively related to guarantor wealth, i.e., to owner wealth conditional on the owner providing a personal guarantee. This interaction effect is also substantial. A $0.2 million increase in owner wealth is associated with an increase in loan amount that is $1.44 million greater than in loans without a guarantee. Subsample analysis in Models 7 and 8 shows that the positive interaction is more pronounced in loan contracts where moral hazard effects are expected to be severe. As in the case of spreads above, this finding suggests that selection effects remain formidable and may bias baseline results.

Collectively, the results in this section offer additional insight into the role of an owner's personal wealth in securing outside financing. This is especially important for small businesses where owner wealth is high relative to firm assets, underscoring the importance of personal guarantees. With the exception of Cavalluzzo and Wolken (2005), who study the role of personal wealth on small business loan turndowns, we know of no other study that investigates the impact of personal wealth on corporate loan terms.

4. Conclusion

Although it is widely recognized that personal guarantees from corporate owners provide financial institutions with recourse to the guarantors' outside wealth in the event of a corporate default, the limited number of existing studies on this topic have produced results that are inconsistent with the basic predictions of moral hazard models. We address this inconsistency by carefully designing our analysis using the 2003 Survey of Small Business Finances (2003 SSBF).

Using this survey, we re-evaluate the role of personal guarantees and their relationship to loan spreads, loan maturity, and loan amounts. Our findings reveal that a firm's borrowing risk, such as low credit quality, is positively related to the likelihood of requiring personal guarantees. More importantly, we discover that personal guarantees are associated with a reduction in loan spreads ranging from 30-59 basis points, with the relation more pronounced when the firm's credit risk is controlled and when guarantor wealth is substantial. Additionally, we find that guarantor wealth is positively related to the loan amount, underscoring a significant role of an owner's personal wealth in securing debt financing for small firms. Overall, our results indicate that the use of personal guarantees aligns with the predictions of moral hazard models in corporate lending.

Although we cannot draw definitive causal inferences due to data limitations, our findings hold promise for future research. We demonstrate that legal liability, the nature of loan contracts, and the credit quality of organizations and their owners are critical factors in the analysis of personal guarantees. There are several promising avenues for future work. First, assessing the generalizability of these results in emerging economies is important, especially given the frequent influence of political connections in corporate lending in such markets. When a company's affiliated political party loses power, financial institutions often have recourse, suggesting that personal guarantees might lead to more efficient loan contracts in these contexts. Another promising direction is exploring how bond and stock prices react to announcements of personal

guarantees by insiders of public firms, a practice commonly observed in countries like China, India, and Mexico. This line of inquiry could yield valuable insights into market perceptions of personal guarantees in different institutional environments.

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Appendix

Definition of Variables

Personal guarantee (0/1)	1 if the firm-owner provided guarantee based on his/her real estate, any specific asset, or overall wealth for the firm's credit lines, mortgage loans, equipment loans, motor vehicle loans, etc. and 0 otherwise. Table 4 defines the variable at the firm level, whereas Tables 5-7 define the variable at the loan level.
Borrower characteristics	
Firm size ($ million)	Total dollar amount of all assets of the firm.
Fixed assets / total assets	(Total assets – cash on hand – accounts receivables and trade notes – inventory – other current assets) / total assets.
Profit / total assets	Income after all expenses and taxes / total assets.
D&B credit score	The Dun & Bradstreet credit score that ranges from 1 to 6. A high score represents a low risk of late payment based on a firm's credit history and payment records.
Total loans / total assets	The combined amount of outstanding principal of loans, mortgages, notes, or bonds, or capital leases, and any nonrecourse loan / total assets.
Payables / total assets	Total amount of accounts payables / total assets.
Unused credit / total assets	(Total credit limit – total amount owed) / total assets.
Service or diff. products	1 if the firm supplies services or sells differentiated products, and 0 otherwise. Service firms operate in industries such as water/air transportation, communications, and electric, gas, sanitary services, whereas firms selling differentiated products operate in industries such as furniture, printing, machinery, and electrical and electronic equipment. Source: Rauch (1999) and Giannetti et al. (2011).
Borrower-lender relation	
Length of banking relation	Total length of relationship in months.
Number of banks	The number of financial institutions a firm deals with.
Firm age (log)	The number of years under the current owners.
Owner attributes	
Owner education	Education level of owners. This variable ranges from 1 (less than high school) to 7 (post graduate degree).
Owner experience	The number of years of experience of owners.
Owner wealth ($ million)	Wealth excluding the owner's primary home and firm ownership.
Loan characteristics	
Spread (basis point)	Difference between the interest rate on the most recent loan and its maturity-matched treasury yield following Gurkaynak et al. (2007).
Maturity (month)	The original period over which the loan is repaid.
Amount ($ million)	Total amount of credit on the most recent loan.

Table 1: Summary Statistics for the Sample of Limited Liability Firms

This table reports summary statistics for our sample of 946 firm-level observations from limited liability firms included in the 2003 SSBF survey. Loan variables are based on 544 loan-level observations using all loan types in the survey data. All variable definitions are presented in the Appendix.

Interpretation: 58.4% small firms (552 out of 946) use personal guarantees of their owners to raise capital.

	Mean	SD	10th	25th	Median	75th	90th
Personal guarantee (0/1)	0.584	0.493	0	0	1.000	1.000	1.000
Borrower characteristics							
Firm size ($ million)	4.423	14.470	0.041	0.207	0.980	3.462	9.720
Fixed assets / total assets	34.059	82.773	0.000	8.631	29.994	57.931	84.201
Profit / total assets	21.792	576.374	-16.667	-0.084	5.483	25.895	114.746
D&B credit score	4.068	1.480	2.000	3.000	4.000	5.000	6.000
Total loans / total assets	63.844	278.072	0	3.704	25.170	60.284	119.403
Payables / total assets	22.533	200.064	0	0.803	7.199	19.466	39.971
Unused credit / total assets	21.649	80.058	0	0	4.196	18.372	39.448
Service or diff. products	0.599	0.490	0	0	1.000	1.000	1.000
Borrower-lender relation							
Length of banking relation	157.857	138.401	25.000	60.000	120.000	228.000	360.000
Number of banks	3.507	2.174	1.000	2.000	3.000	4.000	6.000
Firm age (log)	2.809	0.792	1.792	2.398	2.996	3.367	3.584
Owner attributes							
Owner education	4.835	1.966	2.000	3.000	6.000	7.000	7.000
Owner experience	24.383	11.771	10.000	16.000	25.000	31.000	40.000
Owner wealth ($ million)	4.461	44.220	0.058	0.213	0.624	1.700	4.000
Loan characteristics							
Spread (basis point)	329.891	251.791	19.581	179.972	319.069	471.291	636.676
Maturity (month)	36.784	51.541	12.000	12.000	12.000	48.000	84.000
Amount ($ million)	1.344	4.114	0.028	0.075	0.250	1.000	3.000

Table 2: Overview of Existing Studies and Replication of their Main Findings

Panel A provides an overview of the existing literature on personal guarantees. Column 1 defines the study, column 2 provides the source of data, column 3 reports the types of firms included in the sample, and column 4 specifies the type of loans included in the sample. The main results of the studies are summarized in column 5.

Panel B presents a replication exercise using our SSBF dataset and variables but the sample selection criteria in previous studies. The first column (Model 1) presents firm-level logit regressions to estimate the relation between borrowing risk and the likelihood of personal guarantees, using a sample that includes both limited and unlimited liability firms. Model 2 presents loan-level OLS regressions to estimate the relation between guarantees and loan spreads, using a sample that includes both limited and unlimited liability firms but is restricted to credit lines.

Interpretation (Panel A; Existing Studies): All studies, except Mayordomo et al. (2021), fail to find a relation between the riskiness of corporate borrowers and the pledging of owners' personal assets. More importantly, these studies report an insignificant or (even) positive effect of personal guarantees on loan interest rates.

Interpretation (Panel B; Replication Exercise): Regression results do not support the use of personal guarantees to mitigate moral hazard in samples that include limited and unlimited liability firms and are restricted to credit line borrowing.

Panel A: Review of existing studies

Study	Data source	Legal liability	Loan type	Findings regarding personal guarantees
Berger And Udell (1995)	U.S. SSBF survey	Limited and unlimited liability firms	Credit lines	• Insignificant effect of personal guarantees on loan rates.
Brick and Palia (2007)	U.S. SSBF survey	Limited and unlimited liability firms	Credit lines	• Insignificant effect of firms' borrowing risk on the use of personal guarantees. • Insignificant (positive) effect of personal guarantees on loan rates using OLS (simultaneous) regressions.
Jimenez et al. (2006)	Bank of Spain	Limited and unlimited liability firms	All loans	• Ambiguous as authors *do not* differentiate personal guarantee from collateral.
Mayordomo et al. (2021)	A Spanish bank	Ambiguous[3]	All loans	• Significant effect of borrowing risk on the use of personal guarantees.
Ono and Uesugi (2009)	Japanese Survey	Limited and unlimited liability firms	Credit lines	• Insignificant effect of firms' borrowing risk on the use of personal guarantees.
Peltoniemi and Vieru (2013)	A Finnish bank	Limited and unlimited liability firms	All loans	• Insignificant effect of firms' borrowing risk on the use of personal guarantees. • Positive effect of personal guarantees on loan rates.
Pozzolo (2004a)	Banks' Supervisory Reports (Italy)	Limited and unlimited liability firms	Credit lines	• Positive effect of personal guarantees on loan rates.
Pozzolo (2004b)	Banks' Supervisory Reports (Italy)	Limited and unlimited liability firms	Credit lines	• Negative effect of personal guarantees on loan rates.

[3] While firms are referred to as "corporations" in the paper, the average loan size of 100,000 euros suggests that the sample likely includes proprietorships and partnerships.

Panel B: Replication exercise		
	Dependent variable:	
	Personal guarantee = 1	Loan spread (basis points)
Personal guarantee		-19.829
		(13.621)
Borrower characteristics		
Firm size	-0.064***	-4.360***
	(0.010)	(1.039)
Firm size^2	-0.000	0.017***
	(0.000)	(0.006)
Fixed assets / total assets	0.001***	0.777***
	(0.002)	(0.196)
Profit / total assets	-0.000	0.007
	(0.000)	(0.014)
D&B credit score	-0.023	-2.888
	(0.052)	(5.176)
Total loans / total assets	-0.004**	0.026
	(0.002)	(0.042)
Payables / total assets	-0.001	-0.058
	(0.002)	(0.213)
Unused credit / total assets	0.000	-0.007
	(0.005)	(0.047)
Service or diff. products	0.086	4.185
	(0.117)	(14.792)
Borrower-lender relation		
Length of banking relation	-0.001***	-0.042
	(0.000)	(0.072)
Number of banks	0.260***	-1.540
	(0.036)	(3.397)
Firm age (log)	-0.033	-9.500**
	(0.085)	(10.642)
Owner attributes		
Owner education	-0.012	-16.067***
	(0.034)	(4.377)
Owner experience	0.001	-1.772***
	(0.006)	(0.916)
Owner wealth	0.019	-1.994**
	(0.018)	(1.065)
Owner wealth^2	-0.000	0.003
	(0.000)	(0.002)
Loan characteristics		
Amount		-0.000
		(0.000)
Maturity		-1.816***
		(0.098)
(Pseudo) R^2	0.074	0.170
Observations	1,851	1,230

Table 3: Univariate Firm-level Comparisons Based on Personal Guarantee Use

This table compares summary statistics using a sample of 946 firm-level observations from limited liability firms in the 2003 SSBF survey. ∗∗∗, ∗∗, and ∗ denote statistical significance based on two-sided T-tests or Mann-Whitney tests at the 1%, 5%, and 10% level, respectively. All variable definitions are presented in the Appendix.

Interpretation: Firms that use personal guarantees are smaller and have higher borrowing risk, represented by lower D&B credit score. Owners' outside wealth is much lower than the firm size in these firms.

Univariate comparisons of firms with and without owners' personal guarantee

	Personal guar. = 1			Personal guar. = 0			Difference	
	Mean	Median	SD	Mean	Median	SD	Mean	Median
Borrower characteristics								
Firm size (million)	3.432	1.276	9.104	5.812	0.617	19.595	-2.380**	0.659***
Fixed assets / total assets (%)	37.958	32.388	32.149	28.569	26.554	122.538	9.390	5.834**
Profit / total assets (%)	16.752	5.510	538.968	28.890	5.427	625.910	-12.138	0.083
D&B credit score	3.984	4.000	1.505	4.186	4.000	1.439	-0.202**	0.000*
Total loans / total assets (%)	78.353	35.383	323.813	43.413	9.272	194.961	34.940**	26.111***
Payables / total assets (%)	28.464	9.438	260.209	14.182	4.470	31.581	14.282	4.968***
Unused credit / total assets (%)	30.195	8.460	101.583	9.616	0.000	25.839	20.579***	8.460***
Service or diff. products	0.618	1.000	0.486	0.574	1.000	0.495	0.044	0.000
Borrower-lender relation								
Length of banking relation (month)	152.598	120.000	128.399	165.244	120.00	151.199	-12.647	0.000
Number of banks	4.014	4.000	2.331	2.797	2.000	1.695	1.218***	2.000***
Firm age (log)	2.815	2.996	0.783	2.803	2.944	0.805	0.013	0.052
Owner attributes								
Owner education	4.788	6.000	1.865	4.901	6.000	2.101	-0.113	0.000*
Owner experience (year)	24.672	25.000	10.958	23.977	25.000	12.827	0.695	0.000
Owner wealth (million)	1.924	0.700	6.688	8.123	1.530	68.537	-6.199*	-0.830*
Observations		552			394			

Table 4: Determinants of Personal Guarantee

This table reports firm-level logit regressions to estimate the likelihood of observing personal guarantees. The sample includes only limited liability firms (i.e., excludes firms with unlimited liability). All regressions are estimated with an intercept. Standard errors are in parenthesis and are clustered at the two-digit SIC code level. $***$, $**$, and $*$ denote statistical significance based on two-sided tests at the 1%, 5%, and 10% level, respectively. Variable definitions are reported in the Appendix.

Interpretation: When firms with unlimited liability are excluded, the likelihood of personal guarantee use increases with firm borrowing risk as measured by the D&B credit score. The correlation is consistently significant at the 10% level, with and without controls for the firm's banking relationship and owner characteristics.

	Dependent variable: Personal guarantee = 1				
	(1)	(2)	(3)	(4)	dy / dx
Borrower characteristics					
Firm size	-0.011			-0.047**	-0.012**
	(0.011)			(0.020)	(0.005)
Firm size^2	-0.000			0.000	0.000
	(0.000)			(0.000)	(0.000)
Fixed assets / total assets	0.005*			0.005	0.001
	(0.003)			(0.003)	(0.001)
Profit / total assets	-0.000			-0.000*	-0.000*
	(0.000)			(0.000)	(0.000)
D&B credit score	-0.102*			-0.097*	-0.024*
	(0.054)			(0.057)	(0.014)
Total loans / total assets	0.000			0.000	0.000
	(0.001)			(0.001)	(0.000)
Payables / total assets	0.003			0.001	0.000
	(0.002)			(0.002)	(0.000)
Unused credit / total assets	0.015***			0.015***	0.004***
	(0.003)			(0.003)	(0.001)
Service or diff. products	0.234			0.078	0.019
	(0.148)			(0.138)	(0.034)
Borrower-lender relation					
Length of banking relation		-0.001		-0.001	-0.000
		(0.000)		(0.001)	(0.000)
Number of banks		0.334***		0.402***	0.099***
		(0.047)		(0.051)	(0.013)
Firm age (log)		0.031		0.036	0.009
		(0.101)		(0.125)	(0.031)
Owner attributes					
Owner education			-0.084**	-0.101***	-0.025***
			(0.037)	(0.038)	(0.010)
Owner experience			-0.003	0.000	0.000
			(0.007)	(0.007)	(0.002)
Owner wealth			0.019	0.023	0.006
			(0.022)	(0.023)	(0.006)
Owner wealth^2			-0.000	-0.000	-0.000
			(0.000)	(0.000)	(0.000)
Pseudo R^2	0.046	0.066	0.010	0.136	
Observations	938	945	921	913	

Table 5: Regression Analysis of Loan Spreads and Personal Guarantee Use

This table reports loan-level OLS regressions of loan spread. Column 1 includes all loans to both limited and unlimited liability firms; columns 2-6 include all loans to limited liability firms. All regressions are estimated with an intercept. Standard errors are in parenthesis and are clustered at the two-digit SIC code level. ∗∗∗, ∗∗, and ∗ denote statistical significance based on two-sided tests at the 1%, 5%, and 10% level, respectively. Variable definitions are reported in the Appendix.

Interpretation: Loan spreads are negatively related to personal guarantees when all loans are considered, and more so when unlimited liability firms are excluded. The relation strengthens dramatically when borrowing risk is accounted for. This is consistent with selection effects, where riskier loans are more likely to require personal guarantees, and suggests that estimates may be biased if borrowing risk is not fully controlled.

	All firms		Limited liability			
	(1)	(2)	(3)	(4)	(5)	(6)
Personal guarantee	-29.892**	-32.119*	-58.67***	-34.12*	-39.39*	-56.386**
	(-14.210)	(-19.251)	(20.30)	(19.11)	(19.97)	(22.121)
Borrower characteristics						
Firm size			-4.144***			-3.711**
			(1.253)			(1.535)
Firm size^2			0.013**			0.031***
			(0.006)			(0.009)
Fixed assets / total assets			0.672**			1.213***
			(0.322)			(0.335)
Profit / total assets			-0.003			-0.038
			(0.031)			(0.028)
D&B credit score			-15.17*			-16.71*
			(8.429)			(9.657)
Total loans / total assets			-0.027			-0.092
			(0.146)			(0.136)
Payables / total assets			-0.047			-0.151
			(0.373)			(0.288)
Unused credit / total assets			0.037			-0.065
			(0.073)			(0.074)
Service or diff. products			7.148			4.697
			(24.11)			(22.08)
Borrower-lender relation						
Length of banking relation				-0.100		-0.008
				(0.0868)		(0.100)
Number of banks				-3.342		1.110
				(4.276)		(3.833)
Firm age (log)				-22.41		11.24
				(20.30)		(22.30)
Owner attributes						
Owner education					-6.795	-7.782
					(5.273)	(5.748)
Owner experience					-2.433**	-2.417*
					(1.178)	(1.368)
Owner wealth					-3.092**	-3.524***
					(1.420)	(0.991)
Owner wealth^2					0.0106***	0.012***
					(0.00283)	(0.002)
Loan characteristics						
Amount						-0.000**
						(0.000)
Maturity						-1.917***
						(0.174)
Adjusted R^2	0.003	0.004	0.045	0.014	0.060	0.243
Observations	1,727	544	542	544	524	495

Table 6: Regression Analysis of Loan Spread on Personal Guarantee, Owner Wealth, and their Interaction

This table adds interaction effects between *personal guarantee* and the *personal wealth* of owners to the loan spread regressions in Table 5. Models 2 and 3 present subsample analysis based on loan amount relative to owner wealth. All regressions are estimated with an intercept. Standard errors are in parenthesis and are clustered at the two-digit SIC code level. ∗∗∗, ∗∗, and ∗ denote statistical significance based on two-sided tests at the 1%, 5%, and 10% level, respectively. Variable definitions are reported in the Appendix.

Interpretation: The relation between spreads and personal guarantees is more negative as guarantor wealth increases, particularly when loans are large relative to guarantor wealth.

	Whole sample	Loan amount / Personal wealth	
		< median	≥ median
	(1)	(2)	(3)
Personal guarantee	-39.271	-65.239	41.378
	(24.265)	(43.618)	(47.939)
Personal guarantee × personal wealth	-12.012*	0.890	-99.710*
	(6.672)	(14.984)	(54.196)
Personal guarantee × personal wealth^2	0.282*	-0.965	12.338*
	(0.144)	(0.945)	(6.321)
Personal wealth	-2.525**	-1.709	16.067
	(1.076)	(1.586)	(41.020)
Personal wealth^2	0.010***	0.008***	-2.197
	(0.002)	(0.003)	(4.783)
Controls	Yes	Yes	Yes
Adjusted R^2	0.247	0.308	0.286
Observations	495	242	253

Table 7: Regression Analysis of Loan Maturity and Loan Amount on Personal Guarantee, Owner Wealth, and their Interaction

This table presents loan-level regressions with maturity and amount as dependent variables. It first reports direct relationships with personal guarantees, followed by interactions between guarantees and owner wealth, and then by subsample analysis based on the loan size relative to owner wealth. All regressions are estimated with an intercept. Standard errors are in parenthesis and are clustered at the two-digit SIC code level. ∗∗∗, ∗∗, and ∗ denote statistical significance based on two-sided tests at the 1%, 5%, and 10% level, respectively. Variable definitions are reported in the Appendix.

Interpretation: Personal guarantees do not exhibit a direct relation with loan maturity or loan amount but are related through interactions with owner wealth. For loan amounts, this interaction is more pronounced when the loans are large relative to the guarantor's wealth.

Regressions of loan maturity and loan amount

	Loan maturity				Loan amount			
	Whole sample		Loan amount / Personal wealth		Whole sample		Loan amount / Personal wealth	
			< median	≥ median			< median	≥ median
Personal guarantee	3.395	7.064	8.014	11.366	-0.267	-0.363*	-0.073	-1.173
	(4.192)	(5.017)	(10.037)	(9.334)	(0.217)	(0.208)	(0.064)	(0552)
Personal guarantee		-2.195**	-3.419	-4.553		0.144***	0.033	0.938**
× personal wealth		(0.946)	(2.290)	(7.287)		(0.040)	(0.030)	(0.415)
Personal guarantee		0.033	0.112	0.439		-0.007***	-0.002	-0.054
× personal wealth^2		(0.020)	(0.135)	(0.789)		(0.001)	(0.004)	(0.046)
Personal wealth	-0.481**	-0.116	-0.216	-1.590	-0.055	-0.034	0.020	-0.457
	(0.223)	(0.226)	(0.215)	(4.982)	(0.042)	(0.025)	(0.019)	(0.440)
Personal wealth^2	0.001**	0.000	0.000	0.037	0.000	0.000	-0.000	0.017
	(0.000)	(0.000)	(0.000)	(0.518)	(0.000)	(0.000)	(0.000)	(0.039)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.042	0.046	0.045	0.102	0.666	0.681	0.375	0.700
Observations	504	504	247	257	531	531	256	275