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Differences in the Usage of Credit Guarantees Across Banks[1]

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Abstract

We investigate differences in the use of credit guarantees among banks by using a bank-firm matched dataset from Japan. By following Khwaja and Mian (2008) to control for borrower characteristics and the supply factors of guarantees using firm fixed effects, we extract the part of the ratio of guaranteed loans to total loans that depends solely on banks' factors for the demand for guarantees. We find significant differences in this after-control ratio for some banks, and the distribution of the ratio is significantly different from that of an uncontrolled ratio based on publicly available data. We further find that the controlled ratio does not depend on the financial conditions of the respective banks such as the capital ratio of the banks, which indicates that other observable and/or unobservable bank characteristics determine these differences in the use of credit guarantees across banks.

Keywords: Credit guarantees; banks; loan supply; moral hazard
JEL classification: G21, G28

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1. Introduction

Credit guarantees are a type of guarantee that a guarantor provides when financial institutions underwrite loans to corporate borrowers. In return for obtaining a fee in advance, the guarantor makes the repayment to the lender in case of the borrower's default. The governments of many countries around the world provide public programs for credit guarantees to facilitate loans by private financial institutions to firms that have difficulty in raising funds, especially small and medium-sized enterprises (SMEs) (Beck, Klapper, and Mendoza 2010). Governments have also extensively used credit guarantee programs to cope with a financial crisis. For instance, 19 out of 23 OECD member countries used or enhanced their credit guarantee schemes following the onset of the Global Financial Crisis (Uesugi, Sakai, and Yamashiro 2010).

The most important expected benefit of credit guarantees is to increase the loan supply. Firms face financial constraints for many reasons, for example, the asymmetric information between lenders and borrowers. Credit guarantees can overcome such a constraint by reducing lenders' risk and promoting their loan provision (Stiglitz and Weiss 1981, Mankiw 1986, Gale 1990, 1991). However, theory also suggests that the guarantees might come with costs, and the promotion of loans to inefficient firms is one of the most serious concerns (de Meza and Webb 1987 and de Meza 2002). Because guaranteed loans are safer than non-guaranteed ones, lenders might prefer to provide guaranteed loans even when they recognize that the likelihood of repayment is small. Lenders might also have smaller incentives to screen and monitor guaranteed loans than non-guaranteed ones. These problems are often called the moral hazard behavior that credit guarantees invite. Furthermore, guaranteed loans might be more preferable for banks because their risk weight for the regulatory capital ratio is smaller than non-guaranteed ones. We can thus expect that the willingness to use credit guarantees differs across banks, especially in light of the level of their capital ratios.

Given this background, we use a fact finding study to examine whether there is any difference in the use of guaranteed loans among banks. However, we do not simply compare the actual use of guaranteed loans, for example, measure as the ratio of guaranteed loans to total loans, because such a ratio does not necessarily indicate the use of guarantees stemming from banks' preferences for guaranteed loans. The actual use of credit guarantees depends not only on banks' preferences but also on the borrower's characteristics as well as on the attitude of guarantors to provide guarantees (factor in guarantee supply). For example, banks might have a high ratio of guaranteed loans not only because they have strong preferences for them but also because they have risky borrowers or transact with guarantors that are more willing to provide guarantees. To isolate the use of guarantees that is solely due to banks' demand factors for guarantees, we need to tease out the effects of these factors.

To address this challenge, we use data from a corporate survey, the *Survey on Current Situation of Corporate Finance in Japan*, that a group of researchers conducted from October to November 2010. The data from this survey enables us to construct a unique bank-firm matched dataset. The most significant advantage of this dataset is that for each sample firm, we have information on two loans from two different banks: the bank that lends the largest amount to the firm and the other that lends the second largest. Using this information, we construct and use dummy variables for each sample firm that is possible despite the cross-sectional data. For these dummies, we regress the ratio of guaranteed loans to total loans, and thereby control for firm fixed effects. This control allows us to eliminate the effects of borrower characteristics including the demand factors for loans on the use of credit guarantees. We can also eliminate the effects of the guarantors' characteristics, or the supply factors for guarantees, because in the guarantee programs in Japan, the location of the borrower determines its guarantor. The extracted difference in the ratio of guaranteed loans is solely due to factors on the supply side of loans, that is, on banks. Methodologically, this approach of ours is the so-called *fixed-effect estimator* (Khwaja and Mian 2008).

In the regression analysis, we use two specifications. In the first specification, which we call the bank fixed effect regression, we regress the ratio of guaranteed loans on bank fixed effects (after controlling for firm fixed effects). This specification is to examine whether there are significant differences in the use of guaranteed loans across banks. In the second specification, which we call the bank characteristics regression, we use variables at the bank or the bank-firm level instead of using the bank fixed effects (again, after controlling for firm fixed effects). In this specification, we examine whether any differences in the use of credit guarantees across banks stem from differences in observable bank characteristics or bank-firm relationships. Specifically, we use four financial indicators (regulatory capital ratio, return on asset (ROA), nonperforming loans (NPL) ratio, and size), bank type dummies, and the duration (year) of the bank-firm relationships. The most important variable is the bank's capital ratio, because less capitalized banks might want to use more guaranteed loans to retain regulatory capital ratios. Unprofitable banks and banks suffering from nonperforming loans might also use guaranteed loans to increase profitability or reduce risk by holding safer assets.

Our results show that there is some significant difference in the use of guaranteed loans across banks. The bank fixed effect regression shows that even after controlling for the factors for borrower characteristics and the supply of guarantees, non-negligible differences remain across banks in the ratio of guaranteed loans to total loans that is solely attributable to the bank fixed effects for a few banks with particularly high or low guarantee ratios. When we extract the part of the ratio explained by these effects and compare them to the uncontrolled ratio of outstanding guaranteed loans to total loans by using publicly available financial data at the bank level, we find a significant difference in their distributions.

In contrast, the analysis of the bank characteristics regression finds that the use of credit guarantees does not depend on the banks' observable characteristics that we consider (i.e., their financial condition, type, and borrower relationship). This finding means that the different use of credit guarantees across banks that we find in the bank fixed effect regression is not due to differences in the banks' capital ratio, profitability, and risk, but to differences in their other observable and/or unobservable characteristics.

The main contribution of this paper is in its extraction of the difference in the use of credit guarantees across banks that purely stems from differences across banks. There are many empirical studies on public programs for credit guarantees, but most of them examine the relation between the use of credit guarantees and the ex-post characteristics of borrowers. [1] To the best of our knowledge, ours is the first to extract differences in the use of credit guarantees due solely to banks' demand factors by taking advantage of the strong identification method of the fixed-effect estimator.

The rest of the paper is composed as follows: Section 2 has a review of the empirical literature, and Section 3 gives some institutional background behind the credit guarantee programs in Japan. We then explain our data and the method in Section 4. Section 5 presents the results. Section 6 concludes this paper.

2. Evidence on credit guarantees

Many empirical studies exist on the public programs for credit guarantees. The primary focus in these studies is on whether or not they increase the credit available to potential borrowers, or fill the "funding gap" (also referred to as "incrementality" or "additionality") (Cowling 1998, Cowling and Mitchell 2003, Riding and Haines 2001, Cowling 2010, Riding, Madill, and Haines 2007, Zecchini and Ventura 2009, Boschi, Girardi, and Ventura 2014). To examine whether the increased availability is efficient or not, many studies also examine the ex-post performance of the borrowers of guaranteed loans such as their profitability and riskiness, or real outcomes such as employment and productivity (Riding and Haines 2001, Boocock and Shariff 2005, Kang and Heshmati 2008, Oh, Lee, Heshmati, and Choi 2009, Craig, Jackson, and Thomson 2007, Brown and Earle 2017, Mullins and Toro 2017, and Lee 2018).

Some studies deal with these issues using data from Japan on special guarantee programs to cope with a financial crisis. Uesugi, Sakai and Yamashiro (2010) examine the effect of the Special Credit Guarantee Program for Financial Stability (1998–2001) that was an emergency 100% guarantee program to support SMEs after the banking crisis in Japan. They find that the program significantly increased the credit available to borrowers, and the borrowers, especially low-risk firms, became more efficient. Consistent with these findings, Wilcox and Yasuda (2008) find that the benefit was larger for the first-time users of the program. However, a later study on the Emergency (Safety-Net) Credit Guarantee Program, which is another emergency 100% guarantee program implemented after the global financial crisis, finds that the improved credit availability is associated with poorer ex-post performance of the borrowers and that the borrowers' main banks switched from non-guaranteed loans to guaranteed loans (Ono, Uesugi, and Yasuda 2013).

Compared to the ample attention on borrowers' outcomes, there is relatively little research on the behavior of lenders, or how they use credit guarantees. To answer whether banks provide guaranteed loans to high risk borrowers, Saito and Tsuruta (2018) examine the association between the default rates of borrowers and their ratio of guaranteed loans to total loans and find affirmative evidence. Wilcox and Yasuda (2008) and Ono, Uesugi, and Yasuda (2013) focus on the relation between guaranteed and non-guaranteed loans to examine their substitutability or complementarity. Different from these studies, we examine whether the use of guaranteed loans depends on lender characteristics.

The most closely related study to ours is Hancock and Wilcox (1998), which examine the effects of banks' financial conditions on different financial and real economic activities. One of their dependent variables is the amount of credit guarantees, and they find no significant effect of the banks' financial variables on this amount. However, their analysis is at the state level in the U.S., and although they take into account simultaneity bias by using lagged variables as instrumental variables, they only indirectly control for borrower characteristics. Our use of data at the bank-firm level enables us to completely control for the firm fixed effects to exclude the effects from any unobservable and observable borrower-specific factors, including factors for loan demand and for guarantors, and thereby extract the difference in the usage of credit guarantees solely due to lender-specific factors.

3. Credit guarantee programs in Japan

The providers of the public programs for credit guarantees in Japan are the credit guarantee corporations (CGCs) that are government-affiliated institutions established based on the Credit Guarantee Corporation Law.[2] There are 51 CGCs in Japan (47 prefecture-level corporations and 4 city-level ones) that provide guarantees for the loans to the SMEs that are located in their respective areas.[3] The outstanding amount of liabilities guaranteed by the corporations was 22.2 trillion yen at the end of March 2018 (Japan Federation of Credit Guarantee Corporations 2018).

[2] The guaranteed liabilities associated with the loans are (re)insured by the Japan Finance Corporation's Small and Medium Enterprise Unit. See Nitani and Riding (2005) and Japan Federation of Credit Guarantee Corporations (2017) for more institutional background behind the credit guarantee programs in Japan.

[3] Note that firms located in the four specific cities (Yokohama, Kawasaki, Nagoya, and Gifu) can to obtain credit guarantees from the city's CGC as well as from the CGC of the prefecture in which the city is located. To the extent that firms in these cities can freely choose a CGC, it is hard to perfectly control for guarantee supply effects by using firm fixed effects. However, the number of firms located in these cities is small in our sample (32 firms) and controlling for them using the four city dummies does not qualitatively change the results.

Historically, the CGCs had provided 100% guarantees only. However, due to concerns about reduced incentives for lenders to screen and monitor borrowers, the government reduced the coverage to 80% in 2007 (the so-called responsibility-sharing scheme). However, some "exceptional" 100% guarantee programs still exist that include the two massive emergency programs to cope with financial crises: Emergency (Safety-Net) Credit Guarantee Program of 2008 to respond to the global financial crisis, and the Great East Japan Earthquake Recovery Emergency Guarantee Program of 2011 to respond to the great Tohoku earthquake.

In this paper, we use data obtained from a corporate survey conducted in the fall of 2010. Unfortunately, we have no information in our data to breakdown the amount of loans with 100% and 80% guarantees. The aggregate statistics indicate that among the 35.1 trillion yen of outstanding guaranteed loans at the end of March 2011, the Emergency Credit Guarantee Program (100% guarantee) is responsible for 17.7 trillion yen (50.5%), the other 100% guarantee programs are responsible for 6.1 trillion yen (17.5%), and the responsibility-sharing 80% guarantees equate to 11.2 trillion yen (32.0%).[4]

4. Data and Method

4.1. Dataset and sample selection

The data used in this study are collected from the *Survey on Current Situation of Corporate Finance in Japan* that a group of researchers, including one of the authors, conducted in the period

[4] These figures are obtained from a document presented at the 7th meeting (May 31, 2017) of the Finance Working Group of the Council for Small and Medium Enterprise Policy of the Small and Medium Enterprise Agency of the Government of Japan.

from October to November 2010. The questionnaire was sent to 13,579 target firms that were selected from the database of Tokyo Shoko Research (TSR), one of the largest providers of credit information of firms in Japan.[5] Among the 13,579 firms, 2,703 firms responded (response rate of 19.9%). The survey consists of six parts: company profile, financial transaction between companies and bank, defaulting on loans and related bank, supervision, policy and credit guarantee.[6]

The top three industries of the responding firms are construction (57.9%), manufacturing (12.2%) and wholesale (9.7%). Most of them (61.7%) are firms established more than 30 years ago, and 68.7% of them have 20 employees or less. More than 60% of the responding firms use credit guarantees (64.9%) in which 43.8% use the guarantees for more than 10 years.[7]

4.2. Guarantee ratio and firm fixed effects

Our main variable is the credit guarantee ratio that we define as the ratio of the amount of guaranteed loans to that of the total loans. The survey contains questions that enable us to measure the ratio at the bank-firm level. Specifically, each firm disclose the amount of loans obtained during 2009 from two banks: the one that lend the most, which we call the largest lender, and the one that lend the second most, the second largest lender. The survey also asks for the amount of guaranteed loans from the respective banks. We can thus calculate two guarantee ratios per firm, one for the largest lender and another for the second largest. Because not all responding firms answered the

[5] The SME Agency of the government of Japan has frequently used the TSR database for their annual issues of the White Paper on Small and Medium Enterprises. The selection criteria for the 13,579 target firms are: (i) firms that have financial statements that are available from the TSR for fiscal 2007 and 2009, and (ii) firms that have transactions with one of the pre-specified 286 regional financial institutions (31 regional banks, 183 Shinkin banks, and 72 credit cooperatives). These are the criteria to obtain data suitable for research other than the present one.

[6] Studies using data from this survey include Hattori, Shintani, and Uchida (2015) and Nakaoka, Takada, and Uchida (2017).

[7] For more information on the characteristics of the responding firms, see Nakaoka, Uchida, and Yamori (2011a, b).

relevant questions, the number of observation is smaller than half the number of responding firms: 802 observations for the guarantee ratio at the bank-firm level.[8]

In our analysis, we use this credit guarantee ratio as the dependent variable and regress it on bank variables as well as the indicators (dummy variables) for firms by OLS. We can use the firm dummies because although our data are cross-sectional, we have multiple observations per firm. Among the 802 observations, 430 are for the firms with 2 observations, that is, one observation for the firm and its largest lender, and the other for the firm and its second-largest lender. For these firms, we use dummy variables that completely control for their firm fixed effects, and as we explain below, these dummies enable us a strong identification of banks' demand for credit guarantees. To check the robustness of our results, we also run the regression for the full sample of 802 observations.

Table 1 reports the descriptive statistics for the dependent variables for the 802 and 430 observations, together with those for the other variables we use in the analysis. As for the full sample of 802 observations, the mean value of the guarantee ratio is 7.8%, but the ratio ranges from 0% to 100%. The mean ratio is higher than that for the subsample with two observations per firms, which is 5.3%.

< Insert Table 1 here >

[8] We drop the observations with the ratio being smaller than 0% or larger than 100%.

4.3. Bank variables

4.3.1. Bank fixed effects

In our first specification, we use bank fixed effects (bank dummies) as our main independent variables. We identify 260 different banks in the 802 bank-firm observations. However, because some of these banks lend to only one firm, we can only use dummies for 178 banks (that lend to two or more firms)for this sample, which we label as bank_dummy_2_1 through bank_dummy_2_178. For a robustness check, we alternatively focus on banks that lend to five or more firms. There are 47 such banks, and we create dummy variables labeled bank_dummy_5_1 through bank_dummy_5_47 for them. When we use the subsample for firms with two observations (430 observations), the number of banks that lend to two or more firms decreases to 95, and that for those lending to five or more firms decreases to 17.

Although these bank fixed effects are our main independent variables, the most significant advantage of our approach is examination of these *bank* fixed effects after controlling for the *firm* fixed effects that we explained above. This control enables us to completely eliminate the effects of borrower characteristics, including loan demand factors and firms' preference for credit guarantees. Also, it eliminates the effects of guarantors' characteristics, or guarantee supply factors, because in the guarantee programs in Japan, the location of the borrower determines its guarantor. Thus, the bank fixed effects in our analysis capture the difference in the ratio of guaranteed loans that is due solely to factors on the banks' side (guarantee demand and loan supply factors). Methodologically, this approach is the so-called fixed effect estimator (Khwaja and Mian 2008).[9]

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[9] To obtain an intuitive understanding of the advantage of this approach, Appendix provides an illustrative exposition on the extraction of banks' demand for credit guarantees by using the firm fixed effects.

After obtaining the bank fixed effects as estimated coefficients for these bank dummies, we will line up the banks in the order of the magnitudes of these fixed effects, and compare the usage of credit guarantees that is due solely to banks' guarantee demand factors. In addition to this visual comparison, we will also perform several tests to examine whether the differences in the magnitudes are statistically significant.

4.3.2. Bank characteristics regression

As an alternative specification, which we call the bank characteristics regression, we use different variables for bank characteristics and bank-firm relationships as our main independent variables. This specification is to examine whether the differences that we find, if any, in the guarantee ratios across banks in the bank fixed effect regression stem from differences in bank characteristics. As such variables, we first use four financial indicators for banks: regulatory capital ratio, ROA, nonperforming loan (NPL) ratio, and asset size. The data sources for these variables are banks' financial statements obtained through the Nikkei Financial Quest Database (Nikkei Inc.). We match the survey data and the financial statement data for the firms' largest and the second largest lenders that the responding firms identified in the survey.

We define the ROA as the ratio of current profits to total assets, the NPL ratio as the ratio of risk management loans to total loans, and the size as the natural logarithm of total assets.[10] Because there are banks that comply with the Basel (international) standards and those that comply with the domestic standards in Japan, we use a dummy variable for the former as an additional independent variable. Because the financial statement data are not available for a small number of banks, we have 788 observations of these indicators for the whole sample, and 412 observations for the firms

[10] Not using the natural logarithm does not qualitatively change the results.

with two observations.

Among the four variables, the most important variable is the capital ratio, because less capitalized banks might want to use more guaranteed loans to retain regulatory capital ratios. The ROA and the NPL ratio are also important, because unprofitable banks and banks that suffer from nonperforming loans might also use guaranteed loans to increase profitability, or reduce risk, by holding more guaranteed "safer" loans.

We also use other bank variables. First, to account for the different uses of credit guarantees by different types of banks, we add dummies based on the information obtained from the survey. The survey asks the types of the responding firm's largest and the second-largest lenders, and the firms choose an answer from the options of city banks, regional banks, second regional banks, Shinkin banks, and credit cooperatives.[11] Because no firms in our baseline sample chose credit cooperatives, we use dummies for regional, second regional, and Shinkin banks, with city banks as the default. Second, we use a variable for bank-firm relationships to examine whether the use of credit guarantees differs because of the strength of the relationship. Specifically, using the information from the survey, we use the duration (year) of the lending relationship between the responding firm and its largest or the second-largest lender. To consider any nonlinear effect, we take the natural logarithm of the duration.[12] Because there are some observations for which the information for duration is not available, we report both the results using and not using this variable. Third, we use the indicator for whether the relevant observation is for the firms' largest lenders as opposed to the second largest.

[11] City banks provide universal banking services and operate in the whole country. Regional banks are smaller banks that operate regionally. Second regional banks are similar to regional banks but with smaller size and a different historical background (they used to be former Sogo banks, a type of cooperative banks). Shinkin banks and credit cooperatives are smaller cooperative banks that provide banking services mostly to their members. See Uchida and Udell (2019) for more on the types of banks in Japan.

[12] The main results are unchanged even if we do not use the natural logarithm.

Table 1 shows the descriptive statistics for these variables. The mean regulatory capital ratio for the sample firms is 12.5%. For an average bank, the ROA is 0.2%, the NPL ratio is 4.5%, and the asset size is 7.2 trillion yen. For the majority of firms, their largest lenders are either regional or second regional banks that both have comparable ratios. The average duration of the bank-firm relationship is 14 years. For the subsample with two observations per firm, the capital ratio, the NPL ratio and the ROA are comparable. As for bank types, the ratio of regional banks (50%) is larger than that for second regional banks (40%). The average duration of relationships is 14.9 years, which is slightly longer than that for the full sample.

5. Results

5.1. Results for bank fixed effect regression

Figure 1 presents the results for the bank fixed effect regression. In the four panels of this figure, we plot the values of the coefficients for the bank dummies in the order of their magnitudes together with their confidence interval (the significance level of 95%). Panels A and B are for the results that use the full 802 observations, while panels C and D are for the results that use the subsample of 430 observations for the firms with two observations. Panels A and C show the results for bank_dummy_2_1 through bank_dummy_2_178 (the banks lending to two or more firms), while panels B and D show the results for bank_dummy_5_1 through bank_dummy_5_47 (the banks lending to five or more firms). As already explained, the numbers of banks shown in panels A, B, C, and D are respectively 178, 47, 95, and 17.

<Insert Figure 1 here>

As shown in panel A, the coefficients for the 178 bank_dum_2s range from -0.279 at the minimum to 0.758 at the maximum. However, for most of the bank dummies, the confidence interval includes the value of zero that means there is no difference in the use of credit guarantees between most banks and an average bank. The wide confidence interval is presumably because each bank dummy equals one for two observations only that produces a large standard error for the estimate of its coefficient. We also confirm that there is no difference in the use of credit guarantees between most banks and an average bank with an F-test for the null hypothesis of the equivalence of the coefficients for all 178 banks, which has a p-value of 0.134.

However, we do find that some banks have a significantly large or small coefficient for their fixed effects and the confidence intervals do not include the value of zero (there are 14 such banks). Pairwise tests (t-tests) for the differences in the coefficients between two arbitrarily chosen banks also demonstrate a non-negligible difference. The tests indicate that the highest coefficient (0.758) is statistically different from all those that are smaller than 0.40, except for two coefficients, and the smallest coefficient (-0.279) is different from all the coefficients that are larger than 0.18. Both coefficients are statistically significant at the 10% level.

However, the results in panel A suffer from some drawbacks. Most importantly, the difference between the minimum and the maximum coefficients is larger than one, which is economically difficult to interpret. This is because the actual ratio of guaranteed loans never exceeds one. Part of this extraordinary result should stem from an imperfect control for the firm fixed effects, because we have no firm dummies for 372 (= 802 - 430) observations. The regression results support this view. Although the R-squared for this regression is relatively high at 0.5338, this value is due to a large number of independent variables, as the low adjusted R-squared of 0.0848 indicates.

Panel B shows the results when we use dummies for the 47 banks that lend to five or more firms. The range of the coefficients is now between -0.149 to 0.225 and is more plausible. The confidence interval now includes the value of zero for all the 47 banks, and the F-test for the equivalence of all coefficients is rejected with a p-value of 0.879. The results of no banks that use credit guarantees too much or too little is not necessarily inconsistent with the results in panel A. The majority of the 14 banks that have statistically significant non-zero coefficients in panel A lend to less than five firms. Only one of them is included in panel B, and the confidence interval of this bank's fixed effect ranges from -0.035 to 0.424. However, these are again the results without fully controlling for the firm fixed effects. The R-squared for the regression for panel B is 0.345, but the adjusted R-squared is only 0.0267. Therefore, a focus on the results using 430 observations (i.e., panels C and D) is plausible.

Turning to panel C, the coefficients for the 95 bank dummies range from -0.360 to 0.443. Again, most of the coefficients are not different from zero, and the F-test for the equivalence of all the coefficients yield a p-value of 0.427. However, we find four (three) banks for which the lower (upper) bound of the confidence interval is larger (smaller) than zero. The pairwise t-tests for the difference between the maximum or the minimum and the other coefficients show that at the 10% level of statistical significance, the maximum coefficient (0.443) is statistically different from the coefficients that take a value smaller than 0.13, and the minimum (-0.360) is statistically different from the coefficients that take a value larger than -0.1, with a few exceptions. Thus, the conclusion that there is some meaningful differences in the use of credit guarantees across banks is plausible. These results are trustable in the sense that both the R-squared and the adjusted R-squared are high (respectively 0.9229 and 0.726).

Panel D shows the subsample results for banks that lend to five or more firms. The estimated coefficients range from -0.0564 to 0.0756, and the band is very narrow, but no bank has an estimated coefficient that is statistically different from zero. The F-test for the equivalence of the coefficients is rejected because the p-value is 0.9925. And the t-tests show no pairwise differences between the minimum or the maximum and the other coefficient, except for the difference between the minimum and the second largest.[13] Although these results seem to be inconsistent with those in panel C, we again need to take into account that the numbers of banks shown in this panel is only 17. However, the R-squared and the adjusted R-squared for this regression (for panel D) are both very high (respectively, 0.8667 and 0.7106).

On balance, the results from the four panels of Figure 1 are not necessarily consistent with each other, especially due to a wide confidence interval of the estimated bank fixed effects. However, the analysis in panel C is the most trustable in that it fully controls for firm fixed effects, and there are a sufficient number of banks in the sample. The results from this analysis indicate that there are some banks that use excessively more or less credit guarantees. The significant difference between the largest and the smallest coefficients is relatively robust across the analyses. Thus, we can at least conclude that there is a significant difference in the ratio that stems solely from factors on the lenders' side.

5.2. Results for bank characteristics regression

Table 2 presents the results for the bank characteristics regression. The first four columns of this table show the results from using the full sample, while the remaining four show the results from using the subsample with two observations per firm. The columns with odd numbers do not use the log(duration) and so the number of observations is larger, while those with even numbers use the variable. Columns (1), (2), (5), and (6) present the results without controlling for the firm fixed effects, while columns (3), (4), (7), and (8) present the results with that control. A higher R-squared

[13] The bank with the second largest coefficient is one of the four banks with a statistically significant and positive coefficient in the analysis for panel C. The other three banks, and yet another three banks with a statistically significant negative coefficient in the regression for panel C, are not included in the analysis for panel D because they do not lend to five or more banks.

(or adjusted R-squared) for the latter set of results indicates that the control for the firm fixed effects is important, so we consider the results in columns (3), (4), (7), and (8). Additionally, whether we control for the duration does not make much of a difference in the results, so we consider the results in columns (4) and (8).

<Insert Table 2 here>

From columns (4) and (8), we find that the overall results are somewhat different depending on whether we control for the firm fixed effects completely or partially. In column (4) where we include a non-negligible number of one-observation firms and therefore only partially control for the firm fixed effects, the use of credit guarantees depends on the size and type of bank. However, we find no statistically significant coefficients in column (8) where we completely control for the firm fixed effects. This difference indicates that the variables with significant effects in column (4) might pick up any uncontrolled firm fixed effects. A higher adjusted R-squared in column (8) than that in column (4) supports this interpretation. Therefore, a focus on the results in column (8) is reasonable.

Column (8) shows the overall insignificance of the effects of the independent variables. This finding indicates that the use of credit guarantees does not depend on the capital ratio, profitability, or risk. The insignificance might stem from the lack of statistical power due to a small number of observations per firms. However, we need to account for the previous result from the bank fixed effect regression (panel (C) of Figure 1) for which we did find some significant difference in the use of credit guarantees for some banks. On balance, we can conclude that there is a difference in the use of guaranteed loans across banks, but the difference does not stem from the differences in bank characteristics or bank-firm relationships captured by our independent variables.

5.3. Additional results on bank fixed effects

In this subsection, we report the results for two additional analyses that are closely related to the bank fixed effect regression. The most significant advantage of our approach (the fixed effect estimator) is its ability to completely control for firm fixed effects. One way to highlight this advantage is to compare the results before and after the control. In this vein, Figure 2 compares the ratio of guaranteed loans shown in panel C with the ratio of guaranteed loans outstanding to total loans for the respective banks that we calculate using publicly available financial data at the bank level.[14] This comparison allows us to check whether and how the use of credit guarantees differ when we rely on our ratio that eliminates the firm-fixed effects and on the ratio calculated using publicly available bank-level data.

Figure 2 shows that the plot of the ratio with the publicly available data has a significantly different pattern from that of the ratio without the firm fixed effects. This difference clearly indicates that we should not judge whether the use of credit guarantees by banks is too much or too little without taking into account firm-fixed effects.

<Insert Figure 2 here>

Second, we examine the bank fixed effects after controlling for firm characteristics rather than firm fixed effects. In return for the ability to perfectly control for the firm-specific factors, the use of firm dummies significantly reduces the degree of freedom. Because we have two observations

[14] The numerator and the denominator of this ratio are respectively the amount of loans outstanding at the end of March 2010 (obtained from the financial statement data of the respective banks obtained through Nikkei Needs Financial Quest), and the amount of guaranteed loans outstanding at the end of November 2010 (obtained from the Small and Medium Enterprise Agency of the Government of Japan).

for one firm, the number of the firm dummies are half of the number of observations. To reduce the number of independent variables, we replace the firm dummies with 67 dummies to indicate firms' industry (6 dummies), age (4 dummies), the number of employees (5 dummies), and location (52 dummies) and run the regression for the subsample of 430 firms.[15] Although the number of observations decreases to 424 due to missing values for some dummies, the number of firm variables that we use decreases from 214 to 67.[16]

Figure 3 shows the bank fixed effects when we control for the firm characteristics. Compared with Figure 1 (panel C), we find a larger standard error in the coefficients for the bank dummies and that their distribution is less flat. However, the confidence interval still includes the value of zero for most of the observations. In the figure, we also depict the corresponding fixed effects obtained in the analysis for Figure 1 (panel C). The distributions of the two fixed effects are different, which indicates that the control of the 67 dummies is not perfect. These results indicate that although they are not perfect, the results shown in panel C of Figure 1 are the most reliable.

<Insert Figure 3 here>

6. Conclusion

By using unique data at the bank-firm level from Japan, we investigate whether and how the use of credit guarantees differs across banks. After controlling for borrower characteristics and guarantee supply factors by using a fixed-effect estimator, we find a significant difference in the

[15] These dummies are categorical because the original questions in the survey were categorical.

[16] The number of firm dummies for the subsample analysis (Panel C of Figure 1) is 214, not 215 (= 430 / 2), because even if we do not use a constant, one of the firm dummies has linear dependence on the other variables and is thus automatically dropped from the analysis.

ratio of guaranteed loans to total loans for some banks. We also find that the difference does not stem from differences in the banks' financial conditions, type, or the strength of the bank-firm relationships captured by our independent variables.

The finding that the use does not depend on banks' capital ratios means that banks do not use credit guarantees to increase the regulatory capital ratios by using guaranteed loans with a smaller risk weight. And the finding that the use does not depend on banks' profitability or nonperforming loan ratios means that credit guarantees are not more frequently by riskier banks, suggesting that the guarantees do not invite moral hazard behavior. However, because we could use only a limited number of variables due to the lack of data, we cannot consider all bank or bank-firm level factors to determine the different use of credit guarantees across banks. If the variables to measure the interaction of banks' and firms' riskiness were available, for example, we could test a hypothesis that riskier banks more frequently use credit guarantees for risky borrowers only. As such, our findings call for additional research on what other observable or unobservable factors might drive the difference in the use of credit guarantees across banks.

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Tables and Figures

Table 1 Basic Statistics

This table presents the descriptive statistics for our main variables. The guarantee ratio is the ratio of guaranteed loans to total loans. We have 802 observations for this variable, but when we limit the sample to the firms with two observations only, we have 430 observations. The remaining variables are for bank characteristics: the capital ratio is the ratio of the Basel standards for banks that operate internationally and of the domestic standards for the others; the ROA is the ratio of current profits to total assets; the NPL ratio is the ratio of risk management loans to total loans; and size is the natural logarithm of total assets. Because the financial statement data are not available for a small number of banks, we have 788 observations of these indicators for the whole sample, and 412 observations for the firms with two observations. Regional bank, Second regional bank, and Shinkin bank are the dummy variables for the type of banks (with city banks as the default). Duration is the length of the bank-firm relationships. Largest lender dummy is a dummy variable to indicate that the relevant observation is for the firm and its largest lender, not the second-largest.

	Full					Sub sample with 2 observations per firm				
	# of obs.	Mean	St. Dev.	Min.	Max.	# of obs.	Mean	St. Dev.	Min.	Max.
Guarantee ratio	802	0.0776	0.2380	0.0000	1.0000	412	0.0556	0.1935	0.0000	1.0000
Bank capital ratio	788	12.5156	5.2818	4.6500	65.1500	412	12.3911	4.5782	4.6500	65.1500
Bank ROA	788	0.0021	0.0020	0.0002	0.0285	412	0.0021	0.0018	0.0002	0.0248
Bank NPL ratio	788	0.0452	0.0331	0.0000	0.2748	412	0.0407	0.0323	0.0000	0.2748
Bank size (asset)	788	7176719.1	24969820.3	23517	153920000	412	9020002.6	28380338.3	55576	153920000
Bank capital BIS dummy	788	0.8934	0.3088	0	1	412	0.8641	0.3431	0	1
Regional bank	788	0.4302	0.4954	0	1	412	0.5000	0.5006	0	1
Second regional bank	788	0.4619	0.4989	0	1	412	0.3956	0.4896	0	1
Shinkin bank	788	0.0609	0.2393	0	1	412	0.0413	0.1991	0	1
Duration (years)	693	13.9911	13.9245	0	60	352	14.9067	14.5478	0	60
Largest lender dummy	788	0.6739	0.4691	0	1	412	0.5000	0.5006	0	1

Table 2 Bank Characteristics Regression

This table presents the results for the bank characteristics regression. The dependent variable is the guarantee ratio. The main independent variables are the four financial indicators, bank type dummy variables (see Table 1). Columns (1)-(4) show the results from using the full sample, while columns (5)-(8) show the results from using the subsample with two observations per firm. Columns with odd numbers do not use the log(duration), while those with even numbers use it. Columns (1), (2), (5), and (6) show the results without controlling for the firm fixed effects, while columns (3), (4), (7), and (8) show the results that do control for those effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	Full				Sub sample with 2 observations per firm			
Dependent Variable	Guarantee ratio							
Bank capital ratio	-0.0009	-0.0004	-0.0014	-0.0009	0.0006	0.0009	-0.0003	-0.0001
	(0.0012)	(0.0013)	(0.0016)	(0.0017)	(0.0015)	(0.0017)	(0.0007)	(0.0008)
Bank ROA	3.1061	-4.9837*	5.2701	-4.9241	-6.4146	-6.4623	-2.1538	-3.4674
	(6.6233)	(2.6495)	(8.5019)	(3.1931)	(4.1878)	(4.7511)	(4.0942)	(4.9629)
Bank NPL ratio	0.3263	0.4956	0.1172	0.2289	0.4777	0.8119*	0.2831	0.4892
	(0.3208)	(0.3729)	(0.4009)	(0.4607)	(0.3904)	(0.4717)	(0.3617)	(0.4290)
Log (bank size)	0.0190**	0.0202*	0.0299**	0.0321**	-0.0062	-0.0046	0.0028	0.0070
	(0.0094)	(0.0105)	(0.0126)	(0.0141)	(0.0106)	(0.0123)	(0.0120)	(0.0134)
BIS capital ratio dummy	-0.0132	-0.0088	-0.0089	-0.0172	-0.0113	0.0054	0.0145	0.0299
	(0.0344)	(0.0378)	(0.0508)	(0.0560)	(0.0310)	(0.0356)	(0.0275)	(0.0266)
Regional bank	0.1022**	0.1037**	0.1091*	0.1288*	-0.0037	-0.0091	-0.0510*	-0.0472
	(0.0443)	(0.0509)	(0.0563)	(0.0659)	(0.0492)	(0.0606)	(0.0274)	(0.0309)
Second regional bank	0.1442**	0.1365**	0.1910**	0.2094**	-0.0307	-0.0571	-0.0362	-0.0449
	(0.0575)	(0.0655)	(0.0747)	(0.0873)	(0.0649)	(0.0802)	(0.0322)	(0.0462)
Shinkin bank	0.1325*	0.1403*	0.1580*	0.1801*	0.0200	0.0340	-0.0637	-0.0708
	(0.0725)	(0.0830)	(0.0916)	(0.1077)	(0.0996)	(0.1227)	(0.0985)	(0.1330)
Largest lender dummy	0.0152	0.0253	-0.0001	0.0113	-0.0225	-0.0125	-0.0187	-0.0106
	(0.0198)	(0.0214)	(0.0155)	(0.0178)	(0.0236)	(0.0263)	(0.0134)	(0.0130)
Log (duration)		-0.0178**		-0.0116		-0.0208**		-0.0098
		(0.0073)		(0.0119)		(0.0091)		(0.0098)
Constant	-0.3172*	-0.2979	-0.4574*	-0.4713*	0.1662	0.1707	-0.0334	-0.0957
	(0.1789)	(0.2026)	(0.2338)	(0.2647)	(0.2038)	(0.2404)	(0.2344)	(0.2089)
Firm fixed effects	no	no	yes	yes	no	no	yes	yes
Observations	788	690	788	690	412	342	412	342
R-squared	0.0119	0.0196	0.3253	0.3315	0.0131	0.0329	0.8573	0.8754
Adjusted R-squared	0.000427	0.00521	0.0717	0.0751	-0.00900	0.00364	0.702	0.736

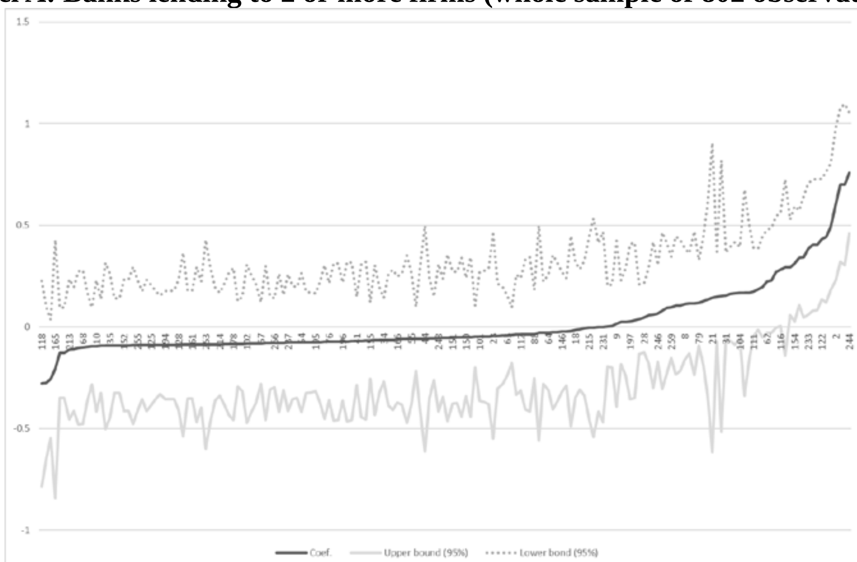
Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Figure 1 Bank Fixed Effects

This figure presents the results for the bank fixed effect regression in which we plot the values of the coefficients for the bank dummies in the order of their magnitudes. Panels A and B show the result from using the whole sample, while panels C and D shows the results from using the subsample of firms with two observations. In panels A and B, we use the dummies for banks that lend to 2 or more firms, while in panels C and D, we use the dummies for banks that lend to 5 or more firms.

Panel A: Banks lending to 2 or more firms (whole sample of 802 observations)



Panel B: Banks lending to 5 or more firms (whole sample of 802 observations)

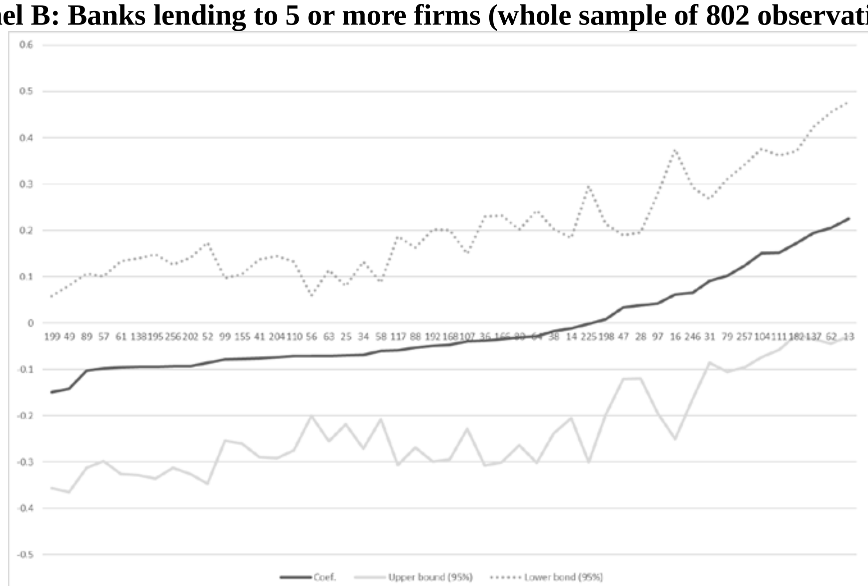
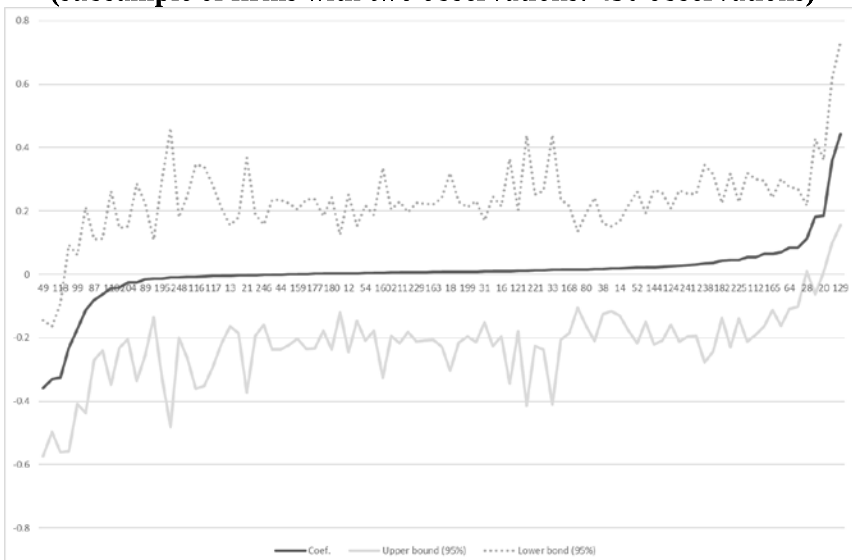


Figure 1 (continued)

Panel C: Banks lending to 2 or more firms
(subsample of firms with two observations: 430 observations)



Panel D: Banks lending to 5 or more firms
(subsample of firms with two observations: 430 observations)

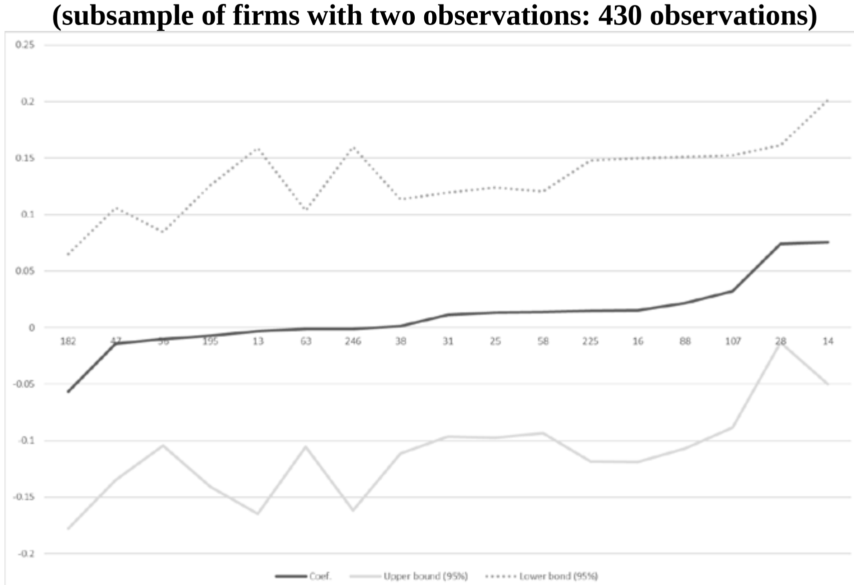


Figure 2 Guarantee Ratios with and without Controlling for Firm Fixed Effects

This figure compares the ratio of guaranteed loans explained by the bank fixed effects (shown in Panel C of Figure 1) with the ratio of overall guaranteed loans outstanding to total loans of the respective banks using publicly available financial data at the bank level.

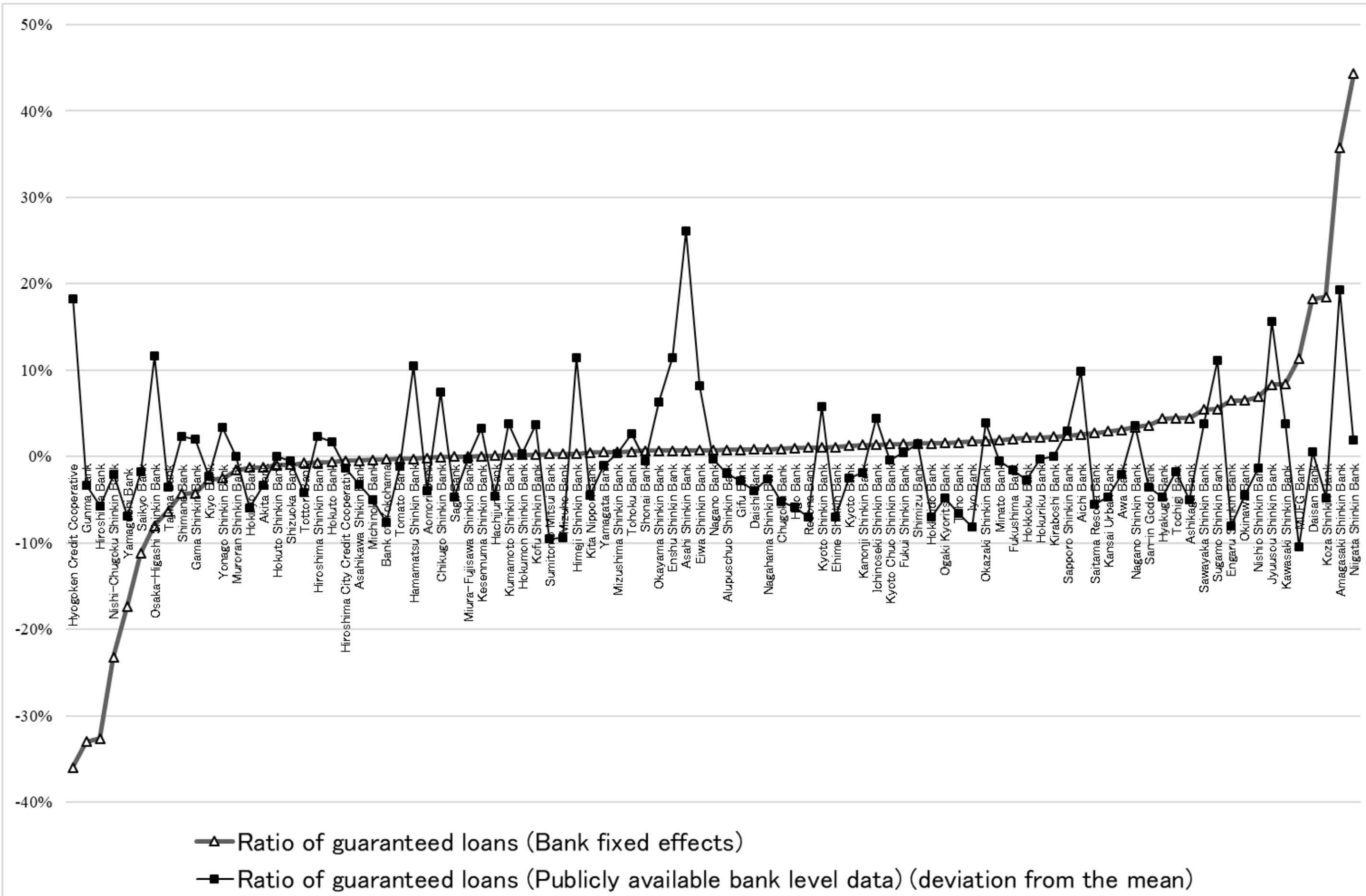
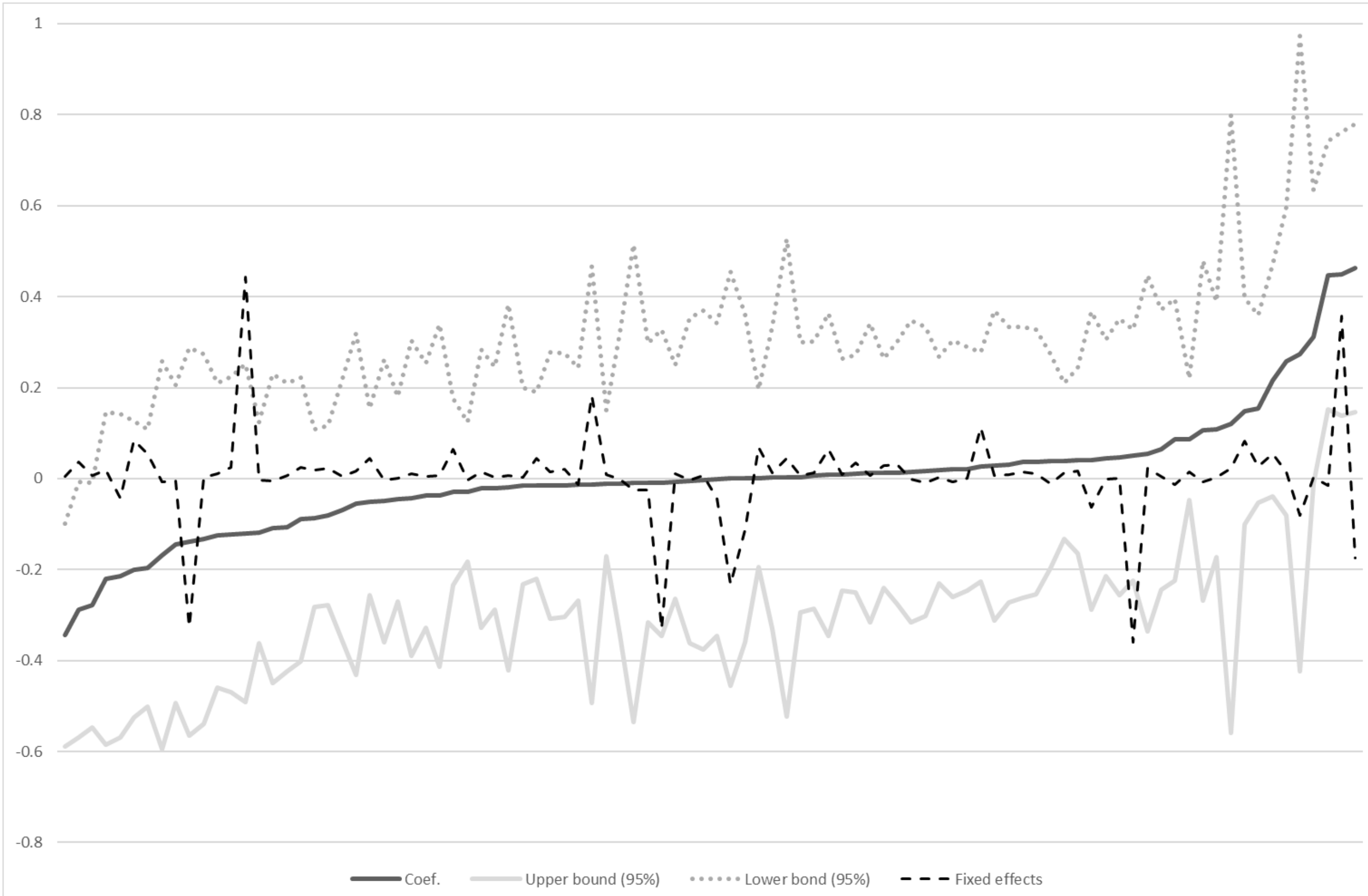


Figure 3 Guarantee Ratios after Controlling for Firm Characteristics

This figure compares the ratio of guaranteed loans explained by the bank fixed effects after controlling for firm characteristics together with their confidence intervals. For comparison, the bank fixed effects after controlling for the firm fixed effects (shown in Panel C of Figure 1) are also depicted.



1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Coef.
Upper bound (95%)
Lower bond (95%)
Fixed effects

Appendix Illustration of the fixed effect estimator

To obtain an intuitive understanding of the advantage of the fixed-effect estimator that controls for the effects of borrower characteristics (including guarantor characteristics), this appendix provides its illustrative exposition. Note that the figures below are simplified for the sake of understanding and therefore sacrifices mathematical rigidity.

Suppose first that one bank (Bank 1) and two firms (Firms A and B) exist. Let us consider two cases, Cases 1 and 2 as depicted in Panel (A) of Figure A1. The differences in the two cases are in the ratios of guaranteed loans of Bank 1 with respect to the respective firms. Comparing the two cases, we might want to conclude that Bank 1 does not necessarily use many guarantees in Case 1 but uses many in Case 2. However, the guarantee ratios shown in Panel (A) include firm fixed effects, and they do not necessarily indicate whether the bank uses more or less guarantees.

< Insert Figure A1 here >

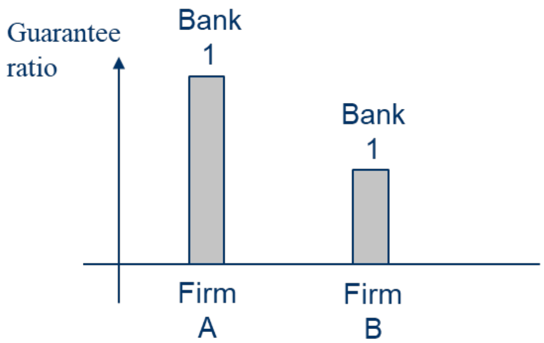
To illustrate the need to control for the firm fixed effects, we add two other banks to Panel (B). If the guarantee ratios for the banks with respect to the two firms are as shown in Case 1, the wrong conclusion is that Bank 1 does not necessarily use many guarantees, because the other two banks use the guarantee far less than Bank 1. In Case 2, in contrast, all the three banks use many guarantees, so wrong conclusion is that (only) Bank 1 uses many guarantees. To judge the portion of the guarantee ratios that is solely attributable to Bank 1's use, we thus need to eliminate the portion of the guarantee ratios that are ordinarily applied to the firms. One way to do so is to subtract the average of the guarantee ratios within firms and across banks. As another way, our fixed-effect estimator does so by regressing the guarantee ratios on the dummy variables for the firms.

Figure A1 Fixed-Effect Estimator (illustration)

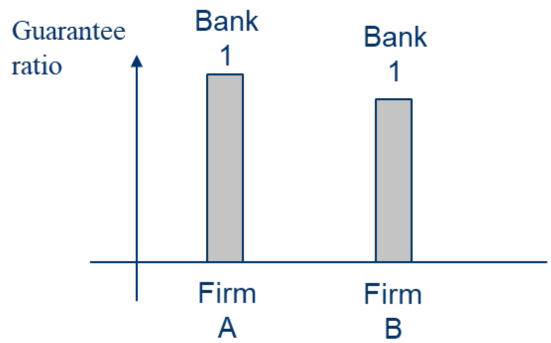
This figure illustrates how our fixed-effect estimator disentangles bank and firm fixed effects.

(A) 1 bank and 2 firms

[Case 1]

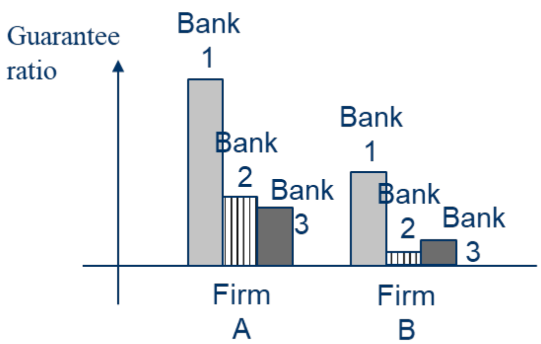


[Case 2]



(B) 3 bank and 2 firms

[Case 1]



[Case 2]