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Differentiated Use of Small Business Credit Scoring by Relationship Lenders and Transactional Lenders: Evidence from Firm-Bank Matched Data in Japan[*]

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Abstract

This paper examines the ex-post performance of small and medium enterprises (SMEs) that obtained small business credit scoring (SBCS) loans, using a unique Japanese firm-bank matched dataset. The ex-post probability of default after the SBCS loan was provided significantly increased for SMEs that obtained an SBCS loan from a transactional lender. Also, the lending attitude of relationship lenders during the recent global financial crisis was more severe if a firm had received an SBCS loan from a transactional lender. These findings suggest that SBCS loans by transactional lenders are more prone to type II errors and detrimental to relationship lenders' incentive to provide "liquidity insurance."

JEL classification: G21, G32

Keywords: small business credit scoring, lending technology, relationship lending

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1. Introduction

Loans to small businesses have traditionally been based on intimate relationships between borrower firms and lenders, because many of these firms are much more informationally opaque than large firms and thus lenders primarily rely on "soft" information gathered through long-lasting transaction relationships. However, advances in information technology over the past decades have considerably transformed the landscape of small business lending, and a number of transaction-based lending technologies that rely on quantifiable and verifiable "hard" information have become available. In particular, small business credit scoring (SBCS) has expanded rapidly in many countries and has attracted a fair amount of research interest.[1] It has been argued that SBCS is effective in increasing the availability of credit to small businesses (Agarwal and Hauswald, 2008; Berger et al., 2011; Berger et al., 2005a; Frame et al., 2001). However, the recent global financial crisis has raised concerns that, in cases where relationship lending plays an important role, SBCS loans may have adverse effects on the provision of credit by relationship lenders during times of crisis.[2]

Against this background, the present paper, focusing on Japan, examines how firms that received SBCS loans weathered the financial crisis that erupted after the failure

[1] See Berger and Frame (2007) for a survey.

[2] See "When Business Credit Scores Get Murky," *Wall Street Journal*, March 18, 2010.

of Lehman Brothers in September 2008. In particular, the paper examines whether the ex-post performance of firms that received an SBCS loan before the crisis depends on whether the lender was a relationship or transactional lender. Most, if not all, previous studies assume that SBCS loans are provided by transactional lenders. However, as we show below, SBCS loans may be provided by relationship lenders as well. We argue that the differentiated use of SBCS by relationship and transactional lenders may affect firms' ex-post performance as well as the relationship lenders' willingness to provide rescue finance when firms face difficulties during crisis.

The analysis in this paper relies on a unique firm-bank matched dataset on SBCS in Japan. Our dataset is based mainly on firm surveys conducted during 2008-2009. The virtue of these surveys is that we can identify SBCS loan user firms and non-user firms as well as firms' primary bank, that is, the bank that has the largest amount of loans outstanding to a particular firm. Moreover, we can identify whether a primary bank (which we assume to be a relationship lender) or a non-primary bank (transactional lender) has extended SBCS loans to a particular firm. Using this rich dataset, we can make inferences on the differentiated use of SBCS by relationship and transactional lenders.

Focusing on the period of financial turmoil after the failure of Lehman Brothers, we conduct two empirical analyses. The first examines the link between SBCS loans and firms' performance during the crisis. Whether the models underlying SBCS loans correctly

identify firms with a higher probability of default (PD) and such loans therefore are superior to relationship loans is of both academic and practical interest, but the evidence to date is rather mixed (see, e.g., Agarwal and Hauswald (2008) and DeYoung et al. (2008) versus Berger et al. (2011)). We conjecture that this mixed evidence potentially stems from the fact that both relationship (primary) and transactional (non-primary) lenders use SBCS, but do so in different ways and/or for different purposes. Consistent with this conjecture, we find that, on average, the ex-post PD of firms that obtained SBCS loans from non-primary banks is higher than that of non-SBCS loan user firms, while the ex-post PD of firms that obtained an SBCS loan from their primary bank is smaller than that of non-SBCS loan user firms.

Second, we investigate whether the use of transactional loans such as SBCS loans adversely affected a relationship lender's incentive to provide assistance to its client-firms during the financial crisis. Theoretical studies on relationship lending suggest that relationship lenders will be willing to lend to profitable client firms during a crisis because they have gathered sufficient information on them (Rajan, 1992; Bolton et al., 2013). However, if a client firm has obtained an SBCS loan from a transactional lender, this may be detrimental to the relationship lender's willingness to provide a loan, because a higher indebtedness of a borrowing firm exacerbates its moral hazard incentives (Degryse et al., 2012). In addition, relationship lenders might infer that their client firms' creditworthiness

had worsened if these firms had obtained an SBCS loans from transactional lenders, which may be more prone to type II errors (approving a loan that will default) than relationship lenders.[3] On the other hand, no such negative spillover effects should occur if SBCS loan have been extended by relationship lenders themselves. Consistent with the first part of this hypothesis, we find that the lending attitude of firms' primary bank worsened during the financial crisis if the firms had obtained an SBCS loan from a non-primary bank. In contrast, when SBCS loans were provided by the primary bank itself, we do not find such detrimental effects of SBCS loans on primary banks' lending attitude.

The study contributes to the literature on SBCS in the following respects. First, as highlighted by, for example, Mester (1997), the accuracy of SBCS models should be assessed based on their performance during an economic downturn. Yet, most studies on SBCS employ datasets for non-crisis periods. Focusing on the recent financial crisis, our study, as far as we are aware, therefore is the first to examine the performance of SBCS loans during a crisis. It also should be noted that most previous studies examine SBCS loans in the United States and there are few studies on other countries. Moreover, our study in fact is the first on Japan. Banking systems differ across countries, and examining the experience of Japan, with its idiosyncrasies, can help to provide a richer understanding of issues surrounding SBCS loans.

[3] See Section 3.2 for details.

Second, most previous studies assume that the provider of SBCS loans is a transactional lender. However, our analysis shows that both relationship and transactional lenders extend SBCS loans, and these loans result in different outcomes. Specifically, we find that firms that obtained SBCS loans from transactional lenders were more likely to default than firms that obtained such loans from relationship lenders. Understanding why SBCS loans are associated with differences in firm performance depending on the type of lender is important. However, to date, this issue has received little attention in the literature, mainly due to data limitations: previous studies have had to rely on bank-level datasets that did not make it possible to distinguish whether banks extending SBCS loans were a relationship lender for particular firms.[4] In contrast, our firm-bank matched dataset allows us to make such a distinction.

Third, this paper empirically examines, to our knowledge for the first time, how the role of relationship lenders as providers of liquidity insurance during a financial crisis is affected by their clients' use of SBCS loans and finds that SBCS loans by transactional lenders have negative externalities. That is, while previous studies (e.g., Bolton et al., 2013) show that relationship lenders play the important role of providing favorable

[4] Most studies are based on a survey of the largest U.S. banks conducted by the Federal Reserve Bank of Atlanta in January 1998. A notable exception is the recent study by Berger et al. (2011) using a survey of U.S. community banks conducted by the U.S. Small Business Administration.

continuation-lending in a crisis, our findings highlight that SBCS loans by transactional lenders may have an adverse impact on the provision of liquidity by relationship lenders in times of crisis.

The remainder of the paper is organized as follows. Section 2 briefly describes the development of the SBCS loan market in Japan. Section 3 then develops our empirical hypotheses on how the use of SBCS loans affects the ex-post performance of borrower firms and the lending attitude of their relationship lenders during times of crisis. Section 4 describes the data and variables used and explains our empirical models. Section 5 presents and discusses the results of our empirical analysis. Section 6 concludes.

2. The Development of Small Business Credit Scoring in Japan

Credit scoring is a quantitative method to evaluate the credit risk (PD) of loan applications. Using both qualitative and quantitative data and statistical techniques, credit scoring produces a "score" for a loan applicant that forms the basis of credit decisions such as whether or not to provide a loan and the loan contract terms. Following Berger and Udell (2006), we define SBCS loans as loans where the primary lending decision is based on numerical credit scores. Note that this definition does not rule out the use of other information (for instance, soft information that is primarily used in relationship lending) as a secondary source.

In the United States, credit scoring has been used for underwriting consumer credit for some time, but was not used for small business credit until the mid-1990s because of the heterogeneity of small businesses. The development of credit scoring models for small business loans in the 1990s was motivated by the casual observation that repayments of small business loans depended less on the business itself than on the credit history of the business owner (Mester, 1997). Since then, many U.S. banks have been using the consumer credit score of small business owners to evaluate small business loan applications.

SBCS has been rising in popularity among Japanese banks as well since the early 2000s. At the end of 2005, the outstanding amount of SBCS loans for the three largest banks was 5 trillion yen (about 50 billion dollars), about 5 percent of their entire loans outstanding to small businesses.[5] SBCS has also spread among regional banks and cooperative financial institutions, who originated more than 8 trillion yen of SBCS loans in total during FY2003 – FY2006.[6] Many scoring models adopted by Japanese banks use only firms' attributes such as financial ratios and do not take into account most, or any, of the business owners' personal attributes, because banks do not have sufficient access to databases on the personal credit histories of business owners (Ono, 2006). In essence, SBCS loans by Japanese banks are based on business credit scores. Note, however, that

[5] *Nikkei Newspaper*, September 20, 2006.

[6] Financial Services Agency (FSA), "Progress Report on the Action Program Concerning Enhancement of Relationship Banking Functions," July 12, 2007.

Japanese banks usually collect information on business owners' personal attributes manually when extending relationship-based non-scoring loans.

3. Empirical Hypotheses

To examine how the use of SBCS affects the performance of loans to small businesses and their ties with relationship lenders in times of crisis, we put forward two empirical hypotheses based on the theoretical and empirical literature.

3.1. The Effect of SBCS on Borrower Performance

Regarding SBCS, DeYoung et al. (2008) point out three potential effects that it may have on banks' risk taking and the performance of loans they extend. First, SBCS may make the loan production process more efficient and reduce associated costs. As a result, banks may be more willing to extend loans to marginally riskier borrowers (risk-taking effect), because, with increased efficiency, they have greater capacity to absorb losses. All else equal, this effect will increase ex-post default rates, regardless of whether such loans are extended by relationship or transactional lenders. Second, if used in isolation, SBCS may be informationally inferior to relationship lending, as credit scores – because they are based on a limited set of quantifiable information – are an imperfect indicator of the creditworthiness of prospective borrowers. This effect of SBCS makes both type I errors

(rejecting good loans) and type II errors more frequent and will result in a higher default rate.[7] This effect is likely to be observed for SBCS loans by transactional lenders that do not have sufficient access to soft information on the borrower. In contrast, and finally, by combining the hard information obtained from the credit scoring model and the soft information gathered through an existing firm-bank relationship and the traditional loan screening process, SBCS may improve the lender's information set and result in a smaller default rate. This effect is likely to be observed for SBCS loans by relationship lenders.

The performance of SBCS loans is likely to be affected not only by banks' lending strategies but also by borrower self-selection. Adverse selection theory suggests that in the presence of informational asymmetry, low-quality firms will tend to self-select and apply for loans from banks that are more prone to type II errors in the hope of being mistaken for a high quality borrower (Ergungor and Moulton, 2011; Gropp et al., 2012). This means that low quality firms would choose to obtain SBCS loans from transactional lenders, while high quality firms would choose relationship lenders that may or may not extend SBCS loans (Shaffer, 1998).

Turning to empirics, previous studies find mixed evidence on the association between SBCS loans and ex-post loan performance. Using loan data from the U.S. Small Business Administration, DeYoung et al. (2008) report that the default rate for SBCS loans

[7] For the sake of brevity, we will only refer to type II errors hereafter.

is higher than that for non-scoring loans. Agarwal and Hauswald (2008) also find that the credit delinquency of online scoring loans is higher than that of relationship-based in-person loans. On the other hand, Berger et al. (2011) report that the use of SBCS does not materially affect the non-performing loan ratio of U.S. community banks. Note, however, that these studies do not distinguish between different types of SBCS lenders.

In sum, preceding studies suggest that the effects of SBCS on loan performance depend on banks' lending strategies and self-selection by borrowers. We put forward the following hypothesis:[8]

Hypothesis 1 (The effect of SBCS on borrower performance)

The average ex-post performance of SBCS loan user firms deteriorates more than that of non-scoring loan user firms if SBCS loans are extended by a transactional lender.

In contrast, the average ex-post performance of SBCS loan user firms improves more than that of non-scoring loan user firms if SBCS loans are provided by a relationship lender.[9]

[8] While most of the preceding studies mentioned above focus on loan performance, we focus on borrower performance, because we employ firm-bank matched data. Although the two are not exactly the same, they are closely related since borrowers' creditworthiness is a key factor for lenders when extending loans.

[9] Note that the latter part of Hypothesis 1 assumes that the risk-taking effect of SBCS on relationship lenders is quantitatively smaller than the improvement in relationship lenders' information set (fewer type II errors) as a result of SBCS.

3.2. The Effect of SBCS on Liquidity Provision by a Relationship Lender in Times of Crisis

Previous studies on relationship lending suggest that firms, especially small firms that are informationally opaque, tend to suffer from credit rationing during financial crises, but that firms that have a close relationship with a relationship lender are less likely to be affected by such crises than other similar firms (see Section 4.3.2.7 of Degryse et al. (2009) and references therein). The reason is that relationship lenders can provide a kind of implicit liquidity insurance in situations where borrowing firms experience a temporary adverse shock, as the proprietary information accumulated through intimate relationships increases lenders' ability to distinguish good and bad firms (Boot and Thakor, 1994; Rajan 1992), and produces rents that allow lenders to offset temporary losses (Boot, 2000). While the nature of adverse shocks in these studies is idiosyncratic, Bolton et al. (2013) develop a theoretical model with aggregate shocks and derive a similar prediction. The empirical literature on main banks, typical relationship lenders in Japan, in particular suggests that they tend to play a critical role when their client firms fall into distress (Hoshi et al., 1990; Sheard, 1989; Suzuki and Wright, 1985). Empirical evidence that relationship lenders provide liquidity in times of crisis is not limited to Japan but has also been found for Germany (Elsas and Krahnen, 1998), Korea (Jiangli et al., 2008), Italy (Bolton et al., 2013), and the United States for the 19th-century (Bodenhorn, 2003).

What has not been explored in the literature is how the use of transactional lending such as SBCS affects relationship lenders' incentives to provide liquidity insurance during financial crisis. On the one hand, if a small business borrower obtains an SBCS loan from a transactional lender, this is likely to lower a relationship lender's willingness to lend during a period of crisis for the following two reasons. First, a higher total indebtedness by obtaining SBCS loans from a transactional lender reduces the borrower's incentive to repay the debt as well as the relationship lender's willingness to provide credit. For instance, Degryse et al. (2012) find that creditors tend to reduce their supply of credit when a borrower obtains loans from another creditor.[10] Second, as argued above, low-quality firms are likely to apply for SBCS loans provided by transactional lenders, which are more prone to type II errors than relationship lenders. The relationship lender of the firm thus would infer that the creditworthiness of the firm had worsened and be less willing to subsequently provide rescue financing.

On the other hand, SBCS loans obtained from a relationship lender do not create such negative externalities and therefore are likely to leave the provision of liquidity by relationship lenders during financial crisis unaffected.

[10] Consistent with this argument, empirical studies show that distressed firms with a smaller dependence on their main bank in their total debt outstanding are less likely to receive rescue financing and other assistance from the main bank (Hoshi et al., 1990; Suzuki and Wright, 1985).

In summary, we put forward the following hypothesis:

Hypothesis 2 (The effect of SBCS on liquidity provision by a relationship lender in times of crisis)

A relationship lender is less willing to provide liquidity insurance during a period of crisis to client firms that have obtained SBCS loans from other, transactional lenders than to firms that have not obtained SBCS loans. In contrast, the lending attitude of a relationship lender to an SBCS borrower is not adversely affected if it is the relationship lender itself providing the SBCS loan.

4. Data, Variables, and Empirical Approach

4.1. Data

The two main sources of our dataset are the "Survey on Transactions between Enterprises and Financial Institutions under the Financial Crisis" (February 2009) and the "Survey on Transactions between Enterprises and Financial Institutions" (February 2008), both conducted by the Research Institute of Economy, Trade and Industry (RIETI). Based on a sample drawn from the Financial Information Database of Tokyo Shoko Research (TSR), a commercial credit research firm that compiles information on more than 1.2 million firms, the 2008 survey questionnaire was sent to 17,018 firms, of which 6,059 responded. The 2009 survey questionnaire was sent to 5,979 firms out of the 6,059 respondents to the 2008

survey. The number of respondent firms for the 2009 survey is 4,103.

The 2009 survey asked whether firms had obtained SBCS loans or not and, if they had, from which financial institutions (which for brevity we refer to as "banks" hereafter). Banks are categorized as "primary," "second-primary," and "other" banks. Primary and second-primary banks are defined as the banks with the largest and second-largest amount of loans outstanding to the firm. Thus, for each firm, we are able to identify its primary and second-primary banks, and whether these banks have extended an SBCS loan. As for the other banks, we are able to identify them only if they have extended an SBCS loan to the firm.[11]

In addition to the information on the usage of SBCS loans, we collect information on firm characteristics, primary bank characteristics, and firm-primary bank relationship variables in order to test our hypotheses. Firm variables are taken from the RIETI surveys as well as from the TSR Financial Information Database, which contains the financial statements of firms surveyed. Because the focus of the paper is on *small business* credit scoring, we exclude firms whose annual gross sales exceed 5 billion yen.

Data for primary bank financial variables come from several sources: data for

[11] We identify other SBCS banks based on a follow-up questionnaire that we sent to firms that reported using SBCS loans in the 2009 survey. The questionnaire was sent to 418 firms that responded to the 2009 survey and answered that they had obtained SBCS loans, with responses received from 284.

most variables are from the Nikkei Financial Quest Database. We then try to supplement missing data from (1) the website of the Financial Services Agency (FSA), (2) "Kinyu Map" published annually by Kinyu Journal Company, (3) the Shinkin Bank and Credit Cooperatives (Shinyo Kumiai) database, and (4) banks' annual reports. Because we are primarily concerned with private banks' usage of SBCS, we drop observations if a firm's primary banks are either government-sponsored financial institutions or non-banks.

Information for firm-primary bank relationship variables is taken from the 2008 RIETI survey, which asks several questions on the relationship between a firm and its primary bank.[12]

Matching the data on the usage of SBCS with firm characteristics, primary bank characteristics, and firm-primary bank relationship variables, we have a maximum of 819 observations for the empirical analysis. The number of observations differs depending on which dependent variable we use and on the estimation strategy. The reduction in the number of observations from the original RIETI surveys (4,103 firms) is due to missing data as well as the exclusion of some firms and financial institutions for the reasons explained above.[13]

[12] In order to maintain consistency regarding the identity of firms' primary bank between 2008 and 2009, we drop observations of firms whose primary bank changed between 2008 and 2009.

[13] To be more precise, the number of observation falls from 4,103 to 2,837 by excluding

4.2. Variables

A list of variables and their definitions is provided in Table 1, while Table 2(a) presents summary statistics for all sample firms, for firms that have obtained SBCS loans, and for firms that have not obtained any SBCS loans. Table 2(b) presents correlation matrices of these variables.

In our analysis below, we assume that primary banks act as relationship lenders, while non-primary banks act as transactional lenders. Given that one of the intrinsic features of the main bank system in Japan is that firms' main bank – typically the bank with which a firm has the largest amount of loans outstanding – acts as a relationship lender, this assumption is likely to be valid for the large majority of firms. To confirm this point, Table 3 compares the mean values of the proxy variables used in the literature (Chapter 4 of Degryse et al., 2009; Ono and Uesugi, 2009) to identify relationship lenders for

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firms whose annual gross sales exceed 5 billion yen in order to focus on small businesses. Among these 2,837 firms, the number of firms for which we can obtain information on whether they have obtained an SBCS loan is 2,002, while information on firm characteristics, primary bank characteristics, and firm-primary bank relationships is available for 2,738, 2,005, and 1,257 firms, respectively. The intersection of these four sets of information makes up our sample of 819 observations.

firm-primary bank and firm-non-primary bank pairs.[14] The results indicate that the intimacy of firm-bank relationships measured by these proxies is, on average, stronger for primary banks than for non-primary banks, underpinning that our assumption that firms' main bank acts as a relationship lender is valid.

The variables of key interest in our empirical analysis are two dummy variables indicating whether a firm had SBCS loans outstanding as of February 2009: whether a firm had obtained SBCS loans from a primary bank (*SC_DUM_PR*), and whether it had obtained SBCS loans from a non-primary bank (*SC_DUM_NPR*). In the RIETI survey, SBCS loans are defined as "loans that are quickly processed (loan approval/denial is usually decided within a few days) and are easy to apply for, that, in general, do not require collateral and/or third-person guarantees, and that are often referred to as 'business loans' and/or 'quick loans.'" The last part reflects the casual observation that many banks in Japan have specific names for their SBCS loans, so that firms can judge whether they are applying for an SBCS loan. Furthermore, in order to avoid any misclassification, the answer "do not know" is allowed in the survey questionnaire. The roughly 20 percent of respondents selecting this choice are dropped from our dataset. Table 2 indicates that 12.6 percent of firms (103 out of the 819 firms) in our dataset obtained SBCS loans.[15]

[14] In Table 3, firms' relationship with non-primary banks is measured in terms of the relationship with their secondary bank.

[15] The ratio of firms that obtained an SBCS loan from their primary bank is 7.6 percent,

4.2.1. Variable for Testing Hypothesis 1: Borrower Firms' Ex-post Performance

As a proxy for ex-post performance to examine Hypothesis 1, we employ borrower firms' (ex-post) PD in 2009 (*F_PD*), that is, firms' PD estimated based on their financial variables after the SBCS (or non-SBCS) loan was extended.[16] As a proxy for the observable riskiness of a firm, we employ the annualized PD within 3 years calculated using Moody's RiskCalc Japan scoring model.[17] Hasumi and Hirata (2013) show that this is a good predictor of default. Table 2 shows that, on average, *F_PD* is higher for SBCS loan user firms than for non-user firms.

4.2.2. Variable for Testing Hypothesis 2: Liquidity Provision by a Relationship Lender

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while that of firms that obtained an SBCS loan from a non-primary bank is 7.3 percent.

[16] Because the number of firms that defaulted in our sample is very limited (9 firms), it is difficult to examine Hypothesis 1 empirically using actual default events.

[17] RiskCalc v3.2 Japan is created using pooled data on 201,000 SMEs for the period 1992 to 2005. Released in 2009 by Moody's KMV, it is one of the most widely used "third-generation" credit scoring models for evaluating the creditworthiness of unlisted companies in Japan. RiskCalc employs probit regressions whose independent variables are inventory to net sales, trade receivables to net sales, EBITDA to interest expense, net sales growth, total liabilities less cash to total assets, retained earnings to total liabilities, cash to total assets, gross profit to total assets, previous year income to previous year net sales, and real net sales.

during the Financial Crisis

To examine Hypothesis 2, we use firms' answers in the RIETI survey to the question on how the lending attitude of their primary bank changed after the failure of Lehman Brothers in September 2008. We use these answers to construct an index variable, *R_ATTITUDE* (1: improved, 2: remained unchanged, 3: worsened). Thus, the variable represents whether relationship lenders were less likely to act as providers of liquidity insurance in times of financial crisis. It should be noted that as a proxy for a relationship lender's willingness to lend during the financial crisis, *R_ATTITUDE* is superior to the actual amount of credit supplied because the latter is contaminated by loan demand factors.[18] Table 2 shows that, on average, *R_ATTITUDE* is slightly higher for SBCS loan user firms than for non-user firms.

The mean value of *R_ATTITUDE* is 2.27 for firms that obtained SBCS loans from non-primary banks, 2.11 for firms that obtained SBCS loans from primary banks, and 2.02 for firms that did not obtain SBCS loans. That is, on average, primary banks' lending attitude was severest toward firms that obtained SBCS loans from non-primary banks.

4.2.3. Other Control Variables

[18] Degryse et al. (2012) in their empirical analysis on loan contracts in Sweden employ a different approach and use banks' internal lending limit for each specific firm as a proxy instead.

To control for other covariates that may affect the ex-post performance of a borrowing firm and the lending attitude of its primary bank, we include the following variables.

First, regarding firm characteristics, we include a firm's ex-ante PD (*PD*) before SBCS loans are extended, because the ex-post PD (*F_PD*) is likely to be positively correlated with the (ex-ante) *PD*. Employing Moody's RiskCalc Japan scoring model, *PD* is estimated using firms' financial variables during March 2006 to December 2008. We also include the logarithm of annual gross sales (*LN_SALES*), the logarithm of firm age (*LN_FIRMAGE*), and the share of equity holdings by a business representative (*OWNERS_HOLD*) as covariates.

Second, to control for the characteristics of a firm's primary bank, we use the logarithm of the bank's asset size (*BK_LN_ASSETS*) and the bank's share of branches within the prefecture of the borrowing firm (*BK_SHARE*). The primary bank's asset size may be an important determinant of the firm-bank relationship, since studies on relationship lending generally find that small banks have a comparative advantage in relationship lending (Berger et al., 2005b). The market share of the bank is included as a covariate to control for the degree of competition in a local loan market. In addition, we use the Herfindahl Index for each prefecture (*HERFINDAHL*) calculated based on the share of banks' branches within the prefecture in which a borrowing firm is located. *BK_SHARE*

and *HERFINDAHL* may also be important for firm-bank relationships, although the existing empirical literature is ambiguous on whether market concentration (competition) is conducive or detrimental to relationship lending (Elsas, 2005; Degryse and Ongena, 2007, Presbitero and Zazzaro, 2011).

Finally, we use a set of variables to measure the strength of the relationship between a firm and its primary bank, as this is likely to affect the ex-post performance of a firm as well as the bank's lending attitude in the midst of a crisis. Specifically, we use the logarithm of the duration of the firm-bank relationship (*R_LN_DURATION*), an index variable representing the frequency of meeting (*R_FREQ*), and an index variable for the physical distance between a firm and the primary bank's branch (*R_DISTANCE*). We also construct a variable that measures the percentage share of the primary bank in a firm's loans outstanding (*R_PRIME_SHARE*). Table 2 shows that, on average, the intimacy of relationships measured by these proxies is stronger for firms that have not obtained SBCS loans than for firms that have obtained SBCS loans.

4.3. Empirical Approach

4.3.1. Baseline Estimations

To examine our hypotheses, we begin by estimating the following linear regression models:

$$F\_PD_i = \beta_0 + \beta_1 \cdot SC\_DUM\_PR_i + \beta_2 \cdot SC\_DUM\_NPR_i + \mathbf{X}_i'\boldsymbol{\beta} + \varepsilon_i \qquad (1)$$

$$R\_ATTITUDE_{ij} = \gamma_0 + \gamma_1 \cdot SC\_DUM\_PR_i + \gamma_2 \cdot SC\_DUM\_NPR_i + \mathbf{X}_i'\boldsymbol{\gamma} + u_i \qquad (2)$$

where subscripts *i* and *j* denote firm *i* and its primary bank *j*, respectively.

The time at which each variable is measured is as follows. The dependent variable F_PD_i is as of year 2009, while $R\_ATTITUDE_{ij}$ is as of February 2009. Next, the two dummy variables for SBCS loans indicate whether a firm had SBCS loans outstanding from either its primary bank (*SC_DUM_PR*) or a non-primary bank (*SC_DUM_NPR*) as of February 2009. Because most SBCS loans to our sample firms were provided before February 2009,[19] F_PD_i and $R\_ATTITUDE_{ij}$ measure the ex-post PD and the lending attitude of a firm's primary bank after the firm had obtained an SBCS loan or loans. Data for the covariates $\mathbf{X}_i$ are the latest available before February 2009 (mostly for 2008). In essence, we examine how SBCS loans extended by either a primary bank or a non-primary bank affect a user firm's ex-post performance and the lending attitude of the firm's primary bank after the crisis, conditional on the firm's and its primary bank's ex-ante characteristics and the strength of the firm-primary bank relationship.

4.3.2. Treatment Effects Estimations

[19] For a limited number of firms (221 firms), we can identify the date at which an SBCS loan was provided. Only 3 firms out of the 221 answered that they obtained an SBCS loan in February 2009.

Whether a firm obtains an SBCS loan – be it from its primary bank or a non-primary bank – is not a random event. Also, as explained above, borrowers will choose which banks to apply to for a loan based on their prospects of being successful in their loan application. Hence, even if we find that the two SBCS loan dummy variables have a significant effect on firms' ex-post performance and their primary bank's lending attitude in the linear regression models, there may be several possible causal interpretations.

Table 4 provides an overview of possible causal interpretations. For instance, suppose we obtain a significantly positive coefficient for *SC_DUM_NPR* in Eq. (1): SBCS loans extended by a firm's non-primary bank are associated with an increase in the future PD, *F_PD*, conditional on the other covariates. One possible explanation for the result would be that SBCS loans by non-primary banks are more prone to type II errors and/or adverse selection by borrowers when such banks are screening loan applications (ex-ante selection effect). However, an alternative possible explanation is that such firms' performance deteriorated as a result of increased moral hazard and/or of less intensive monitoring by banks. In a similar vein, the provision of an SBCS loan by a non-primary bank may be associated with a tightening of the primary bank's lending attitude during the financial crisis either because the firm-primary bank relationship became less intimate after the firm obtained an SBCS loan from a non-primary bank and the primary bank perceived such a loan to have increased the credit risk of the firm (ex-post treatment effect), or

because firms that obtained an SBCS loan from a non-primary bank had a less intimate relationship with their primary bank in the first place (ex-ante selection effect).

In order to make sharper inferences on the mechanisms underlying the empirical results obtained from linear regression models (1) and (2), we need to distinguish the selection effect (selection bias) and the treatment effect of SBCS loans. [Guo and Fraser (2010) list several models that can consistently estimate treatment effects. Among those, we employ propensity score matching (PSM) estimation, which was first proposed by Rosenbaum and Rubin (1983). The basic idea of using PSM here is to compare the average performance of firms that obtained SBCS loans (treatment group) to the average performance of treatment firms' identical "twins" that did not obtain SBCS loans (control group). By matching treatment firms to appropriate benchmark firms that have the "closest" propensity scores, we create a sample that is akin to one generated by randomization. In particular, we estimate the treatment effect for SBCS loans using kernel matching estimators: we match each treatment firm with non-treated firms, each of which has its own weight that is proportional to its "closeness" to the treated firm. A detailed description of the PSM procedure is provided in Appendix A.1.

5. Results

5. 1. Baseline Estimations

Table 5 presents the ordinary least squares (OLS) regression results of Eqs. (1) and (2). Regarding the effect of SBCS on ex-post borrower performance, the coefficient on *S_DUM_NPR* in the *F_PD* regression is significantly positive, indicating that the PD during the financial crisis increased by as much as 0.82 percentage points for borrowers that obtained an SBCS loan from a non-primary bank. This result is consistent with the first part of Hypothesis 1, which states that the provision of SBCS loans by transactional lenders is associated with a deterioration in borrower ex-post performance. In contrast, the coefficient on *S_DUM_PR* is significantly negative and indicates that obtaining an SBCS loan from the primary bank is associated with a reduction in the PD by 0.46 percentage points. The result is consistent with the second part of Hypothesis 1, which states that the average ex-post performance of SBCS loan user firms improves in comparison with non-scoring loan user firms.

Turning to other covariates, the coefficient on *PD* is positive and significant, indicating that an observably riskier borrower ex-ante is likely to be riskier ex-post as well. The coefficient on *R_DISTANCE* is also positive, although only statistically significant at the 10 percent level. The positive coefficient is consistent with the finding in previous empirical studies (e.g., DeYoung et al., 2008) that a borrower that is located farther away from a lender is more likely to default.

Regarding the lending attitude of primary banks during the financial crisis, the

coefficient on *S_DUM_NPR* in the *R_ATTITUDE* regression is significantly positive, indicating that firms that obtained an SBCS loan from a non-primary bank prior to the crisis were more likely to experience a tightening in the lending attitude of their primary bank during the crisis. The result is consistent with the first part of Hypothesis 2, which states that an SBCS loan by a transactional lender has an adverse effect on the provision of liquidity by a firm's relationship lender during financial crisis. In contrast, the coefficient on *S_DUM_PR* is statistically insignificant; that is, SBCS loans provided by the primary bank did not have any positive or negative effect on its lending behavior during the crisis period. This result is consistent with the second part of Hypothesis 2.

The coefficient on *PD* is again positive and significant, indicating that the lending attitude of primary banks is worse for ex-ante riskier firms. Although only significant at the 10 percent level, the negative coefficients on the relationship variables (*R_PRIMESHARE*, *R_LN_DURATION*, *R_FREQ*) suggest that having established a closer relationship with the primary bank has a positive effect on its lending attitude in times of crisis.

5. 2. Treatment Effects Estimations

The empirical results in the previous section generally support Hypotheses 1 and 2 posited in Section 3. As noted in Section 4.3.2, however, simple linear regression models allow several causal interpretations.

To investigate whether the results obtained in Table 5 are due to the ex-ante selection effect or the ex-post treatment effect, we employ PSM. Based on the propensity scores obtained from the probit regression models in the first stage, we then estimate the treatment effect for SBCS loans using kernel matching estimators.[20]

The estimation results for the treatment effect are reported in Table 6. For each variable, there is an unmatched estimator and an average treatment effect on the treated (ATT) estimator. For example, regarding the unmatched estimate of the treatment effect of SBCS loans by a primary bank on the variable *F_PD*, the table shows two values in the "Unmatched" row, one for the treatment group (labeled "Treated": firms that obtained an SBCS loan from a primary bank) and the other for the non-treated group (labeled "Controls": firms that did not obtain an SBCS loan). The former value (1.715) indicates that SBCS loan user firms' average PD after the crisis was 1.7 percent, whereas the latter (1.483) indicates that it was 1.5 percent for non-user firms. The difference between these two figures, 0.2 percentage points, is the unmatched estimate of the treatment effect, as shown in the column labeled "Difference."

[20] The estimation results of probit models to calculate propensity scores are reported in Appendix A.2. Regarding the second stage treatment effect estimations, we also employed other matching algorithms, namely, 5-nearest matching and radius matching. The estimation results in most cases are qualitatively the same as those of the kernel matching estimation and can be obtained from the authors upon request.

We should note, however, that the unmatched estimate of the treatment effect may well be driven by selection bias. The ATT estimator takes the sample selection problem into account and provides the unbiased treatment effect of SBCS. In the "ATT" rows, the value for the non-treated group in the "Unmatched" row is replaced by the value for the control group, in which the counterfactual firms are non-SBCS loan users with similar ex-ante characteristics as SBCS users. The difference between the values for *F_PD* for "Treated" and "Controls" is -0.3 percentage points, but is statistically insignificant. This suggests that the improvement in the ex-post performance of SBCS loan borrowers from primary banks that we found in the baseline OLS estimation (Table 5) is driven by the selection effect, that is, a reduction in type II errors due to effective screening by banks and/or self-selection by high quality firms.

Table 6 further indicates that the treatment effect on *R_ATTITUDE* is also insignificant for firms that obtained SBCS loans from a primary bank.

Turning to the treatment effects of SBCS loans by non-primary banks, Table 6 shows that the treatment effects on both *F_PD* and *R_ATTITUDE* are positive and significant. The treatment effect on *F_PD* suggests that the ex-post performance of SBCS loan user firms deteriorated more than that of non-user firms, presumably because the non-primary banks of SBCS loan user firms exerted less effective monitoring, since these lenders do not have sufficient soft information on these firms. In particular, as noted in

Section 2, non-primary banks typically have no information on business owners' personal attributes, and this may have contributed to less effective monitoring. It should also be noted that the increase in *F_PD* may have been driven by increased incentives for moral hazard on the part of borrowing firms. The treatment effect on *R_ATTITUDE* indicates that the lending attitude of firms' primary banks during the financial crisis tightened after the provision of an SBCS loan by a non-primary bank.

5. 3. Discussion

The empirical results from the OLS and PSM estimations indicate that there are certain differences between SBCS loans by primary and non-primary banks and suggest that these banks adopt SBCS for different motives. Specifically, previous studies argue that there are two potential benefits for lenders of adopting SBCS: (i) cost-saving in screening loan applications and monitoring borrowers, and (ii) the mitigation of the borrower-opacity problem (Mester, 1997; Berger and Frame, 2007). While it is beyond the scope of this study to empirically investigate this issue, our results suggest that the main motive of non-primary banks in adopting SBCS is (i), while that of primary banks is (ii).

Suppose that non-primary banks adopt SBCS for the cost-saving motive. Then, because credit scores alone are based on a limited set of hard information, they are more prone to type II errors. This is consistent with our finding in the OLS estimations that the

ex-post PD for firms that obtained an SBCS loan from a non-primary bank is higher than that of non-user firms (selection effect). In addition, because of the cost-saving motive, non-primary banks are likely to exert less effort on monitoring activities, which may result in borrower moral hazard. This is consistent with our finding in the PSM estimation that the treatment effect of SBCS loans by non-primary banks on *F_PD* is significantly positive.

Next, suppose that primary banks adopt SBCS to mitigate the borrower-opacity problem. Because these banks use scores to complement the soft information they have accumulated, they may be able to evaluate the creditworthiness of small businesses more accurately than would otherwise be the case, enabling them to secure more creditworthy borrowers. This conjecture is consistent with the result of the OLS estimation that the ex-post PD for firms that obtained an SBCS loan from a primary bank is lower than that of non-user firms (selection effect).

6. Conclusion

This paper empirically examined the ex-post performance of SMEs that obtained SBCS loans, using a unique firm-bank matched dataset for Japan. The paper further examined whether a relationship lender's willingness to provide liquidity to its client firms in times of crisis was negatively affected by the provision of SBCS loans by other banks. Our rich dataset allowed us to investigate whether (and how) the impact of SBCS loans differed

depending on whether they were extended by a relationship or a transactional lender. The findings of our investigation can be summarized as follows.

First, we find that a firm's ex-post PD increased if the firm had obtained an SBCS loan from a non-primary bank (transactional lender). Our PSM estimation results indicate that both the selection effect (transactional lenders are more prone to type II errors) and the treatment effect (weakening monitoring activity by non-primary banks and increased incentives for moral hazard on the part of firms) of SBCS played a role. In contrast, we find that SBCS loans extended by a primary bank (relationship lender) were associated with a decrease in the ex-post default probability of user firms, presumably because the use of SBCS augmented the information set of the primary bank.

Second, we find that the lending attitude of a firm's primary bank in the midst of the recent financial crisis was adversely affected by the use of SBCS loans if these loans were extended by a non-primary bank. Thus in addition to the selection effect that firms with a less intimate relationship with their primary bank are more likely to obtain an SBCS loan from a non-primary bank, the PSM estimation results indicate that the lending attitude of primary banks worsened after non-primary banks provided SBCS loans to firms (treatment effect). In contrast, we find neither a positive nor a negative effect on loan availability in the case of SBCS loans provided by a primary bank.

The practical implications of our empirical findings for small business financing

are not necessarily straightforward. Although SBCS loans from transactional lenders may be beneficial in increasing the availability of credit during normal times (Agarwal and Hauswald, 2008; Berger et al., 2011; Berger et al., 2005a; Frame et al., 2001), they may be detrimental to a firm's close ties with its relationship lender, which may be particularly valuable during times of crisis. Thus, in obtaining SBCS loans from transactional lenders, small businesses need to weigh the costs and benefits of doing so. On the other hand, SBCS loans from a relationship lender – our results suggest – do not have such a potentially detrimental effect. That being said, however, having an exclusive relationship with a relationship lender may have an adverse impact when the lender itself is affected by the crisis.

Finally, some of the shortcomings of the present study should be noted. First, in evaluating borrowers' ex-post performance, we only have a one-year window for analysis due to data limitations. Further, the analysis relied on estimated PDs rather than actual default events. As more data become available over time, we may be able to extend the window to several years and incorporate additional ex-post performance variables, including actual default rates. Second, our findings may not hold during non-crisis periods, as we only examine the ex-post performance of firms during the recent financial crisis. Finally, we did not pay attention to the composition of relationship-based SBCS loans and transaction-based SBCS loans within a bank. However, it may well be the case that at one

bank, SBCS loans are mostly relationship-based, while at another bank, they are mostly transaction-oriented. Exploring the determinants of banks' SBCS strategies further represents an interesting topic for future research. Tackling these issues may reinforce the study's findings and further expand our understanding of the nature of SBCS loans.

Appendix. A.1. Procedure of Propensity Score Matching

Procedure of propensity score matching is as follows:

(i) We implement the following probit estimations that model the probability of a firm obtaining an SBCS loan from a primary or non-primary bank:

$$\Pr(SC\_DUM\_PR_i = 1) = f(\mathbf{X}_i'\boldsymbol{\delta}) \quad \text{(A.1)}$$

$$\Pr(SC\_DUM\_NPR_i = 1) = g(\mathbf{X}_i'\boldsymbol{\delta}) \quad \text{(A.2)}$$

where vector $\mathbf{X}_i$ contains the same covariates as in Eq. (1) and Eq. (2). Borrower firms that obtained an SBCS loan (*SC_DUM_PR*=1, *SC_DUM_NPR*=1) are labeled treatment observations. Based on the estimation results, we then attach a propensity score to each observation. The propensity score is defined as $e_{PR}(\mathbf{X}_i) \equiv \Pr(SC\_DUM\_PR_i = 1 \mid \mathbf{X}_i)$ for Eq. (A.1) and as $e_{NPR}(\mathbf{X}_i) \equiv \Pr(SC\_DUM\_NPR_i = 1 \mid \mathbf{X}_i)$ for Eq. (A.2).

(ii) Next, for each treatment observation, we identify matched observations from

non-treatment observations. We define non-treatment observations as firms that did not obtain an SBCS loan from *any* bank. That is, in matching observations, firms that obtained an SBCS loan from a non-primary bank are excluded from non-treatment observations in estimating Eq. (A.1). Similarly, firms that obtained an SBCS loan from their primary bank are excluded from the sample in estimating Eq. (A. 2). The matched observations are observations that have the "closest" propensity score to a particular treatment observation and are labeled control observations. There are several matching algorithms to find the "closest" control observations. As a baseline for our analysis, we employ kernel matching.

(iii) Finally, we compare the change in the probability of default and in the lending attitude of the primary bank, *F_PD* and *R_ATTITUDE*, of the treatment group and the control group after the eruption of the financial crisis.[21]

One of the benefits of employing propensity score matching estimation is that we

[21] To be precise, *F_PD* measures the level of the probability of default after the crisis. However, because we control for the probability of default before the crisis by including it as one of the covariates in the first-stage probit estimation and the balancing condition explained in Eq. (4) below ensures that the probability of default before the financial crisis is the same on average between the treatment and control groups, we are effectively looking at the change in the probability of default.

can match treatment and control observations using the scalar propensity score. The propensity score, which is the conditional probability of being treated given the value of observed characteristics, is a very useful variable in dealing with a highly dimensional vector of covariates. Rosenbaum and Rubin (1983) showed that treatment observations (in our case firms that obtained SBCS loans) and control observations (firms that obtained non-SBCS loans) with the same propensity score value have the same distribution of the full vector of covariates. It is thus sufficient to match firms in terms of the propensity score in order to obtain the same probability distribution of covariates for treatment and control observations.

In propensity score matching, an assumption known as unconfoundedness has to be satisfied so that the differences in *F_PD* and *R_ATTITUDE* between the treated observations and the control observations with the same propensity scores are attributable to the treatment effect of SBCS loans (Rosenbaum and Rubin, 1983). For instance, regarding *F_PD*,

$$(F\_PD^T, F\_PD^C) \perp SC\_DUM\_PR \mid e_{PR}(\mathbf{X}_i) \text{ and}$$

$$(F\_PD^T, F\_PD^C) \perp SC\_DUM\_NPR \mid e_{NPR}(\mathbf{X}_i) \qquad \text{(A. 3)}$$

need to hold (superscripts *T* and *C* stand for the treatment group and the control group, respectively). Although there is no direct test for unconfoundedness, this assumption means that it is necessary to control for all relevant variables $\mathbf{X}_i$ that influence the selection of

treatment observations and their ex-post probability of default (outcome variable). We believe our data is rich enough to include all the necessary covariates.

In addition to unconfoundedness, the following balancing condition of the covariates given the propensity score must be satisfied (Becker and Ichino, 2002):

$$SC\_DUM\_PR_i \perp \mathbf{X}_i \mid e_{PR}(\mathbf{X}_i) \quad \text{and} \quad SC\_DUM\_NPR_i \perp \mathbf{X}_i \mid e_{NPR}(\mathbf{X}_i). \qquad \text{(A. 4)}$$

In other words, for a given propensity score, treatment observations are randomly chosen and, therefore, the treatment sample and the control sample are on average identical. In order to verify the balancing condition Eq. (A. 4), we implement t-tests for equality of means for each covariate between treated and controls. If there are no statistically significant differences between the two groups, then we can proceed to estimate the treatment effect in the second step with some confidence.

Appendix. A.2. Probit Estimations for Propensity Score Matching

Table A-1 shows the results of the probit estimations for the determinants of whether a firm obtained an SBCS loan from a primary (*S_DUM_PR*) or non-primary bank (*S_DUM_NPR*).[22] The results are mostly in line with the findings of the previous studies.

[22] In estimating a firm's probability of obtaining an SBCS loan from a primary bank (non-primary banks), observations for firms that have obtained an SBCS loan only from non-primary banks (a primary bank) are dropped from the sample ("control" group in the treatment effect estimation). This is because we want to restrict our control observations to

Starting by looking at *LN_SALES* and *LN_FIRMAGE*, we find that the coefficients are negative, indicating that smaller and younger firms are more likely to obtain SBCS loans (Frame et al., 2001; Cowan and Cowan, 2006), either from a primary bank or a non-primary bank. Next, the positive coefficient on *PD* implies that SBCS loans are more likely to be extended to observably riskier firms. This is consistent with the point made by De Young et al. (2008) mentioned in section 3.2 that the adoption of SBCS may lead banks to take a more aggressive risk-taking stance. Turning to the firm-primary bank relationship variables, the positive coefficient on *R_DISTANCE* in the primary bank estimation indicates that the primary bank is more likely to extend an SBCS loan to a firm that is located farther away from the bank's branch. One possible explanation for this result is that primary banks use SBCS in order to complement soft information on borrower firms that are farther away, because soft information on these firms may be less accurate. The negative coefficient on *R_PRIMESHARE* in the non-primary bank estimation suggests that a firm is more likely to obtain an SBCS loan from a non-primary bank when it has a less intimate relationship with its primary bank as measured in terms of the primary bank's share in the firm's loans outstanding.

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firms that have not obtained an SBCS loan from *any* bank.

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Table 1: Definitions of Variables [a]

Dependent variables	
F_ PD	Ex-post probability of default (PD): annualized default rate within 3 years estimated using Moody's RiskCalc.
R_ATTITUDE	Index variable indicating the change in lending attitude of a primary bank during the crisis: 1: better, 2: unchanged, 3: worse.
Use of small business credit scoring (SBCS) loans	
SC_DUM_PR	1 if a firm has SBCS loans outstanding from a primary bank, 0 otherwise.
SC_DUM_NPR	1 if a firm has SBCS loans outstanding from a non-primary bank, 0 otherwise.
Firm characteristics	
LN_SALES	Log of gross annual sales.
LN_FIRMAGE	Log of firm age.
PD	Ex-ante PD: annualized default rate within 3 years
OWNERS_HOLD	Share of equity holdings by business representatives.
INDUSTRY_X	Industry dummy variable: X=1: construction, 2: manufacturing, 3: wholesale and retail, 0 (default): other.
REGION_X	Dummy variable for region (metropolitan area) of headquarters: X=1: Tokyo, 2: Chukyo, 3: Kinki, 0 (default): other.
Primary bank characteristics	
BK_LN_ASSETS	Log of asset size.
BK_SHARE	Share of branches within the prefecture of a borrowing firm.
HERFINDAHL	Herfindahl Index computed based on the shares of bank branches within the prefecture of a borrower firm
Firm-primary bank relationship	
R_LN_DURATION	Log of years a firm has been transacting with its primary bank.
R_FREQ	Index variable regarding the frequency of meeting between a firm and its primary bank: 1: less than annually, 2: annually, 3: semi-annually, 4: once every 2-3 months, 5: monthly, 6: weekly, 7: daily, 0: no direct meeting.
R_DISTANCE	Index variable indicating the physical distance (in kilometers) between a borrower firm and its primary bank's branch: 1: less than 0.5, 2: 0.5-1, 3: 1-10, 4: 10-30, 5: 30-50, 6: 50 and more.
R_PRIMESHARE	Share of loans obtained from the primary bank in a firm's total loans.

[a] The dependent variable *F_PD* is based on the financial statement of the firm in 2009. *R_ATTITUDE* represents the change in the lending attitude after September 2008. The independent variables *SC_DUM_PR* and *SC_DUM_NPR* are as of February 2009. Firm variables are taken from the 2009 RIETI survey conducted in February 2009 and firms' most recent financial statement, ranging from March 2006 to December 2008. *BK_LN_ASSETS* is as of the end of March 2008, while *BK_SHARE* and *HERFINDAHL* are as of October 2007. Firm-primary bank relationship variables are as of February 2008.

Table 2(a): Summary Statistics - SBCS Loan User Firms and Non-user Firms [b]

	All firms						Firms with SBCS loans			Firms without SBCS loans		
	N	Mean	SD	Min	Median	Max	N	Mean	SD	N	Mean	SD
Dependent variables												
F_PD	581	1.577	1.699	0.130	1.010	10.510	58	2.422	2.254	523	1.483	1.602
R_ATTITUDE	819	2.042	0.429	1.000	2.000	3.000	103	2.175	0.532	716	2.022	0.409
SBCS dummies												
SC_DUM_PR	819	0.076	0.265	0.000	0.000	1.000	103	0.602	0.492	716	0.000	0.000
SC_DUM_NPR	819	0.073	0.261	0.000	0.000	1.000	103	0.583	0.496	716	0.000	0.000
Firm characteristics												
LN_SALES	819	13.589	1.051	10.104	13.631	15.419	103	13.041	0.994	716	13.668	1.036
LN_FIRMAGE	819	3.505	0.525	1.099	3.638	4.663	103	3.295	0.527	716	3.535	0.519
PD	819	1.542	1.738	0.130	0.920	10.890	103	2.349	2.177	716	1.426	1.634
OWNERS_HOLD	819	0.642	0.350	0.000	0.720	1.000	103	0.719	0.287	716	0.631	0.357
INDUSTRY_1	819	0.286	0.452	0.000	0.000	1.000	103	0.350	0.479	716	0.277	0.448
INDUSTRY_2	819	0.245	0.431	0.000	0.000	1.000	103	0.146	0.354	716	0.260	0.439
INDUSTRY_3	819	0.286	0.452	0.000	0.000	1.000	103	0.311	0.465	716	0.282	0.450
REGION_1	819	0.179	0.384	0.000	0.000	1.000	103	0.272	0.447	716	0.166	0.373
REGION_2	819	0.095	0.294	0.000	0.000	1.000	103	0.058	0.235	716	0.101	0.301
REGION_3	819	0.127	0.333	0.000	0.000	1.000	103	0.107	0.310	716	0.130	0.336
Primary bank characteristics												
BK_LN_ASSETS	819	15.252	1.701	10.672	15.117	18.755	103	15.086	1.597	716	15.276	1.716
BK_SHARE	819	0.149	0.121	0.000	0.112	0.462	103	0.158	0.130	716	0.148	0.120
HERFINDAHL	819	0.115	0.067	0.037	0.103	0.292	103	0.122	0.070	716	0.113	0.067
Borrower-primary bank relationship												
R_LN_DURATION	819	3.087	0.824	0.000	3.401	4.605	103	2.891	0.824	716	3.115	0.821
R_FREQ	819	5.172	1.185	0.000	5.000	7.000	103	5.155	1.211	716	5.175	1.182
R_DISTANCE	819	2.683	0.898	1.000	3.000	6.000	103	2.728	0.782	716	2.676	0.914
R_PRIMESHARE	819	0.612	0.250	0.000	0.600	1.000	103	0.584	0.230	716	0.616	0.252

[b] This table presents summary statistics of variables used in the OLS estimations (Table 5). Definitions of variables are provided in Table 1.

Table 2(b): Correlation matrices [c]

(a) Dependent variable: *F_PD*

	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)
1) *F_PD*	1.000	0.021	0.184 ***	-0.268 ***	0.688 ***	0.117 ***	-0.073 *	-0.171 ***	0.012	0.060	-0.065	0.062	0.044	0.064
2) *S_DUM_PR*		1.000	0.250 ***	-0.095 **	0.070 *	0.054	-0.091 **	-0.038	0.089 **	0.102 **	-0.057	-0.022	0.070 *	0.033
3) *S_DUM_NPR*			1.000	-0.111 ***	0.134 ***	-0.003	-0.148 ***	0.007	0.012	0.063	-0.082 **	0.011	0.011	-0.058
4) *LN_SALES*				1.000	-0.296 ***	-0.284 ***	0.267 ***	0.352 ***	-0.044	-0.204 ***	0.176 ***	0.160 ***	0.075 *	-0.164 ***
5) *PD*					1.000	0.092 **	-0.037	-0.230 ***	0.014	0.124 ***	-0.028	0.038	-0.004	0.071 *
6) *OWNERS_HOLD*						1.000	-0.058	-0.160 ***	0.053	0.019	0.041	0.048	-0.109 ***	0.008
7) *LN_FIRMAGE*							1.000	0.115 ***	-0.020	-0.025	0.616 ***	0.111 ***	-0.089 **	-0.032
8) *BK_LN_ASSET1*								1.000	-0.065	-0.325 ***	0.018	-0.125 ***	0.100 **	-0.081 *
9) *BK_SHARE*									1.000	0.667 ***	0.155 ***	0.075 *	-0.115 ***	0.019
10) *HERFINDAHL*										1.000	0.134 ***	0.062	-0.003	0.036
11) *R_LN_DURATION*											1.000	0.200 ***	-0.166 ***	0.038
12) *R_FREQ*												1.000	-0.125 ***	-0.067
13) *R_DISTANCE*													1.000	0.112 ***
14) *R_PRIMESHARE*														1.000

(b) Dependent variable: *R_ATTITUDE*

	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)
1) *R_ATTITUDE*	1.000	0.048	0.148 ***	-0.057	0.251 ***	0.041	-0.026	-0.003	-0.059 *	-0.038	-0.075 **	-0.048	0.006	-0.066 *
2) *S_DUM_PR*		1.000	0.256 ***	-0.144 ***	0.140 ***	0.075 **	-0.109 ***	-0.036	0.068 *	0.080 **	-0.046	0.013	0.029	0.020
3) *S_DUM_NPR*			1.000	-0.142 ***	0.079 **	0.039	-0.129 ***	-0.006	-0.024	0.010	-0.102 ***	-0.009	0.005	-0.110 ***
4) *LN_SALES*				1.000	-0.353 ***	-0.277 ***	0.288 ***	0.348 ***	-0.042	-0.183 ***	0.155 ***	0.179 ***	0.088 **	-0.204 ***
5) *PD*					1.000	0.098 ***	-0.075 **	-0.203 ***	0.019	0.109 ***	-0.002	0.034	-0.031	0.069 **
6) *OWNERS_HOLD*						1.000	-0.068 *	-0.157 ***	0.042	0.047	0.041	0.040	-0.119 ***	0.036
7) *LN_FIRMAGE*							1.000	0.132 ***	0.011	-0.012	0.564 ***	0.117 ***	-0.069 **	-0.050
8) *BK_LN_ASSET1*								1.000	-0.023	-0.311 ***	-0.008	-0.142 ***	0.103 ***	-0.087 **
9) *BK_SHARE*									1.000	0.672 ***	0.182 ***	0.045	-0.084 **	0.025
10) *HERFINDAHL*										1.000	0.168 ***	0.056	0.001	0.047
11) *R_LN_DURATION*											1.000	0.216 ***	-0.141 ***	0.020
12) *R_FREQ*												1.000	-0.122 ***	-0.061 *
13) *R_DISTANCE*													1.000	0.075 **
14) *R_PRIMESHARE*														1.000

[c] These tables show correlations among variables used in OLS estimations (Table 5). ***, **, * indicate the significance at the 1, 5, and 10% level, respectively, of the Pearson's product-moment correlation test under the null hypothesis that the true correlation is equal to 0.

Table 3: Measures of Firms' Relationship with Primary and Non-primary Banks [d]

Variables	With a primary bank			With a non-primary bank			Mean Difference: (a)-(b)	
	N	Mean (a)	SD	N	Mean (b)	SD	(a)-(b)	t-stat
Borrower-bank relationship								
DURATION	819	28.287	16.908	700	20.501	15.498	7.786 ***	13.350
FREQ	819	5.172	1.185	733	4.244	1.655	0.928 ***	16.081
DISTANCE	819	2.683	0.898	737	3.006	1.138	-0.323 ***	-7.913
LOANSHARE	819	0.612	0.250	696	0.227	0.138	0.385 ***	31.783

[d] This table compares the means of firm-bank relationship variables for primary banks and non-primary banks. "Non-primary bank" here refers to firms' second-primary bank (the bank accounting for the second-largest amount of a firm's loans outstanding). *DURATION* indicates the number of years a borrower firm has been transacting with a bank; *FREQ* is an index variable indicating the frequency of meeting between a borrower firm and a bank and takes a value from 0 to 7, with a larger value representing more frequent meetings; *DISTANCE* is an index variable indicating the physical distance between a borrower firm and a bank's branch and takes a value from 1 to 6, with a larger value representing a larger distance: *LOANSHARE* refers to a bank's share in a firm's total loans outstanding. ***, **, * indicate significance at the 1, 5, and 10% level, respectively.

Table 4: Selection and Treatment Effects of SBCS on Firms' Ex-Post Performance and Primary Banks' Lending Attitude

(a) Effects of SBCS on *F_PD*

	Lender	Borrower
Ex-ante selection effect	More type II errors	Increased incentives for adverse selection
Ex-post treatment effect	Less intensive monitoring	Increased incentives for moral hazard

(b) Effects of SBCS on *R_ATTITUDE*

	Lender	Borrower
Ex-ante selection effect	Non-primary banks seek to extend SBCS loans to firms whose relationship with their primary bank is less intimate	Firms that obtain SBCS loans from non-primary banks have a less intimate relationship with their primary bank
Ex-post treatment effect	Primary banks become less willing to provide liquidity insurance to client firms in times of crisis after firms obtained SBCS loans from non-primary banks	

Table 5: OLS Estimation Results for Firms' Ex-Post Performance and Primary Banks' Lending Attitude [e]

	Dep. variable: *F_PD* Estimation method: OLS				Dep. variable: *R_ATTITUDE* Estimation method: OLS			
	Coef.	Std. Err.	t	P>t	Coef.	Std. Err.	t	P>t
SBCS dummies								
SC_DUM_PR	-0.459 **	0.223	-2.060	0.040	-0.028	0.057	-0.490	0.626
SC_DUM_NPR	0.816 ***	0.233	3.500	0.000	0.211 ***	0.059	3.610	0.000
Firm characteristics								
LN_SALES	-0.133 **	0.062	-2.150	0.032	0.018	0.017	1.030	0.305
LN_FIRMAGE	-0.004	0.128	-0.030	0.973	0.023	0.035	0.670	0.506
PD	0.719 ***	0.037	19.600	0.000	0.068 ***	0.009	7.460	0.000
OWNERS_HOLD	0.179	0.155	1.160	0.249	0.051	0.044	1.150	0.251
INDUSTRY_1	0.121	0.166	0.730	0.465	0.022	0.045	0.500	0.619
INDUSTRY_2	0.227	0.167	1.360	0.176	0.109 **	0.046	2.340	0.019
INDUSTRY_3	0.031	0.164	0.190	0.849	-0.009	0.044	-0.200	0.844
REGION_1	-0.102	0.180	-0.560	0.573	0.093 *	0.050	1.880	0.061
REGION_2	0.079	0.199	0.400	0.691	0.093 *	0.054	1.720	0.086
REGION_3	-0.050	0.173	-0.290	0.773	0.075	0.049	1.520	0.128
Primary bank characteristics								
BK_LN_ASSETS	-0.002	0.038	-0.060	0.955	-0.004	0.011	-0.350	0.723
BK_SHARE	0.929	0.605	1.540	0.125	-0.033	0.171	-0.190	0.846
HERFINDAHL	-2.257 *	1.209	-1.870	0.062	0.150	0.337	0.440	0.657
Borrower-primary bank relationship								
R_LN_DURATION	-0.076	0.084	-0.910	0.363	-0.037 *	0.022	-1.660	0.098
R_FREQ	0.079 *	0.045	1.770	0.078	-0.022 *	0.013	-1.690	0.091
R_DISTANCE	0.108 *	0.059	1.830	0.068	-0.004	0.017	-0.240	0.811
R_PRIMESHARE	0.060	0.212	0.280	0.778	-0.114 *	0.060	-1.910	0.056
Constant	1.840 *	0.990	1.860	0.064	1.857 ***	0.274	6.780	0.000
Number of observations	581				819			
Adj.-R^2	0.487				0.094			
Prob. > F	0.000				0.000			

[e] This table presents the OLS estimation results for *F_PD* (ex-post probability of default) and *R_ATTITUDE* (lending attitude of the primary bank). Definitions of the variables are provided in Table 1. ***, **, * indicate significance at the 1, 5, and 10% level, respectively.

Table 6: Treatment Effect Estimations for Firms' Ex-Post Performance and Primary Banks' Lending Attitude [f]

(a) Primary Bank

Variable		Treated	Controls	Difference	S.E.	T-stat.
F_PD	Unmatched	1.715	1.483	0.232	0.277	0.84
	ATT	1.715	1.981	-0.266	0.236	-1.13
R_ATTITUDE	Unmatched	2.113	2.022	0.091 *	0.055	1.65
	ATT	2.113	2.077	0.036	0.065	0.56

(b) Non-primary Bank

Variable		Treated	Controls	Difference	S.E.	T-stat.
F_PD	Unmatched	2.846	1.483	1.363 ***	0.303	4.50
	ATT	2.846	1.801	1.045 **	0.490	2.13
R_ATTITUDE	Unmatched	2.267	2.022	0.244 ***	0.057	4.31
	ATT	2.267	2.055	0.211 ***	0.075	2.83

[f] This table presents the estimation results for the treatment effects for *F_PD* (ex-post probability of default) and *R_ATTITUDE* (lending attitude of the primary bank) of SBCS loan users. Definitions of the variables are provided in Table 1. ***, **, * indicate significance at the 1, 5, and 10% level, respectively.

Table A-1: Probit Estimation Results for the Determinants of SBCS Loans [g]

	Dep. variable: *S_DUM_PR* Estimation method: Probit				Dep. variable: *S_DUM_NPR* Estimation method: Probit			
	Coef.	Std. Err.	z	P>z	Coef.	Std. Err.	z	P>z
Firm characteristics								
LN_SALES	-0.219 ***	0.084	-2.610	0.009	-0.311 ***	0.089	-3.480	0.001
LN_FIRMAGE	-0.292 *	0.166	-1.760	0.078	-0.292 *	0.167	-1.750	0.081
PD	0.091 **	0.037	2.490	0.013	0.082 **	0.040	2.030	0.043
OWNERS_HOLD	0.265	0.229	1.160	0.246	0.066	0.239	0.280	0.782
INDUSTRY_1	0.228	0.226	1.010	0.313	-0.159	0.208	-0.760	0.446
INDUSTRY_2	0.235	0.247	0.950	0.342	-0.520 *	0.269	-1.930	0.053
INDUSTRY_3	0.308	0.230	1.340	0.180	-0.051	0.204	-0.250	0.803
REGION_1	0.707 ***	0.241	2.940	0.003	0.781 ***	0.240	3.260	0.001
REGION_2	0.122	0.280	0.440	0.663	-0.064	0.367	-0.170	0.862
REGION_3	0.103	0.260	0.400	0.693	0.573 **	0.243	2.350	0.019
Primary bank characteristics								
BK_LN_ASSETS	0.013	0.056	0.240	0.812	0.020	0.054	0.370	0.708
BK_SHARE	0.917	0.840	1.090	0.275	-0.483	0.861	-0.560	0.575
HERFINDAHL	2.354	1.678	1.400	0.161	2.597	1.691	1.540	0.125
Borrower-primary bank relationship								
R_LN_DURATION	-0.018	0.115	-0.160	0.873	-0.027	0.110	-0.240	0.807
R_FREQ	0.091	0.066	1.380	0.167	0.100	0.067	1.490	0.136
R_DISTANCE	0.137 *	0.083	1.660	0.098	0.106	0.089	1.190	0.235
R_PRIMESHARE	-0.209	0.291	-0.720	0.473	-1.112 ***	0.312	-3.560	0.000
Constant	0.510	1.366	0.370	0.709	2.810 **	1.378	2.040	0.041
Number of observations	785				782			
Log likelihood	-193.8				-177.6			
Pseudo R^2	0.1162				0.1612			

[g] This table presents the probit estimation results for S_DUM_PR (SBCS loans from a primary bank) and S_DUM_NPR (SBCS loans from a non-primary bank). Definitions of the variables are provided in Table 1. ***, **, * indicate a significance level of 1, 5, and 10%, respectively.