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How do Japanese Banks Discipline Small and Medium-Sized Borrowers? : An Investigation of the Deployment of Lending Technologies

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Abstract

This paper empirically investigates how banks evaluate the creditworthiness of small- and medium-sized enterprises (SMEs). Following SME loan underwriting literature that distinguishes among different *lending technologies*, we test whether the typical SME bank loan is underwritten primarily based on just a single technology. We find that although financial statement lending is the most commonly used and serves as a kind of basic technology, it tends not to be used to the exclusion of other technologies. These findings imply that, at least in Japan, SME lending practice may be inconsistent with academic research on how banks underwrite loans elsewhere.

Keywords: Lending technology, Financial statement lending, Fixed asset lending, Relationship lending, Small- and medium-sized enterprises
JEL classification code: G21, L14, D82, L22

1. Introduction

In Japan, banks have long played a major role in corporate governance. Although its economy has grown rapidly since World War II and large firms' access to capital markets has increased, most small- and medium-sized enterprises (SMEs), which comprise 99.7% of Japanese firms, still rely heavily on banks as a source of finance. Banks that can threaten to withhold funding to SMEs may thus be one of the few players capable of disciplining SME management. To clarify the role of banks in Japanese SME corporate governance, this paper empirically investigates how banks evaluate the creditworthiness of SMEs in providing loans to assess firm quality and monitor firm/management behavior.

We note at the outset that corporate governance in the context of SMEs is somewhat different than corporate governance in the context of publicly owned firms. With respect to the latter, corporate governance mainly focuses on the wedge between a manager's incentive to maximize his/her utility at the expense of maximizing shareholder wealth. Because in the SME sector entrepreneurs tend to own most or all of the shares of the firms that they manage (i.e., they are owner/managers), the manager-shareholder conflict less likely exists. Nevertheless, there exists a significant wedge between owner/managers and the other stakeholders in the firm (e.g., creditors, employees, venders, and customers). In particular, the incentive for owner/managers to exploit other stakeholders by extracting private benefits from the firm or engaging in risk-shifting behavior drives a significant wedge between entrepreneurs and these stakeholders. Banks' monitoring role as shown in theoretical studies such as Diamond (1984) and Rajan (1992) is thus of particular importance for SMEs.

Our approach is based on recent literature on "lending technologies" (i.e., methods of

underwriting loans). This literature suggests that banks use different lending technologies in underwriting loans, and that there are two broad categories of lending technologies: the relationship lending technology and transaction-based lending technologies.[1] These technologies are primarily identified based on the type of information that banks use to evaluate borrower creditworthiness. The relationship lending technology focuses on qualitative and non-verifiable information called "soft" information, which is collected through a strong bank-borrower relationship. Transaction-based lending technologies focus on quantitative "hard" information, such as strong financial ratios or collateral appraisals, that can be easily verified.

Despite a growing body of academic literature on such hypothetical forms of SME financing, relatively little empirical work has been conducted on exactly how banks underwrite SME loans. It is therefore still unclear how banks screen and monitor SMEs, and whether such activities impose disciplinary pressure on SMEs. The investigation of the deployment of lending technologies is particularly important in Japan because Japanese banks have often been criticized as relying too much on real estate collateral and exerting insufficient screening and monitoring effort. If this is the case, banks are not likely to play an important role in disciplining SME management, despite substantial SME dependence on bank finance in practice and their potential role suggested in theoretical studies.

This paper empirically assesses for the first time whether different lending technologies are actually evident in the data from Japan. Specifically, we create indices that identify four lending technologies: (i) relationship lending, plus three types of transaction-based technologies; (ii) financial statement lending, which is underwritten based on financial

[1] See section 2 for more details about these technologies.

statement information, (iii) real estate lending, based on collateral value of real estate, and (iv) other fixed asset lending (i.e., equipment lending), based on collateral value of other fixed assets. To construct these indices we use a unique data set, the *Management Survey of Corporate Finance Issues in the Kansai Area*, which was conducted in the Kansai area of Japan in June 2005. The data contain questions about factors that banks considered in screening and monitoring their loans. We construct our indices from these questions. Thus, our indices are intended to reflect the extent to which the bank *relied* on a specific technology in underwriting its loan. We then use this methodology to investigate the relative importance of different lending technologies in SME lending in the commercial loan market of a large developed economy.

Our data also allow us to empirically analyze whether lending technologies are substitutes for, or complements to, each other. The lending technology paradigm acknowledges that lending technologies are not necessarily mutually exclusive and commercial lenders may lend to SMEs using a combination of lending technologies. However, the paradigm also argues that overall loan underwriting focuses on one *primary* lending technology (Berger and Udell 2002, 2006). Thus the investigation of the degree of complementarity among the lending technologies would reveal how much lenders actually emphasize a primary technology as predicted in the paradigm. A low degree of complementarity would imply that underwriting is based on a primary lending technology. To the best of our knowledge we are the only paper to analyze whether these hypothesized technologies are distinct and whether banks rely on a single primary lending technology.

By way of preview we find that financial statement lending is the most frequently employed lending technology. We also find evidence that financial statement lending is a

kind of basic technology in the sense that it is used regardless of what other technologies are used, i.e., it is typically used in conjunction with other lending technologies. Thus, our analysis suggests that, at least in Japan, lending technologies are not as uniquely employed as suggested by the recent hypothesized lending technology paradigm. This observed *eclectic* approach to commercial lending by Japanese banks is generally inconsistent with the conventional view of SME lending that emphasizes the dichotomy of relationship lending vs. transaction lending. Interestingly, however, our results appear to be consistent with anecdotal evidence about Japanese lending practices.[2]

Overall our findings suggest one of two possible interpretations. They either imply that key components of the new lending technology paradigm are not generally valid or, alternatively that the Japanese lending environment may be idiosyncratic. On the one hand, the finding of significant complementarities among the technologies tested suggests that lenders may not rely on a dominant underwriting technology – at least in Japan. This also implies that banks today do not appear to rely predominantly on real-estate collateral in lending to SMEs. This stands in contrast to anecdotal evidence that banks excessively relied on real estate collateral in lending to SMEs during the asset price bubble in the 1980s prior to the banking crisis.

The remainder of the paper is composed as follows. In the next section, we review different lending technologies in more details. Section 3 introduces the data. In Section 4, we construct the lending technology indices and examine their characteristics and their prevalence in Japanese SME lending. Section 5 analyzes the complementarity among

[2] Practitioner books on bank lending in Japan appear to emphasize an eclectic approach to SME loan underwriting (e.g. Takahashi 2006). This is also consistent with interviews with bankers by the authors.

lending technologies. The final section concludes the paper.

2. Lending technology

The conventional view reflected in most of the literature is that based on the type of information that is used in loan underwriting, there are two important lending technologies: relationship lending and transactions-based lending (e.g. Stein 2002 and Berger and Udell 2002). The former technology refers to loans underwritten based on "soft" information collected through a strong bank-borrower relationship. That is, relationship lending focuses on qualitative and non-verifiable information, such as entrepreneur's skill and competence, that banks collect through long-term relationships and multiple transactions (e.g. lending plus deposit taking) with borrowers. The latter technology refers to loans underwritten based on quantitative and verifiable information, or "hard" information, such as the strength of the financial statements or the value of collateral.

Recent work departs from this view by suggesting that banks use a variety of distinctly different lending technologies, and that the typical SME bank loan is underwritten primarily based on just one of these technologies (e.g., Berger and Udell 2006). Consistent with the prior literature, this new hypothesized *lending technology paradigm* categorizes loans as either relationship lending or transactions-based lending. However it suggests that transactions-based lending is not a single homogeneous lending technology. Instead transactions-based lending consists of at least seven distinctly different lending technologies.

According to this new paradigm lending technologies are distinguished by the primary source of information used in loan underwriting and monitoring. All of the lending technologies except relationship lending utilize hard quantitative information that is relatively

easy for banks to document and transfer internally -- for example, ratios calculated from financial statements (used in financial statement lending) or information about the appraised value of real estate (used in real estate-based lending). These transactions-based technologies (i.e., hard information-based technologies) include financial statement lending, small business credit scoring, asset-based lending, factoring, equipment lending, real estate lending, and leasing (Berger and Udell 2002, 2006).[3] The new lending technology paradigm suggests that all of these transactions-based technologies, with the exception of financial statement lending, can be used to lend to opaque SMEs.

This new paradigm has potentially significant policy implications regarding the impact of banking industry consolidation, monetary policy shocks and financial system infrastructure. For example, if large banks can offer alternatives to the relationship lending technology to opaque SMEs, then the effect of a reduction in the number of small banks caused by industry consolidation may be less critical given that small banks may have an advantage in providing relationship lending. Likewise if the lending channel in the transmission of monetary policy runs through small bank funding of opaque SMEs, its effect may be attenuated if large banks can offer alternative lending technologies. Regarding financial system architecture, if overall SME credit availability depends on access to a full menu of these technologies, then policymakers in developing economies (and some developed economies) should implement legal and regulatory environments where all of these technologies are feasible.

[3] Despite the intuitive nature of its name, asset-based lending is quite distinct from fixed asset lending. Asset-based lending is focused on lending against accounts receivables and inventory using a very high-intensity monitoring structure. It requires sophisticated commercial laws on security interests, a sophisticated collateral notification system, and a highly creditor-friendly bankruptcy system. Probably for these reasons, asset-based lending in its pure form appears to be only practiced in five common law countries - Australia, Canada, New Zealand, the U.K. and the U.S. (Udell 2004).

3. Data

The primary data source of this paper is the *Management Survey of Corporate Finance Issues in the Kansai Area*, which was conducted in June 2005 by the Regional Finance Workshop in the Research Institute of Economy, Trade, and Industry (RIETI). The survey, hereafter the RIETI survey, asks respondent firms about their characteristics, management strategy, bank relationships, and loan characteristics.[4] We eliminated large firms from the sample in order to confine ourselves to SMEs only.[5] We further eliminated firms for which their main bank was not one of seven types: a city bank, a long-term credit bank, a trust bank, a regional bank, a second-tier regional bank, a Shinkin bank, or a credit cooperative. This eliminated firms with non-private banks as their main banks. Finally, we excluded sample firms for which important data for our analysis are not available. This resulted in a base sample of 1584 firms.

The sample firms' industries include: Construction (13.8% of the sample firms), Manufacturing (36.4%), Information technology and Transportation (9.1%), Wholesale

[4] The distribution, collection, and data aggregation of the survey was conducted for RIETI by Tokyo Shoko Research (TSR), a credit reporting and information provision company in Japan. The questionnaires were sent out by hard mail to 9,000 firms in three prefectures, Osaka, Hyogo, and Kyoto, in the Kansai area of Japan, which is located in the middle of the main island of Japan, and forms the focal point for the economy of western Japan. These firms were chosen from TSR's database. In proportion to the relative size of prefecture GDP and the number of enterprises in the prefectures, 5,000 firms were chosen from the Osaka prefecture, 2,500 firms from the Hyogo prefecture, and 1,500 firms from the Kyoto prefecture. In each prefecture, firms were evenly selected from four employee-size categories, 1) 1 to 20 persons, 2) 21 to 50 persons, 3) 51 to 100 persons, and 4) more than 100 persons. For example, in Osaka prefecture, 1250 (= 5000/4) firms were randomly chosen from firms with 1 to 20 employees. 2041 responses were received (by hard mail) yielding a response rate of 22.7%.

[5] In accordance with the Small and Medium Enterprise Basic Law in Japan, SMEs are defined here as enterprises with 300 or fewer regular employees (100 or fewer in Wholesale and Services, 50 or fewer in Retail and Food) or a capital stock of 300 million yen or less (100 million yen or less in Wholesale, 50 million yen or less in Retail, Food and Services).

(21.1%), Retail (4.8%), Restaurant (1.5%), and Real estate (11.0%).[6] Summary statistics on the sample firms are shown in Table 1. The average (mean) firm was established in 1968, employs 71 persons, has a capitalization of 75 million yen, and has 312 million yen of sales.

Table 1. Summary Statistics

	N	Mean	Median	Std. Dev.	Min	Ma
Year of establishment (year)	1569	1,967.72	1968	16.12	1898	
# of employees (person)	1584	70.79	51	84.34	1	
Capitalization (thousand yen)	1568	74,949.60	30,000	249,333.80	3,000	4,6
Sales (thousand yen)	1465	311,642.40	138,877	570,019.60	25	7,8

Source: The Management Survey of Corporate Finance Issues in the Kansai Area (June 2005).

4. Lending technology indices

4.1 Construction of lending technology indices

The first step in our methodology is to identify the technology used in underwriting at the loan level. In order to do this we construct indices that reflect the extent to which an average loan to an SME reflects characteristics that seem to be clearly and distinctly associated with the underwriting used in a specific lending technology. We capture these characteristics from questions in the RIETI survey about inputs or factors based on which an SME's main bank made its lending decisions (in the opinion of the respondent SME).

Specifically, 22 candidate (i.e., potential) factors (shown in Data Appendix A-1) are available based on how respondent SMEs answered this question: "*to what extent did the firm's main bank ACTUALLY focus on each of the factors in making loans to the firm*" (from

[6] Firms in Agriculture, Fisheries, Electricity, Gas, Finance, Insurance, Medicare, and Education industries were excluded in advance before the questionnaires were sent out.

the SME's perspective). Most of these factors appear to be clearly related to a single lending technology. For each factor, respondent firms were requested to choose an answer from a five point scale (from 1 (very much) to 5 (not at all)). We then link the factors that we believe to be most closely associated with each lending technology to construct our *lending-technology indices.*

The emerging literature on loan underwriting lists seven *transaction-based lending* technologies ((i) financial statement lending, (ii) small business credit scoring, (iii) asset-based lending, (iv) factoring, (v) real estate lending, (vi) other fixed asset lending, and (vii) leasing), together with *relationship lending*.[7] Based on our assessment of these technologies in the Japanese context using various sources such as press articles and the practitioner literature, we narrow our focus to the four lending technologies that seem to be particularly important in the Japanese commercial lending market.

First, *financial statement lending* is a lending technology which is primarily based on hard information contained in financial statements. The new paradigm hypothesizes that banks underwrite commercial loans using the financial statement lending technology by relying on financial ratios calculated from these financial statements. From the list of 22 factors shown in Data Appendix A-1, four appear to be closely related to financial statement lending. These factors (numbers 3, 4, 5, and 6) are ratios calculated from the firm's financial statements: a coverage ratio, a leverage ratio, a profitability ratio and a growth ratio. From these four factors we created the financial statement lending index, LT_FINSTAT, by calculating the *average* of the four dummy variables each of which takes a value of one if the

[7] A persuasive argument can be made that trade credit can also be viewed as a distinct lending technology. One paper specifically investigated whether trade creditors are relationship lenders that utilize soft information (Uchida, Udell and Watanabe 2006). For more detailed explanations of lending technologies, see Berger and Udell (2006).

firm answered 1 (very much) to the four relevant lending factors, respectively.[8]

The virtue of using an average index is that it can be directly compared with the other (averaged) indices, as we explain below, since all the indices are constructed from dummy variables. We also conducted preliminary analysis using the *summed* indices of the relevant dummy variables, or the *first principal component* of the principal component analysis over the dummy variables. Because the results were qualitatively the same, and because we cannot easily compare these indices with each other, we only report results that are based on the averaged indices. It may also be useful to extract information not only from a "1" (very much) answer but also from a "2" (much) answer. We also discuss some of our findings using this alternative measure.

Next, we focus on the two types of fixed asset lending, *real estate lending* and *other fixed asset lending*. Real estate lending appears to merit special attention in Japan. Japanese banks have often been criticized as relying too much on real estate collateral and exerting insufficient screening and monitoring effort. This problem has been referred to as the "collateral principle." The criticism was originally levied in the context of the popping of the real estate bubble in 1990 and the subsequent decade-long banking crisis (e.g. Nakaso (2001)). Regarding the post-crisis era, Ono and Uesugi (2005) found based on data taken from the Survey of Financial Environment by the Small and Medium Enterprise Agency of Japan, that 77.4% of Japanese SMEs pledged collateral in 2001, and that in 95.9% of these cases at least some of the collateral was real estate.[9]

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[8] For example, the dummy variable for the coverage ratio is set to one if the firm responded that its main bank focuses "very much" on the coverage ratio in making loans to the firm.

[9] The figures reported by Ono and Uesugi (2005) are based on SMEs only. The Bank of Japan's "Loans Collateral Amounts" statistics (available at http://www.boj.or.jp/en/theme/research/stat/dl/zan/loan_etc/index.htm) indicate that the ratio of collateralized loans to total loans

In the context of the lending technology paradigm the Japanese "collateral principle" could be interpreted as meaning that Japanese banks rely too heavily on the real estate lending technology and too little on other lending technologies. If this reliance on real estate lending comes at the expense of soft information production or monitoring through regular periodic analysis of financial statements, then the role of banks in disciplining their SME borrowers (i.e., the role of banks in SME corporate governance) could be diminished.

The *real-estate lending* index, LT_REALESTATE, is a dummy variable which takes a value of one if the firm answered 1 (very much) to lending factor no. 7 (real estate is available as collateral). The *other fixed asset lending index*, LT_OTHERFAL, is an *average* of the two dummy variables each of which takes a value of one if the firm answered 1 (very much) to lending factors no. 8 and 12, respectively (fixed assets other than real estate are available, and personal assets are available). This index captures the availability of fixed assets as collateral (excluding real estate) including the entrepreneur's personal assets. Note that the basic technology used in real estate lending and other fixed asset lending is the same, and the distinction is solely based on the type of collateral.

Finally, we construct the index, LT_RELATION, to capture the relationship lending technology. This index is constructed from the answers regarding the factors that seem most related to soft information accumulation by banks through close relationships. The index is an average of six dummy variables related to soft/qualitative information which take a value of one if the firm answered 1 (very much) to seven lending factors respectively: numbers 11, 14, 15, 18, 20, and 22. These include subjective dimensions such as the "personal managerial ability" of the entrepreneur and the level of the SME's "creativity".

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outstanding has been small and decreasing (from around 28% at the beginning of the 1990s to 17% in 2005). However, these figures include loans to large companies.

We also tried two alternative definitions of LT_RELATION: i) adding factor no. 19 (whether the bank is the SME's main bank or not) and ii) a more parsimonious index that uses only three factors (numbers 11, 14, and 15).[10] These alternative specifications generally produced consistent results, so we only report the index using the six factors above.

In sum, we focus on four technology indices in the analysis below: LT_FINSTAT, LT_REALESTTE, LT_OTHERFAL, and LT_RELATION. These indices capture the extent to which loan underwriting by the main bank reflects the characteristics of each technology. In other words, the indices represent *financial statement lending*-ness and *other* [three] *lending*-ness in a typical loan from the main bank to this respondent firm.

By focusing on just these four technologies, we exclude four other technologies listed in the literature, small business credit scoring, asset-based lending, factoring, and leasing. These exclusions appear reasonable in the Japanese context. Credit scoring has only recently been applied by large banks in Japan. Asset-based lending does not exist in Japan.[11] In fact, lending collateralized by movable assets (other than factoring as explained below) has been very rare in Japan, at least until recently.

Finally, we cannot investigate the use of leasing and factoring in a manner similar to the four lending technologies explained above. In Japan the Banking Act prohibits banking entities from offering these two technologies except in organizationally distinct affiliates.[12] This regulatory-driven organizational constraints renders our analysis of lending technology complementarity problematic because the underwriting decision involves, at best, a different

[10] The assumption behind i) is that the main bank is special in the sense of producing soft information.
[11] As explained in footnote 1, asset-based lending is a unique technology that is distinct from fixed asset lending.
[12] There are also non-banks that are allowed to deploy these types of lending.

entity within the organizationally structure. Thus we do not analyze factoring and leasing in this paper.

We caution that our four lending technology indices may not be perfect proxies for the use of different lending technologies, since they are based on the *borrowers*' perception of the lending factors used by their main bank in underwriting its loans, and thus may not precisely capture the banks' underwriting process. However, the indices are novel in the sense that they are created to represent criteria that banks likely focus on in underwriting their SME loans. Another prominent feature of our indices is that they are constructed from information at an individual borrower level. Such detailed information has not been used in the literature before to distinguish among a menu of the different lending technologies beyond just soft vs. hard information.[13]

4.2 The relative importance of individual lending technologies

We first investigate the use of lending technologies in loan underwriting. We directly compare the magnitudes of the lending technology indices together with their component dummy variables which constitute the indices. Table 2 shows the summary statistics of these variables.

[13] To the best of our knowledge there is only one other study that has examined more than two lending technologies at the same time (Berger and Black 2007). However, their methodology for identifying the lending technologies is quite different from ours. They do not have data on the extent to which banks rely on a specific lending technology; they only have data on contract terms. Thus, they cannot allow for the possibility that a bank may have a relationship with a borrower but does not rely on information culled from that relationship in underwriting the loan. Also, by construction their identification of lending technologies are mutually exclusive. Thus, they cannot examine the issues of a primary lending technology and technology complementarity because their methodology does not allow for simultaneous deployment of lending technologies.

Table 2. Descriptive Statistics of Lending Technology Indices

Relevant Lending Technology	Indices/Factors	N	Mean	Std. Dev.
Financial Statement Lending	LT_FINSTAT	1129	**0.331**	0.357
	#3	1129	**0.330**	0.471
	#4	1129	**0.356**	0.479
	#5	1129	**0.395**	0.489
	#6	1129	**0.241**	0.428
Real Estate Lending	LT_REALESTATE	1129	**0.189**	0.391
Other Fixed-Asset Lending	LT_OTHERFAL	1129	**0.073**	0.202
	#8	1129	**0.056**	0.230
	#12	1129	**0.090**	0.287
Relationship Lending	LT_RELATION	1129	**0.113**	0.183
	#11	1129	**0.189**	0.391
	#14	1129	**0.156**	0.363
	#15	1129	**0.157**	0.364
	#18	1129	**0.068**	0.252
	#20	1129	**0.094**	0.292
	#22	1129	**0.015**	0.122

Note: This table shows descriptive statistics of the lending technology indices and their components. The components are dummy variables, which take a value of one if the firm answered 1 (very much) to the question "to what extent did your main bank actually focuses on each of the factors in making loans to the firm" with respect to the relevant factor, which are listed in Appendix A-1. The lending technology indices are simple averages over the relevant dummy variables. They represent to what extent loans from the main bank on average bear characteristics of the following four lending technologies, respectively: financial statement lending, real estate lending, other fixed-asset lending, and relationship lending. "LARGE=1," "REGIONAL=1," and "UNION=1" columns represents the indices and their components when the main bank is a city, a long-term credit, or a trust bank, when the main bank is a regional or a second tier regional bank, and when the main bank is a Shinkin bank or a credit cooperative, respectively.

The table shows that the lending factors related to financial statement lending are on average relatively more frequently emphasized, i.e., the mean of the financial statement

lending index is the largest among the four indices. Moreover, 56.3% of the firms answered "very much" to at least one of the four questions that comprise the financial statement lending index (not shown). If we also include the "much" answer as well as the "very much" answer (to the question of how much the bank relies on this factor), the mean response increases to 94.2%. This suggests that Japanese banks almost always value information from financial statements when they make lending decisions. This makes financial statement lending the most frequently used technology. Its ubiquitous use also suggests that in some sense it may also be a type of basic SME lending technology in Japan.

It is also interesting to observe that the mean of the real estate lending index is the next largest. However, the magnitude (18.9%) is relatively smaller than implied by the *collateral principle*, although if we include the "much" answer the frequency rises to 52.5%. Overall this suggests that collateral value is of secondary importance in SME loan underwriting by banks. However, we cannot opine on the applicability of the *collateral principle* criticism of Japanese lending behavior during the financial crisis because our data is limited to 2005. Our data could, nevertheless, imply that the collateral principle has decreased in economic significance, possibly sufficiently to the point where it is no longer a fair characterization of Japanese loan underwriting. This also suggests that bank monitoring of the behavior of SMEs and their entrepreneurs in Japan through monitoring financial statements is relatively important suggesting that the bank corporate governance mechanism is operative.

Based on the mean level of the index (11.3%), relationship lending is the third most important technology. If we look into its component factors, 36.4% of the firms answered "very much" to at least one of the six factors that comprise of the index (not shown). If we include the "much" answer as well, the figure goes up to 89.0%, which is nearly as much as

that of financial statement lending. This implies that although the relationship lending technology may not be the most important technology, it is still relatively important.

Finally, Table 2 demonstrates that the remaining technology, the other fixed asset lending technology (the combination of the SMEs' other fixed assets and the personal assets of the SMEs' entrepreneur), is the least frequently used lending technology (7.3%). Furthermore, 87.3% of the respondent firms did not answer "very much" to *both* of the two component factors that comprised the index (not shown).[14]

To summarize we can conclude that the ubiquitous use of the financial statement lending technology suggests that in Japan it may be a kind of basic technology. The second and third most important technologies, real estate lending and relationship lending, are used less frequently but both are nontrivial.

This is, however, just a univariate test. Controlling for factors such as firm characteristics that may affect the choice of lending technologies may be important. We will pursue this issue further in the context of a simultaneous regression analysis in Section 5. Also, this univariate analysis does not allow for complementarity among this technologies and the possibility that these lending technologies may not be strictly distinct from each other. In other words, it is possible that different technologies complement each other and loans contain characteristics of multiple technologies at the same time. We will investigate this complementarity in the next section.

5. Complementarity among the lending technologies

5.1 Univariate analysis

[14] The percentage of the firms that did not answer "very much" or "much" was 54.1%.

Table 3. Correlation between Lending Technology Indices

	LT_FINSTAT	LT_REALESTATE	LT_OTHERFAL
LT_FINSTAT			
LT_REALESTATE	0.192 ***		
LT_OTHERFAL	0.210 ***	0.403 ***	
LT_RELATION	0.389 ***	0.120 ***	0.237 ***

Number of observations: 1129.

Note: Coefficients of correlation between lending technology indices (see footnote for Table 2) are shown. ***, **, and * represents statistical significance at a 1%, 5%, and 10% level, respectively.

We now turn to an analysis of the interrelationship among the four lending technology indices and to the issue of complementarity among them. First, we check the simple correlations among the four lending technology indices (Table 3). For all combination of indices there is a significant positive correlation. Interestingly, the magnitude of correlation is very high between LT_FINSTAT and LT_RELATION. This implies that the financial statement lending technology and the relationship lending technology may be highly complementary and used in tandem. This is inconsistent with the prediction in the new paradigm literature (e.g., Berger and Udell 2006) that these should be, in effect, substitutes. It also runs counter, in some sense, to the spirit of the conventional view in the prior literature that emphasizes that transactions-based lending and relationship lending are separable.

We also observe a high correlation between LT_REALESTATE and LT_OTHERFAL. This may be related to the fact that both of them are based on an underwriting process that

focuses on assessing the liquidation value of a fixed asset. For other combinations of technologies, a significant positive correlation is observed but its level is not comparable to the two aforementioned combinations.

5.2 Simultaneous regression analysis

Methodology

Because our LT indices have mutual dependence, we need to take into account their simultaneous determination. Therefore, we estimate a simultaneous equation model with four equations. For this model we need at least four instrumental variables to identify the four technology indices that are endogenous variables in the system of regressions. Our model, consisting of four regressions that are simultaneously estimated by three-stage least squares (3SLS), is:

$$LT_1 = f_1 (LT_2 , LT_3 , LT_4 , X_1)$$

$$LT_2 = f_2 (LT_1 , LT_3 , LT_4 , X_2)$$

$$LT_3 = f_3 (LT_1 , LT_2 , LT_4 , X_3)$$

$$LT_4 = f_4 (LT_1 , LT_2 , LT_3 , X_4)$$

LT_i (i = 1, …, 4) represents the four lending technology indices. X_i is a vector of instrumental variables for technology i. These are variables that affect the relevant technology but do not affect the other three technologies.

We use the following instrumental variables. First, as an instrument for LT_FINSTAT, we use a dummy variable AUDIT, which takes a value of one if the firm has its financial

statements audited by a CPA.[15] We also use FREQ_FINSTAT which indicates how many times a year the firm submits financial statements (irrespective of whether it is audited or not) to its main bank. We are assuming that the choice of the other lending technologies is independent of the decision to have audited financial statements and the frequency of financial statements.

Second, as instruments for the real estate lending technology, we use data from the firms' balance sheet. BUILDINGR and LANDR are the ratios of the book value of buildings and land, respectively, to the total assets. The industry dummy for real estate firms, REALEST, is also likely to contribute to the adoption of the real estate lending technology. We thus expect that these variables have a positive effect on LT_REALESTATE. Since balance sheet information is not available for all the sample firms, the use of BUILDINGR and LANDR together with other balance sheet ratios explained below greatly reduces the number of observation.[16]

Third, our LT_OTHERFAL captures the bank's reliance on personal assets and the firm's non-real estate fixed assets in its loan underwriting. The proxy for the former is HOMEOWNER, which takes the value of one if the entrepreneur of the firm owns a house. For the latter we use the balance sheet ratios of fixed assets other than real estate to total assets. Specifically, MACHINER, VEHICLER, and TOOLR respectively represent the ratios of machinery, vehicles, and tools to the total outstanding assets.

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[15] Our indices, including LT_FINSTAT, are constructed based on survey questions that focus on the extent to which the main bank *relies* on financial ratios (whether audited or not). Our AUDIT variable, on the other hand, is based solely on the *existence* of audited financial statements independent of whether it relies on them.

[16] We conducted analysis with a larger sample by excluding these balance sheet ratios, but doing so greatly reduces efficiency of the results. This means that these variables are good instruments.

Finally, we use several instruments for relationship lending. Since relationship lending is considered to be a technology for SMEs with little hard information, we use as an instrument the unavailability of financial statement information as represented by a dummy variable NOFINSTAT which takes the value of one if the respondent firm does not have any financial statements (i.e., whether audited or unaudited). Similarly, we use AUDIT to capture the quality of hard information noting, however, that we expect the opposite sign, i.e., we expect AUDIT to have a negative impact on LT_RELATION. We also employ as an instrument the entrepreneur's age, CEOAGE, because it may be associated with the availability of soft information about the entrepreneur and his/her managerial skills. Our logic here is that there may be more soft information available about an older entrepreneur's skills than a younger entrepreneur.

In addition to these instruments, we also add a variety of control variables to the right hand side of the all four equations. Details for the control variables are shown in Appendix A-2. Descriptive statistics for all of our variables are shown in Table 4.

Table 4. Descriptive Statistics

	N	Mean	Std. Dev.	Min	Max
AUDIT	1521	0.116	0.320	0	1
FREQ_FINSTAT	1375	2.505	3.040	1	13
LARGE	1584	0.620	0.486	0	1
REGIONAL	1584	0.210	0.408	0	1
UNION	1584	0.170	0.376	0	1
NOFINSTAT	1547	0.033	0.179	0	1
HOMEOWNER	1355	0.946	0.226	0	1
CEOAGE (year)	1515	59.937	9.786	27	93
REALEST	1584	0.022	0.147	0	1
BUILDINGR	561	0.083	0.093	0	1
MACHINER	561	0.038	0.085	0	1
VEHICLER	561	0.008	0.035	0	0
TOOLR	561	0.008	0.019	0	0
LANDR	561	0.128	0.127	0	1
ASSET (ten thousand yen)	1413	261,169.100	457,297.800	-2,880	5,690,000
FIRMAGE (year)	1569	37.284	16.118	1	107
EMPLOYEE (person)	1584	70.791	84.338	1	1,172
PERFORMANCE_SS	1549	0.744	0.437	0	1
PERFORMANCE_DS	1549	0.105	0.306	0	1
PERFORMANCE_SD	1549	0.079	0.269	0	1
PERFORMANCE_DD	1549	0.073	0.260	0	1
NODIVIDEND	1527	0.590	0.492	0	1
OSAKA	1584	0.410	0.492	0	1
KOBE	1584	0.097	0.296	0	1
KYOTO	1584	0.145	0.352	0	1
CONST	1584	0.138	0.345	0	1
MANUFAC	1584	0.364	0.481	0	1
IT_TRANS	1584	0.091	0.288	0	1
WHOLE	1584	0.211	0.408	0	1
RETAIL	1584	0.048	0.214	0	1
RESTAURANT	1584	0.015	0.122	0	1
SERVICES	1584	0.110	0.314	0	1

Source: The Management Survey of Corporate Finance Issues in the Kansai Area (June 2005).

Results

Table 5. 3SLS estimation of four lending technology regressions

Financial statement lending regression (dep. var. = LT_FINSTAT)								
	(A)				(B)			
Indep. var.	Coef.		Std. Err.	Prob.	Coef.		Std. Err.	Prob.
LT_REALESTATE	0.6251	**	0.2771	0.0240	0.4896	**	0.2422	0.0430
LT_OTHERFAL	-0.9323		0.5965	0.1180	0.0855		0.4963	0.8630
LT_RELATION	1.7249	***	0.5421	0.0010	1.8139	***	0.3785	0.0000
AUDIT	0.0004		0.0251	0.9860	0.0253		0.0286	0.3760
FREQ_FINSTAT	-0.0003		0.0026	0.8960	-0.0017		0.0024	0.4740
REGIONAL					-0.0875		0.0661	0.1860
UNION					-0.0487		0.0763	0.5230
LOG(ASSET)					0.0323		0.0280	0.2480
FIRMAGE					-0.0047	***	0.0017	0.0080
LOG(EMPLOYEE)					-0.0446		0.0382	0.2420
PERFORMANCE_DS					-0.0633		0.0778	0.4160
PERFORMANCE_SD					0.0082		0.0945	0.9310
PERFORMANCE_DD					-0.0235		0.1045	0.8220
NODIVIDEND					-0.1156	**	0.0538	0.0320
OSAKA					-0.0067		0.0543	0.9010
KOBE					-0.1076		0.0894	0.2290
KYOTO					-0.0141		0.0668	0.8330
CONST					0.1513		0.1114	0.1740
MANUFAC					0.1122		0.1047	0.2840
WHOLE					0.1836		0.1127	0.1030
RETAIL					-0.0376		0.1774	0.8320
RESTAU_HOTEL					0.2304		0.2991	0.4410
SERVICES					0.4021	***	0.1352	0.0030
Intercept	0.1065	*	0.0619	0.0850	-0.0094		0.2945	0.9740

Other fixed-asset lending regression (LT_OTHERFAL)								
	(A)				(B)			
Indep. var.	Coef.		Std. Err.	Prob.	Coef.		Std. Err.	Prob.
LT_FINSTAT	0.8046		0.4945	0.1040	1.4769		0.9308	0.1130
LT_REALESTATE	0.1879		0.2419	0.4370	-0.0676		0.2524	0.7890
LT_RELATION	-0.4829		0.7235	0.5040	-2.3718		1.9256	0.2180
HOMOWNER	0.1230		0.0795	0.1220	0.1477		0.1326	0.2650
MACHINER	0.7229	**	0.3637	0.0470	0.7959		0.7308	0.2760
VEHICLER	0.8495		0.5363	0.1130	0.7050		0.6115	0.2490
TOOLR	0.4433		0.6962	0.5240	0.8230		0.7490	0.2720
REGIONAL					0.1003		0.1158	0.3860
UNION					0.0841		0.0833	0.3130
LOG(ASSET)					-0.0214		0.0280	0.4450
FIRMAGE					0.0058	*	0.0033	0.0800
LOG(EMPLOYEE)					0.0411		0.0471	0.3830
PERFORMANCE_DS					0.0065		0.0725	0.9290
PERFORMANCE_SD					0.0484		0.0797	0.5440
PERFORMANCE_DD					0.0055		0.0899	0.9510
NODIVIDEND					0.1577	**	0.0764	0.0390
OSAKA					0.0530		0.0761	0.4860
KOBE					0.0999		0.1027	0.3310
KYOTO					0.0471		0.0611	0.4410
CONST					-0.2070		0.1745	0.2350
MANUFAC					-0.1744		0.1641	0.2880
WHOLE					-0.2508		0.1821	0.1680
RETAIL					0.0552		0.1530	0.7180
RESTAU_HOTEL					-0.2752		0.2585	0.2870
SERVICES					-0.5428		0.3406	0.1110
Intercept	-0.3439	*	0.1813	0.0580	-0.0214		0.0280	0.4450

Real Estate Lending regression (dep. var. = LT_REALESTATE)								
	(A)				(B)			
Indep. var.	Coef.		Std. Err.	Prob.	Coef.		Std. Err.	Prob.
LT_FINSTAT	1.4521	***	0.3770	0.0000	1.5765	***	0.3692	0.0000
LT_OTHERFAL	1.6508	*	0.8585	0.0550	0.9448		1.6450	0.5660
LT_RELATION	-2.8009	**	1.1801	0.0180	-3.6111	**	1.7863	0.0430
LANDR	0.0232		0.1135	0.8380	0.0669		0.3771	0.8590
BUILDINGR	0.0804		0.1974	0.6840	0.0606		0.2386	0.8000
REALEST	0.1328		0.2228	0.5510	0.1076		0.3180	0.7350
REGIONAL					0.2086		0.1418	0.1410
UNION					0.0718		0.1011	0.4780
LOG(ASSET)					-0.0676		0.0515	0.1890
FIRMAGE					0.0071	**	0.0027	0.0100
LOG(EMPLOYEE)					0.0918		0.0643	0.1530
PERFORMANCE_DS					0.1016		0.1177	0.3880
PERFORMANCE_SD					-0.0810		0.1625	0.6180
PERFORMANCE_DD					0.0594		0.1371	0.6650
NODIVIDEND					0.1451		0.1222	0.2350
OSAKA					0.0298		0.1026	0.7720
KOBE					0.2016		0.1525	0.1860
KYOTO					0.0032		0.0893	0.9720
CONST					-0.2409		0.1526	0.1140
MANUFAC					-0.1857		0.1405	0.1860
WHOLE					-0.2627	*	0.1541	0.0880
RETAIL					0.0395		0.2349	0.8660
RESTAU_HOTEL					-0.1798		0.5581	0.7470
SERVICES					-0.6114	***	0.2200	0.0050
Intercept	-0.1347		0.1062	0.2050	-0.0676		0.0515	0.1890

Relationship lending regression (dep. var. = LT_RELATION)								
	(A)				(B)			
Indep. var.	Coef.		Std. Err.	Prob.	Coef.		Std. Err.	Prob.
LT_FINSTAT	0.4772	***	0.1502	0.0010	0.5162	***	0.0858	0.0000
LT_REALESTATE	-0.2970	*	0.1691	0.0790	-0.2612	**	0.1224	0.0330
LT_OTHERFAL	0.5806	**	0.2298	0.0120	0.0971		0.2442	0.6910
AUDIT	-0.0014		0.0227	0.9520	-0.0098		0.0140	0.4840
NOFINSTAT	0.0008		0.0893	0.9930	0.0016		0.0422	0.9710
CEOAGE	0.0000		0.0008	0.9500	0.0002		0.0004	0.5700
REGIONAL					0.0548	*	0.0300	0.0680
UNION					0.0240		0.0362	0.5070
LOG(ASSET)					-0.0169		0.0133	0.2010
FIRMAGE					0.0023	**	0.0009	0.0160
LOG(EMPLOYEE)					0.0252		0.0181	0.1650
PERFORMANCE_DS					0.0318		0.0376	0.3980
PERFORMANCE_SD					-0.0101		0.0445	0.8210
PERFORMANCE_DD					0.0148		0.0496	0.7660
NODIVIDEND					0.0550	*	0.0284	0.0530
OSAKA					0.0063		0.0254	0.8030
KOBE					0.0544		0.0411	0.1850
KYOTO					0.0042		0.0316	0.8940
CONST					-0.0798		0.0519	0.1240
MANUFAC					-0.0604		0.0489	0.2170
WHOLE					-0.0913	*	0.0532	0.0860
RETAIL					0.0115		0.0845	0.8920
RESTAU_HOTEL					-0.0917		0.1452	0.5280
SERVICES					-0.2020	***	0.0704	0.0040
Intercept	-0.0373		0.0690	0.5890	-0.0169		0.0133	0.2010

Number of observations: 361.

Note: This table shows the results for the 3SLS esimation of the four lending technology regressions. The four dependent and endogenous variables are the four lending technology indices (see the footnote for Table 2 for more detail on the indices). Panel (A) shows the results with only instrumental variables (for the four endogenous variables) on the right hand side of the equations, while panel (B) includes other control variables as well. ***, **, and * represent statistical significance at a 1 %, 5 %, and 10% level, respectively.

Results for the simultaneous estimation of the four technology regressions by 3SLS are shown in Table 5. Panel (A) and (B) report the specification without and with control variables, respectively. The results imply that some lending technologies are complementary to each other. Specifically, irrespective of whether control variables are included or not, there is a mutual positive dependence between LT_FINSTAT and LT_RELATION, i.e., financial statement lending technology and relationship lending technology are used in tandem. Given that this result reinforces our earlier findings, we can conclude that in the loan market in Japan there likely exists a complementarity between financial statement lending and relationship lending.

We also find that LT_FINSTAT and LT_REALESTATE exhibit mutual dependence in both specifications. There seems to be a synergy in deploying financial statement lending and real estate lending at the same time. This result, together with the previous result, reinforce our former analysis that financial statement lending technology appears to be a kind of basic technology that is used regardless of what other technology is used.[17] This suggests that using real estate as collateral does not appear to come at the expense of monitoring firms through their financial statements. That is, relying on real estate as collateral does not seem to diminish the role of banks in corporate governance in terms of monitoring entrepreneur behavior through financial statements.

It is also interesting to observe that LT_REALESTATE has a negatively significant impact on LT_RELATION. A negatively significant impact is also observed in the opposite direction. We can therefore reconfirm, in a stronger form, that the real estate lending

[17] However, different from the univariate analysis, here LT_FINSTAT and LT_OTHERFAL have no mutual impact.

technology and the relationship lending technology do not appear to be mutually compatible.[18] In contrast to our findings on complementarities between real estate lending and financial statement lending, findings here suggests that concerns that real estate lending may come at the expense of monitoring firms through relationship building may be justified. That is, relying on real estate as collateral seems to diminish the incentive to generate soft information.

On balance, the results in Table 5 imply that even after taking into account the simultaneous determination of lending technologies, some of the technologies deployed by Japanese banks, especially financial statement lending, are still highly complementary, although there is a robust exception between relationship lending and real estate lending. In this sense, we can conclude that Japanese banks generally take an *eclectic* approach in choosing lending technologies.[19] The results, however, are not consistent with the view in the literature that transactions (hard information-based) lending and relationship (soft information-based) lending are substitutes and that SME loan underwriting emphasizes a primary lending technology at the loan level.

6. Conclusion

In Japan, banks have long been one of the major providers of financing to SMEs, and thus play an integral role in disciplining SMEs. This paper uses data from a unique survey

[18] This result is consistent with the *lazy-bank hypothesis* which shows that the use of collateral reduces banks' incentive to screen borrowers (Manove, Padilla, and Pagano 2001). Jiménez, Salas, and Saurina (2006) obtain evidence consistent with the hypothesis, while the results in Voordeckers and Steijvers (2006) do not support it.

[19] This eclectic approach of Japanese banks is consistent with the practitioner literature on how banks screen borrowers (e.g. Takahashi 2006) and with interviews by the authors with some bankers.

in Japan to investigate the banks' most powerful tool to discipline SMEs, i.e. loan granting decisions. We examined the deployment of different lending technologies which can be used in lending to small- and medium-sized enterprises (SMEs) in Japan, through which banks assess borrower quality at loan origination and through which they monitor their existing borrowers. In the context of the new lending technology paradigm (e.g., Berger and Udell 2002, 2006), we assess the extent to which different lending technologies are used, and how complementary the technologies are with respect to each other.

We found that the financial statement lending technology is the most commonly used technology in our sample of Japanese SMEs. We also found that the different lending technologies are not generally distinct in the sense that multiple lending technologies appear to be commonly used at the same time. This latter finding is generally inconsistent with prior theoretical and empirical work that has emphasized that certain lending technologies (i.e., relationship lending) will be used to the exclusion of other technologies (transactions-based technologies) and vice-versa (e.g., Stein 2002, Berger et al. 2005, Berger and Udell 2006). Further, we find that the financial statement lending technology was so commonly used that it could be considered a "basic" technology.

It is not clear, however, that our results would generalize to other countries. That is, it is not clear that our results should be better interpreted as being inconsistent with the prior literature or better interpreted as a reflection of an idiosyncratic situation in Japan. In this regard, we speculate that Japan could be idiosyncratic because it is in a post financial crises period of transition. Alternatively, we speculate that Japan may be idiosyncratic because of a credit culture that is driven by an unusual lending infrastructure. Ultimately, however, it is difficult to draw strong conclusions about whether Japanese commercial loan underwriting is

idiosyncratic in the absence of other comprehensive tests of loan underwriting in other countries. We encourage other researchers to develop data that be used to analyze commercial loan underwriting and the complementarity among lending technologies in other countries. As far as we know, this is the only paper to date that is comprehensive in this regard.

Finally, we find one result that may be important from a corporate governance point of view. There was considerable concern during the period of the financial crises (i.e., the "lost decade" of the 1990s) that bankers relied heavily on real estate in making SME loans. Our results here based on post-crises data suggest that banks do not predominantly rely on real estate collateral (e.g., the entrepreneur's home, the company's factory) in underwriting SME loans. Specifically, other lending technologies appear to be considerably more important than the real estate lending technology. This implies that banks, at least recently, actively screen and monitor their SMEs and thus are thus likely to impose disciplinary pressure on SME management.

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Data Appendix

A-1 Lending Factors in the RIETI survey

1. SME's type of business
2. SME's size
3. SME's ability to make repayments (such as years to make repayment)
4. SME's soundness (capital asset ratio)
5. SME's profitability (current profit / sales ratio)
6. SME's growth (e.g. growth in sales)
7. Real estate is available as collateral[20]
8. Fixed assets are available as collateral (other than real estate)[21]
9. Guarantee by the Credit Guarantee Corporation (a government financial institution)
10. Personal guarantee
11. Personal managerial ability of the SME's entrepreneur
12. Personal assets of the SME's entrepreneur are available as collateral
13. Past record of the bankruptcy of the SME's entrepreneur

[20] The survey question does not distinguish between real estate assets owned by the firm and real estate assets owned by the entrepreneur. Thus, an affirmative response to this question may indicate either.

[21] The survey question here also does not distinguish between assets owned by the firm and assets owned by the entrepreneur. Thus, an affirmative response to this question could indicate either. However, in the case of assets such as equipment it seems most likely that the assets would be owned by the firm.

14. SME's operating base (customer pool, supply system)

15. SME's strength (e.g. creativity)

16. SME's frequency or quality of disclosure

17. Third party's evaluation of the SME

18. Length of relationships

19. Whether the bank is the SME's main bank or not

20. Trust between your company and loan officer

21. Attitude of the potential lenders other than the main bank

22. The evaluation of the SME from a CPA or tax accountant

A-2 Control variables

ASSET: the size of the firm's asset

FIRMAGE: the age of the firm

EMPLOYEE: the number of employees

PERFORMANCE_DS: a dummy variable indicating that the firm first posted a deficit (D) and then in surplus (S) (i.e., unprofitable and then profitable) in the past two years

PERFORMANCE_SD: similarly defined as PERFORMANCE_DS (surplus followed next year by deficit

PERFORMANCE_DD: similarly defined as PERFORMANCE_DS (deficit followed next year by another deficit)

NODIVIDEND: = 1 if the firm did not pay dividend in the last accounting year

OSAKA, KOBE, KYOTO: regional dummies = 1 if the area code of the firm's telephone number is 06 (Osaka city fringe), 078 (Kobe city fringe), and 075 (Kyoto city fringe),

respectively

CONST (construction), MANUFAC (manufacturing), WHOLE (wholesale), RETAIL (retail), REALEST (real estate), RESTAU_HOTEL (restaurants and hotels), and SERVICES (other services): Industry dummies

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