Banks' Lending Behavior under the "Zero-Zero" Loan Policy *

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Abstract

This study focuses on a special credit guarantee program called the "zero-zero" loan policy implemented by the Japanese government during the COVID-19 pandemic. The "zero-zero" loan policy had special characteristics, such as 100% credit guarantee and interest payment support by the government. In addition, the interest rate setting was different from usual loans by private banks. We analyzed how such design of the "zero-zero" loan affected the lenders' behavior. In particular, we examined whether moral hazard problem in lending behavior occurred. We conducted the analysis in collaboration with Tokyo Shoko Research (TSR), using original data generated from a combination of firm-level financial statement data and the results of a firm questionnaire survey. We found that banks took advantage of the loan design to maximize their own profits while at the same time they properly screened borrowers when lending. Our results suggest that the moral hazard problem in lending behavior did not occur when banks lent "zero-zero" loans. Although there were concerns about the occurrence of moral hazard in loans with 100% credit guarantees, this study is a valuable empirical analysis in that it provides some evidence on this issue.

Keywords: public credit guarantee, 100% credit guarantee, lending behavior, moral hazard, COVID-19

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1 Introduction

The "zero-zero" loan policy was the Japanese government's support measure for small and medium-sized enterprises (SMEs) against COVID-19 pandemic, which provided 100% credit-guaranteed loans and interest payment support for SMEs that have experienced a significant decline in sales due to the impact of COVID-19. The economic shocks derived from the COVID-19 pandemic were not only massive but also unexpected, and small and medium-sized firms, in particular, were severely affected and faced liquidity problems. Most governments provided business support to help them overcome the shock through massive fiscal policies. These supports included financial measures such as loans with public credit guarantees and loans with more lenient terms than usual, including interest payment supports. In Japan, this "zero-zero" loan policy was implemented. A series of business support policies including the "zero-zero" loan policy were utilized by a lot of firms and helped to solve their short-term liquidity problems. In fact, the number of bankruptcies in Japan in 2020 and 2021, immediately after the COVID-19 pandemic, was lower than the number before COVID-19 (TokyoShokoResearch, 2022).

On the other hand, the generous features of the "zero-zero" loan such as loose borrowing terms, loans with 100% credit guarantees, and assistance with interest payments may have altered the behavior of the borrower firms as well as the lender private banks. Since loans with both a 100% credit guarantee and support for interest payments were virtually risk-free for private banks, they had an incentive to lend to borrowers regardless of borrowers' quality. In addition, because firms believed that they had fewer requirements to meet for borrowing and were more likely to be approved for their application, those that would not have applied for loans under normal circumstances would have also applied for the "zero-zero" loan. Special credit guarantee programs led by the government in Japan during past shocks caused moral hazard problems (Uesugi et al., 2010; Ono and Yasuda, 2017), and the government support measures in COVID-19 have already raised concerns, such as contributing to the survival of the "zombie" firms (Hoshi et al., 2023).

Against this background, this study empirically examines whether the "zero-zero"

loan implemented in Japan immediately after COVID-19 caused moral hazard problems in the lending behavior of private banks. There are two types of moral hazard considered in this study. The first type is caused by losing the incentive for private banks to select good borrowers because there is no risk of default on the loans due to the 100% credit guarantee. The second type of moral hazard arises from the government's support of interest payments, which encouraged private banks to accept and provide loans with higher interest rates in order to receive the interest income. In the latter case, private banks were able to earn interest income immediately after they began lending. Also, the lending interest rate for the "zero-zero" loan was not freely decided by private banks for each borrower, but each prefectural government set the standard for setting the interest rate independently of the will of the private banks, and the private banks decided the interest rate based on that standard. As a result, some prefectures had higher interest rates, and others did not, and we believe that moral hazard may have occurred because the private banks that lent in the prefectures with higher interest rates were more likely to lose their incentive to select good borrowers. We use regression analysis to reveal whether these two types of moral hazard occurred using the results of a firm-level questionnaire survey.

This study is unique in that it focuses on the risk of borrower default as well as the lending interest rates for each prefecture, and analyzes the problem of lender moral hazard, which is one of the issues of concern in the "zero-zero" loan policy and lending with 100% credit guarantees. The previous literature mentioned above focused on the default risk of borrowers and showed concern about the survival of "zombie" firms. We focused on the fact that the interest rate for the "zero-zero" loan was set by the prefectural government. In normal loans, the interest rate is set by each lender for each borrower, but in the "zero-zero" loan policy, lenders decided their action based on the standard set by the prefecture. This situation was unique to this policy. Considering this interest rate setting and the design of the policy, this study examines whether the two types of moral hazard problem described above occurred.

This study uses a unique dataset that combines firm-level corporate financial data and survey results. The corporate financial data is provided by Tokyo Shoko Research (TSR), a major Japanese rating agency, to the Center for Research and Education in Policy Evaluation (CREPE) at the University of Tokyo. The questionnaire survey used in this study is an excerpt from a survey conducted jointly by TSR on the use of the "zero-zero" loan policy and the subsequent situation of firms. Using this original dataset, we analyze the relationship between the application for, acceptance of, and amount of the "zero-zero" loan and firms' business characteristics and loan interest rates, respectively. We use linear regression with fixed effects and nonlinear regression for estimation. We also analyze the relationship between the repayment status of the "zero-zero" loan and the business characteristics of the firms and the interest rates on the loan. We use nonlinear regression for this estimation. In all estimations we control for the number of employees, sales before COVID-19, and differences in industry and prefecture.

Our main finding through empirical analysis is that when private banks lend "zero-zero loans", they behaved in a way that maximized their own profits, and the two types of moral hazard problems mentioned above did not occur. Specifically, we found that when loans were 100% credit-guaranteed, private banks were more likely to approve loans and provide larger amounts of loans in prefectures with higher interest rates. Since 100% credit-guaranteed loans were risk-free and interest income was guaranteed, private banks effectively used this mechanism to earn profits. On the other hand, despite such loans, we found that the probability of approval for loans to firms with high default risk before COVID-19 pandemic decreased as the interest rate increased. In addition, we confirmed that there was no tendency for firms that received 100% credit-guaranteed loans from banks to be less likely to repay on schedule. While credit guarantees and interest income incentives existed, the support for interest payments was for up to three years, so it seemed that banks screened borrowers to avoid the risk of the borrower being unable to repay the loan and going bankrupt. Previous research has been limited in its analysis of the lending behavior of credit-guaranteed loans, and this study is valuable in that it is an empirical study that focuses on the rare case of 100% credit guarantees.

The rest of this paper consists of the following sections. Section 2 reviews the literature in economics related to our study. Section 3 describes the "zero-zero" loan policy in Japan during COVID-19. Section 4 outlines the data. Section 5 describes the empirical strategy about estimations on lending status, and Section 6 shows the estimation results. Section 7 and 8 provides additional analysis as robustness checks. Section 9 describes the estimation about repayment status of the "zero-zero" loan, and Section 10 concludes the paper.

2 Literature Review

This study contributes to the literature on credit-guaranteed loans and their impact. Support for firms through credit-guaranteed loans has often been discussed in relation to information problems. As Stiglitz and Weiss (1981) argued theoretically, when there is asymmetric information between lenders and borrowers, in the equilibrium in the free market a shortage of loan supply can occur. However, it has been theoretically shown that the introduction of public credit guarantees can alleviate the credit rationing problem and make it possible to provide financing for more profitable projects that weren't previously provided (Mankiw (1986); Gale (1990), Gale (1991)). In addition, several empirical studies reported results consistent with the theoretical literature on the effectiveness of credit guaranteed loans. Cowling (2010) showed that in the UK, firms that used credit guarantee programs had a lower probability of being credit rationed because they had better access to debt financing. Riding and Haines Jr (2001) and Riding, Madill, and Haines (2007) found that SMEs in Canada that used credit guarantee programs had easier access to loans.

On the other hand, there are also empirical studies that showed the existence of credit guarantees made the information problem worse and created inefficiency, which was inconsistent with the theory. One of these results is that the existence of credit guarantees has made the moral hazard problem of borrowers worse. In other words,

lenders couldn't sufficiently monitor the subsequent behavior of firms that had used the credit-guaranteed loans and ended up providing funds for inefficient projects. Uesugi, Sakai, and Yamashiro (2010) used a dataset in Japan during the financial crisis of the late 1990s to show that special credit guarantee programs improved the availability of credit to SMEs, but that the subsequent performance of users of the programs compared to non-users was worsened, which suggested that the credit guarantee program exacerbated the moral hazard problem in the credit market. Ono and Yasuda (2017) also found that the special credit guarantee program implemented in Japan after the Great Financial Crisis worsened the ex-post performance of firms that used the program compared to firms that didn't use it, highlighting the moral hazard problem. Saito and Tsuruta (2018) analyzed the effectiveness of a 100% credit guarantee program implemented in Japan and implied a similar moral hazard problem.

This study is also related to the literature on the moral hazard problem of lenders' behavior. Moral hazard problems in banks' behavior basically occur since the government's bailout to prevent the bankruptcy of banks and the subsequent systemic risk will lead to banks' more risky lending behavior. One of the research on this problem is studies related to deposit insurance. Deposit insurances exist to prevent bank runs, but because of its existence, banks may choose where to lend without considering depositors' withdrawals. Diamond and Dybvig (1983) showed theoretically the importance of deposit insurance and such side effects of it, and empirical studies such as Demirgüç-Kunt and Detragiache (2002) and Calomiris and Jaremski (2019) demonstrated the pros and cons of deposit insurance.

Another research is related to the so-called "too-big-to-fail" and "too-many-to-fail" problems. Unlike the bankruptcy of ordinary firms, the bankruptcy of banks will cause large subsequent costs, such as systemic risk, when it occurs. Therefore, when a large bank or multiple banks are in danger of bankruptcy, the government will provide a bailout to the bank to avoid such risk. As in the case of deposit insurance, such action will lead to banks providing loans without considering the risk of their own bankruptcy. Research

such as Acharya and Yorulmazer (2008) and Chari and Kehoe (2016) theoretically clarified these problems.

Third, there are studies related to the "evergreening" of firms. In Japan in the late 1990s, as studies like Caballero, Hoshi, and Kashyap (2008) discussed, since banks avoid reporting losses on their balance sheets to comply with the international standards governing their minimum level of capital (the so-called Basle capital standards), they had a perverse incentive to provide additional loans to the risky borrowers. Some empirical studies like Peek and Rosengren (2005) showed this type of moral hazard problem, which was different from that related to government bailouts.

Finally, this study contributes to the literature on the impact of Japanese government support measures after the COVID-19 shock occurred. There are several empirical studies on a series of firm support measures after the COVID-19 shock, including the zero-zero loan policy. Morikawa (2021) examined the relationship between pre-pandemic firm productivity and receipt of government support measures based on an independent survey. As a result, it was found that firms that received government support were more likely to have low productivity prior to COVID-19 compared to firms that did not receive government support. Honda et al. (2023) and Hoshi, Kawaguchi, and Ueda (2023) respectively conducted their own questionnaire survey and analyzed the use of a series of corporate support measures and the characteristics of firms that used them. They found that firms that had not performed well prior to COVID-19 were more likely to use corporate support measures, and suggested that these measures may have contributed to the survival of so-called "zombie" firms.

3 "Zero-zero" Loan Policy Description

The "zero-zero" loan policy is refers to a special concessional loan program known as "effective zero interest loans without collaterals" and it was one of the main business support measures provided by the Japanese government during COVID-19. Special

concessional loan programs are classified into two types: loans provided by government financial institutions and loans provided by private sector banks. Initially, only the former type existed immediately after COVID-19 pandemic occurred. However, due to increasing demand for loan applications, a special loan program implemented by private sector banks was created in May 2020 by using the public credit guarantee system. Applications for these loans were allowed until the end of March 2021. This study focuses on "effective zero interest loans without collaterals" provided by private sector banks, and for convenience, this program will be referred to as the "zero-zero" loan policy.

The conditions for using the "zero-zero" loan policy were much more lenient and generous than standard loans provided by private sector banks. First, SMEs could apply for and receive the program without collateral if they experienced more than a 5% monthly sales drop compared to the same month of the last year. Furthermore, as mentioned above, the "zero-zero" loan policy was based on the public credit guarantee system, but the guarantee fee required to obtain the loan was also reduced. Specifically, the guarantee fee, which is normally around 1%, was cut in half for SMEs whose sales fell by 5% or more, and cut to zero for SMEs whose sales fell by 15% or more and micro-enterprises whose sales fell by 5% or more.

One of the main features of this loan program is that the credit guarantee rate was increased to 100% for SMEs whose sales dropped by 15% or more. In Japan, SME bank loans in which 80% of the loan amount is guaranteed by the government agencies have been widely used. On the other hand, there have been special bank loan programs in which the government guarantees 100% of the loan amount. This type of loan program had just begun to be phased out prior to the COVID-19 crisis, but the government reintroduced this special scheme in response to COVID-19.

Also, SMEs that were severely affected by COVID-19 were able to receive the loans at effectively zero interest. For loans to SMEs that were severely affected by COVID-19, the Organization for Small & Medium Enterprises and Regional Innovation provided a subsidy equivalent to up to three years' worth of interest to private sector banks. As a

	common	only sales criteria (15% or more decline or not)	loan length criteria (less than 3 years etc···)	others	total
set constant rate	17	3	10	1	31
set range	9	4	3	0	16
total	26	7	13	1	47

Table 1: Interest Rate Criteria Classification

result, such SMEs were able to receive loans without interest payments. Small businesses and SMEs with sales declined by 15% or more were eligible for this treatment.

Note that the interest rate standards under the ”zero-zero loan policy” were determined by prefectural governments. The standards varied from prefecture to prefecture and in some prefectures the interest rate level was set in a unique value while in other prefectures the range of interest rate levels was set in a range. In addition, some prefectures set multiple criteria according to the subject of the loan, such as whether sales were 15% or more and the length of the loan period. On the other hand, each private bank determined the interest rate according to the standards of the prefecture in which it was located, and then decided whether or not to accept the loan.

Table 1 shows the details of the standards for interest rates by prefecture. There are 47 prefectures in Japan, and according to this table, while 17 prefectures set a consistent interest rate level regardless of the borrower, we can see that the standards vary from prefecture to prefecture. Figure 1 shows a histogram of the interest rate levels set by prefecture. Here, we show the histogram of the interest rate levels in the case where the firms' sales drop was 15% or more. For prefectures that have standards depending on the loan period, the minimum and maximum interest rate levels for each standard are used in the respective graphs. According to this figure, the level is various.

Figures 2 and 3 show the correlation between interest rate levels and economic scale indicators for each prefecture. Figure 2 shows the correlation between interest rate levels and GDP per capita for each prefecture, and Figure 3 shows the correlation between interest rate levels and the Herfindahl-Hirschman Index (HHI) for each prefecture's loam

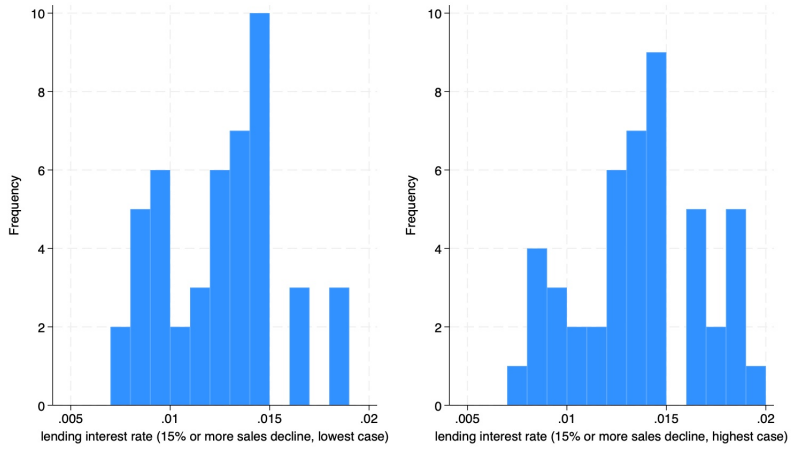

Figure 1: Histogram about Interest Rate by Prefecture

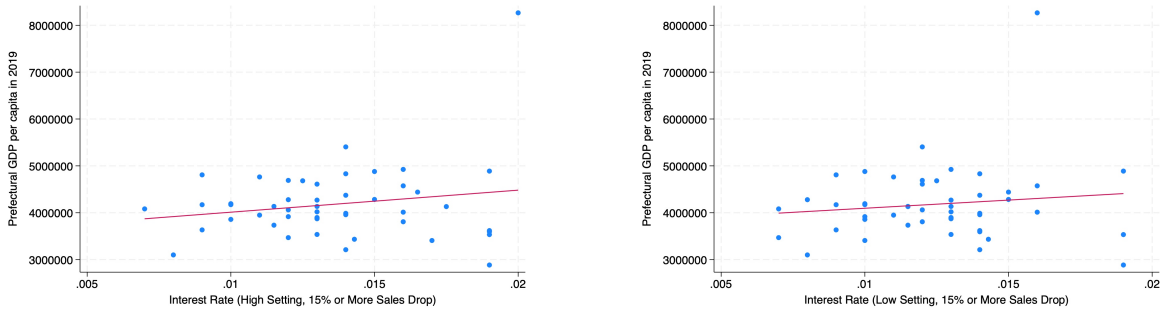

Figure 2: Correlation between Interest Rate and GDP Per Capita

market[1]. The Herfindahl-Hirschman Index is one of the indicators used to measure market concentration. When the HHI value for a prefecture approaches 0, it implies that there are many financial institutions in that prefecture and the market is close to perfect competition. When it moves away from 0 and approaches 10,000, it implies that there are few financial institutions in that prefecture and the lending market is close to a monopoly. This HHI has been shown to be positively correlated with the average interest rate on ordinary loan contracts in each prefecture(Uebayashi (2018)), and Figure 3 suggests a relationship between the interest rate on loans in normal periods and the interest rate set by the "zero-zero" loan policy. In both figures, the interest rate levels on the horizontal axis are the same as in Figure 1, i.e. the interest rate levels for cases where the sales decline rate is 15% or more. The vertical axis for each indicator uses the level in 2019, before COVID-19. Looking at these, we can see that there is no correlation between

[1]We use prefectural HHI calculated by Uesugi et al. (2024).

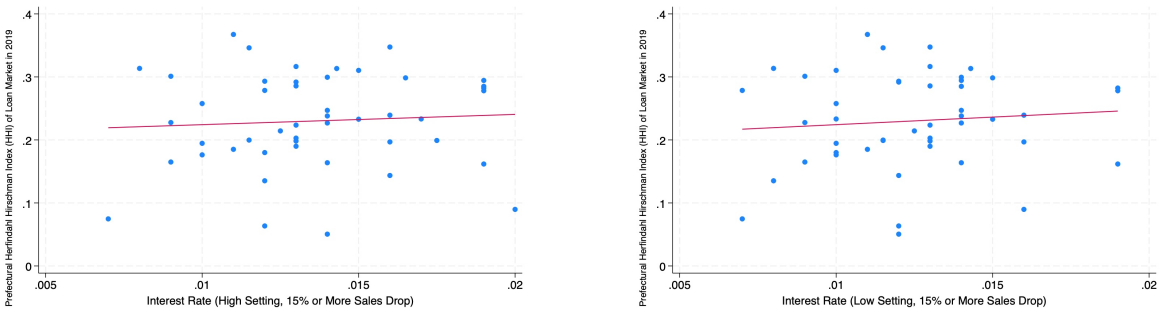

Figure 3: Correlation between Interest Rate and Herfindahl-Hirschman Index

Table 2: Simple Regression about Interest Rate

	(1) GDP per capita	(2) GDP per capita	(3) HHI loan market	(4) HHI loan market
interest rate	47017054.793	34774252.215	1.628	2.398
	(37164055.406)	(41552096.382)	(3.538)	(3.911)
Observations	47	47	47	47
Interest Rate Setting	High	Low	High	Low

Standard errors in parentheses

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

the GDP per capita or HHI for each prefecture and the interest rate level of the "zero-zero" loan for each prefecture. In addition, table 2 is the estimation results of simple regressions to check whether two variables are significantly correlated and shows that all estimated coefficients are not significant. These suggest that the interest rate setting of the "zero-zero" loan does not depend on the economic scale of that prefecture[2], and that the interest rate differs from that for normal loan contract.

4 Data Description

One of the main data sets used in this study is a firm-level credit research report produced by Tokyo Shoko Research (TSR), one of the major credit rating agencies in Japan. This dataset contains information on Japanese firms, regardless of size, industry, or region, such as year of establishment, location of headquarters, industry as defined by major products and services, sales, number of employees, profits, and CEOs. We use the dataset as of end-2019 since we believe it is important to conduct our analysis

[2]We check other the interest rate setting in each prefecture is not correlated with other major economic measures. Details are explained in Appendix.

with information on each firm prior to COVID-19, like the analysis conducted in Hoshi, Kawaguchi, and Ueda (2023).

The other main data set is the results of an original firm questionnaire survey on the use of zero-zero loan and its subsequent status, designed and conducted in collaboration with the TSR. The survey was conducted between May 16 and May 24, 2024, inviting TSR's email magazine subscribers to participate in the survey. Of the 3800 companies that responded to the survey, we were able to match 3364 companies to the data set described above.

To better understand the characteristics of firms that responded to the survey, we compare the sample of responding firms to firms in the TSR database at the end of 2019. The top row of Table 1 shows that firms with higher credit scores and larger numbers of employees were more likely to have responded to the survey. The bottom row of Table 3 shows a distribution of the sample in terms of industry sector. It shows that in the survey samples the manufacturing and wholesale and retail industries is overrepresented, whereas construction, real estate and lease, hotel and restaurant, and health and welfare sectors are underrepresented. Figure 4 shows the distribution of default scores. It indicates that the survey sample had lower default scores on average than the total sample, and that the distribution was more to the left. We have to keep in mind that there are some potential biases due to sample selection. Our sample has a slightly larger number of firms with low default scores and large firms compared to the entire database. In addition, industries that may have been particularly affected during the pandemic, such as hotel and restaurant, are underrepresented in our sample.

In this survey, we asked in detail about the use of the "zero-zero loan policy" by selecting the appropriate options. Specifically, we asked whether the "zero-zero loan policy" was applied for, whether it was approved (if it was applied for), the amount received (if it was approved), as well as the loan period, interest rate, and whether they used other loan programs in addition to the loan. In addition to the questions on the use of the "zero-zero" loan, we also asked about subsequent conditions after using the "zero-zero" loan, such

	Population	In sample
Default Score (Good 0.0 – Bad 1.0)	0.548	0.485
	(0.069)	(0.061)
Profit / Worker and Month (1,000 JPY)	115.75	101.1
	(63625.7)	(612.6)
Number of Employees	18.76	49.169
	(344.9)	(127.3)
SMEs	0.895	0.874
	(0.307)	(0.331)
Industry		
Agriculture, Forestry and Fishery	1.23	0.51
Mining	0.08	0.11
Construction	16.96	12.19
Manufacturing	9.83	30.28
Public Utility	0.37	0.16
Information	4.89	6.92
Transportation	2.15	3.62
Wholesale and Retail	19.56	26.63
Finance	1.95	0.95
Real Estate and Lease	8.99	3.30
Professional Services	9.39	5.33
Hotel and Restaurant	5.77	1.65
Life Services	3.76	1.14
Education	0.82	0.24
Health and Welfare	5.47	1.14
Postal Service and Cooperatives	0.66	0.46
Other Services	7.93	4.97
Public Sector	0.19	0.38
Not identified	0.00	0.02
Total	100.00	100.00

Table 3: Comparison between Population and Samples

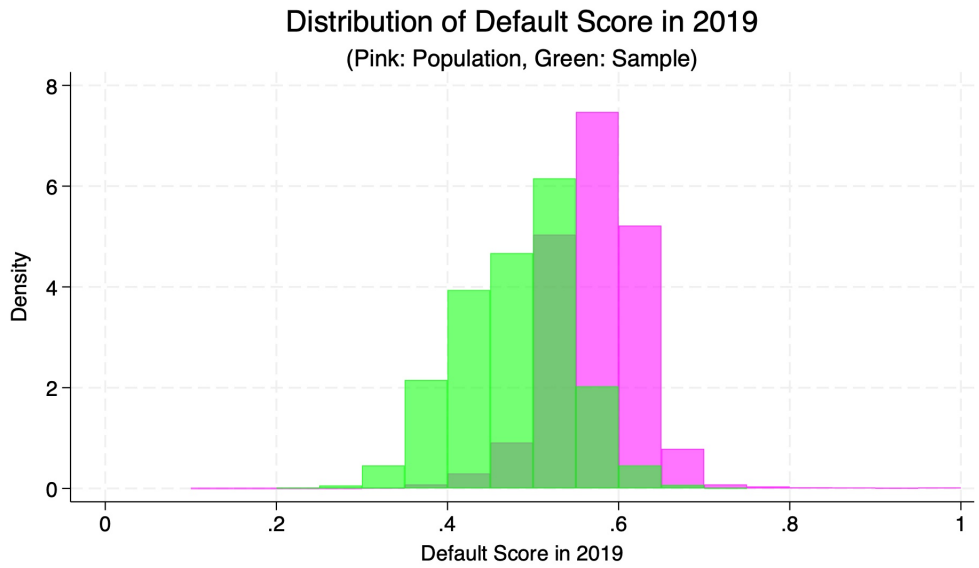

Figure 4: The Distribution of Default Score

Variables	Explanation	N	mean	SD
Bankapprove	Binary variable that takes 1 if a firm was approved for "zero-zero" loan.	1,471	0.533	0.499
Bankborrowing	The amount of borrowing a firm received as "zero-zero" loan. (thousand yen)	1,471	2799.3	5017.0
Notrepayment	The dummy variable that takes 1 if a firm has not finished repaying "zero-zero" loan as planned and takes 0 if otherwise.	784	0.212	0.409
Creditscore_2019	Credit score of each firm in 2019. It's normalized (Bad 0.0 – Good 1.0).	1,396	0.515	0.061
Defaultscore_2019	It's equal to the value of "1 - credit score" of each firm in 2019.	1,396	0.485	0.061
Interest Rate (High Setiing)	Interest rate of the "zero-zero" loan policy set in each prefecture. (High Setiing)	1,471	0.0153	0.0042
Interest Rate (Low Setiing)	Interest rate of the "zero-zero" loan policy set in each prefecture. (Low Setiing)	1,471	0.0134	0.0032
Interest Rate (Median Setiing)	Interest rate of the "zero-zero" loan policy set in each prefecture. (Median Setiing)	1,471	0.0144	0.0036
Interest Rate High Dummy (High Setiing)	The dummy variable that takes 1 if the interest rate of "zero-zero" loan is in the top 1/3, and takes 0 if otherwise. (High Setiing)	1,471	0.402	0.490
Interest Rate High Dummy (Low Setiing)	The dummy variable that takes 1 if the interest rate of "zero-zero" loan is in the top 1/3, and takes 0 if otherwise. (Low Setiing)	1,471	0.421	0.494
Interest Rate High Dummy (Median Setiing)	The dummy variable that takes 1 if the interest rate of "zero-zero" loan is in the top 1/3, and takes 0 if otherwise. (Median Setiing)	1,471	0.404	0.491
Emp_19	The number of employees of a firm in 2019	1,394	49.169	127.3
Sales_19	Sales of a firm in 2019. (thousand yen)	1,367	2165533	8763081
Sales Drop Dummy	The dummy variable that takes 1 if a firm's largest monthly sales drop after COVID-19 was 15% or larger.	1,471	0.644	0.479

Table 4: Descriptive Statistics

as the repayment status as of May 2024 and the reasons for any repayment difficulties. Specifically, we asked borrowers whether they had completed repayment, whether they had changed repayment conditions, whether they had used refinance programs or other loans to repay, and so on. Also, if borrowers changed repayment conditions, we asked them what kind of changes they did, and if they used refinance programs or other loans, we asked them which programs they used. Furthermore, in order to grasp the shock that firms experienced during the pandemic, we also asked about the monthly sales decline rate immediately after COVID-19 and the sales recovery rate in each year thereafter. In this study, we mainly used the following information from the survey results: whether the "zero-zero loan policy" was approved, the amount received (if approved), whether the loan was fully repaid, whether the repayment terms were changed, whether refinancing or another loan was used to repay the loan, and the percentage decrease in monthly sales immediately after the onset of the COVID-19 pandemic. In order to conduct a rigorous analysis, this study uses data on the rate of decrease in monthly sales immediately after COVID-19 and only uses companies that were able to use the "zero-zero loan policy" as a sample. Table 4 shows the descriptive statistics for each variable used in this study, and Table 5 shows the correlation table.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Bankapprove	1.000													
(2) Bankborrow	0.520	1.000												
(3) Notrepayment	0.327	0.183	1.000											
(4) Creditscore_2019	-0.080	0.012	-0.119	1.000										
(5) Defaultscore_2019	0.080	-0.012	0.119	-1.000	1.000									
(6) interest rate (High Setting)	-0.043	0.021	0.028	-0.060	0.060	1.000								
(7) interest rate (Low Setting)	-0.026	0.040	0.037	-0.063	0.063	0.855	1.000							
(8) interest rate (Median Setting)	-0.037	0.030	0.033	-0.064	0.064	0.974	0.950	1.000						
(9) interest rate high dummy (High Setting)	-0.053	0.006	0.035	-0.039	0.039	0.868	0.653	0.808	1.000					
(10) interest rate high dummy (Low Setting)	-0.000	0.032	0.050	-0.055	0.055	0.677	0.834	0.771	0.498	1.000				
(11) interest rate high dummy (Median Setting)	-0.044	0.003	0.031	-0.040	0.040	0.848	0.716	0.818	0.913	0.586	1.000			
(12) Sales_2019	-0.130	-0.025	-0.065	0.319	-0.319	0.001	-0.012	-0.005	0.002	-0.018	0.006	1.000		
(13) Emp_2019	-0.132	-0.042	-0.056	0.270	-0.270	0.022	0.006	0.016	0.014	-0.001	0.014	0.896	1.000	
(14) Sales Drop Dummy	0.065	0.031	0.030	-0.033	0.033	0.017	-0.004	0.008	-0.011	-0.037	-0.034	-0.051	-0.071	1.000

Table 5: Correlation Table

5 Empirical Strategy

We identify the characteristics of firms that received the "zero-zero" loan from private sector banks through regression analysis. We use the following two variables as the dependent variables. One is a binary variable that takes the value of 1 if the firm is approved for the "zero-zero" loan from a private financial institution, and the other is the amount of the loan that the approved firm obtained. For the amount of the loan, we include all samples that did not apply for the loan as 0 in the sample to estimate the model.

We use the default score for each firm in 2019, the interest rate on loans by prefecture, and dummy variables for the rate of monthly sales decline during the pandemic and their interaction terms as explanatory variables. The default score is calculated by subtracting the credit score for each firm from 1. In addition, for firms with 15% or more monthly maximum sales decline during the pandemic, the loan was a 100% guaranteed loan and they also received interest payment support. Since for lenders, lending to such firms was no risk, it is possible that provide banks provided more loans. Since for lenders, lending to such firms was no risk, it is possible that lenders provided more loans. Therefore, we verify this point by using a dummy variable of whether the maximum monthly sales

decrease rate was 15% or more. As control variables, we use sales and the number of employees before the pandemic. We also use industry and prefecture dummy variables to control for industry and prefecture heterogeneity. We use nonlinear regression for estimation. Specifically, we use a probit model for approval of loans and a Tobit model for loan amounts.

We explain how to use in estimations the interest rate for each prefecture in detail. Basically, firms that did not receive loans had no information about interest rates, so we need to assign interest rates somehow. Therefore, we assign expected interest rates according to the following two rules. First, we assign expected interest rates according to the information on the monthly sales decline rate due to COVID-19. This assumption is based on the idea that in prefectures that use a range standard, banks will set the highest interest rate regardless of the borrower and try to earn as much interest income as possible. Under these two assumptions, we use three settings about interest rate in prefectures: high setting, low setting and median setting. In high setting, we assume that banks assign highest interest rate among all candidates in each prefecture. This setting reflects the upper limit of interest rate in each prefecture. In low setting, we assume banks assign lowest interest rate among all candidates in each prefecture. This setting reflects the interest rate level that banks in each prefecture at least offered to firms. In median setting, we set the median of the interest rates given in high and low settings. We use all of these in this analysis. The regression model is as follows.

$$
\begin{aligned}
&Pr(Y_{ijk,2020} = 1|X_{ijkt}) \\
&= \Phi\big(\beta_1 DefaultScore_{ijk,2019} + \beta_2 IR_{ijk,2020} + \beta_3 SalesDropDummy_{ijk,2020} \\
&+ \beta_4(DefaultScore_{ijk,2019} \times IR_{ijk,2020}) + \beta_5(DefaultScore_{ijk,2019} \times SalesDropDummy_{ijk,2020}) \\
&+ \beta_6(IR_{ijk,2020} \times SalesDropDummy_{ijk,2020}) + \beta_7(DefaultScore_{ijk,2019} \times IR_{ijk,2020} \\
&\times SalesDropDummy_{ijk,2020}) + \beta_8 \ln(Sales)_{ijk,2019} + \beta_9 \ln(Emp)_{ijk,2019} \\
&+ \sum_j \gamma_j Industrydummy_{i,j} + \sum_k \delta_k Prefecturedummy_{i,k})
\end{aligned}
$$

$$
\begin{aligned}
&Pr(Y_{ijk,2020} \geqq 0 | X_{ijkt}) \\
&= \Phi\big(\beta_1 DefaultScore_{ijk,2019} + \beta_2 IR_{ijk,2020} + \beta_3 SalesDropDummy_{ijk,2020} \\
&+ \beta_4 (DefaultScore_{ijk,2019} \times IR_{ijk,2020}) + \beta_5 (DefaultScore_{ijk,2019} \times SalesDropDummy_{ijk,2020}) \\
&+ \beta_6 (IR_{ijk,2020} \times SalesDropDummy_{ijk,2020}) + \beta_7 (DefaultScore_{ijk,2019} \times IR_{ijk,2020} \\
&\times SalesDropDummy_{ijk,2020}) + \beta_8 \ln (Sales)_{ijk,2019} + \beta_9 \ln (Emp)_{ijk,2019} \\
&+ \sum_j \gamma_j Industrydummy_{i,j} + \sum_k \delta_k Prefecturedummy_{i,k})
\end{aligned}
$$

where $Y_{ijk,2020}$ indicates one of dependent variables of firm i in industry j in prefecture k explained above, $DefaultScore_{ijk,2019}$ is the default score of firm i in 2019, $IR_{ijk,2020}$ is the interest rate of the "zero-zero" loan policy set in each prefecture k explained above, $SalesDropDummy$ is the dummy variable that takes 1 if the largest monthly sales drop of a firm i after COVID-19 was 15% or larger, $\ln (Sales)_{ijk,2019}$ is the natural logarithm of the amount of sales in 2019, $\ln (Emp)_{ijk,2019}$ is the natural logarithm of employment in 2019, $Industrydummy_{i,j}$ and $Prefecturedummy_{i,k}$ is respectively industry and prefecture dummy variable. The former specification is the probit model one that use the estimation for approval while the latter specification is the Tobit model one that use the estimation for the amount of borrowing.

6 Benchmark Results

Tables 6 and 7 show the estimation results of nonlinear regression analysis. Table 6 shows the estimation results for the binary variable of approval for the "zero-zero" loan, and Table 7 shows the estimation results for the loan amount of the "zero-zero" loan. In both tables, the results in columns 1 to 3 are the results of the estimation without including the interaction terms, and those in columns 4 to 6 are the results of the estimation that includes the interaction terms. Columns 7 to 9 are the results of the estimation that includes the interaction terms of the three explanatory variables. In addition, columns 1, 4 and 7 are the estimation results using the high setting, columns

2, 5 and 8 u are the estimation results using the low setting, and columns 3, 6 and 9 are the estimation results using the median setting.

Table 6: Benchmark Result 1: Approval

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Bankapprove	Bankapprove	Bankapprove	Bankapprove	Bankapprove	Bankapprove	Bankapprove	Bankapprove	Bankapprove
defaultscore_2019	1.902**	1.902**	1.902**	9.466***	8.733***	9.692***	3.503	2.528	3.074
	(0.899)	(0.899)	(0.899)	(2.877)	(3.163)	(3.115)	(4.321)	(4.828)	(4.689)
interest rate	184.214**	184.214**	184.214**	423.495***	422.738***	445.293***	236.080	203.039	224.847
	(89.919)	(89.919)	(89.919)	(125.080)	(138.448)	(133.802)	(161.674)	(189.681)	(178.208)
SalesDropDummy	0.233**	0.233**	0.233**	1.190	1.533**	1.360*	-3.493	-3.245	-3.874
	(0.091)	(0.091)	(0.091)	(0.759)	(0.778)	(0.771)	(2.653)	(2.921)	(2.886)
defaultscore_2019 * interest rate				-451.482***	-452.870**	-493.682**	-53.794	12.563	-26.578
				(172.042)	(216.510)	(200.189)	(277.748)	(350.740)	(320.562)
defaultscore_2019 * SalesDropDummy				-1.543	-1.681	-1.640	8.113	8.198	9.148
				(1.454)	(1.465)	(1.459)	(5.441)	(6.003)	(5.916)
interest rate * SalesDropDummy				-13.510	-36.450	-23.076	299.339*	330.792	351.045*
				(20.982)	(27.218)	(24.603)	(171.825)	(218.654)	(200.993)
defaultscore_2019 * interest rate * SalesDropDummy							-643.456*	-757.870*	-769.517*
							(350.665)	(447.634)	(410.195)
Sales_2019	-0.093	-0.093	-0.093	-0.105*	-0.104*	-0.105*	-0.106*	-0.108*	-0.108*
	(0.060)	(0.060)	(0.060)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)
Employees_2019	0.076	0.076	0.076	0.075	0.076	0.075	0.081	0.082	0.082
	(0.068)	(0.068)	(0.068)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)
Observations	1186	1186	1186	1186	1186	1186	1186	1186	1186
Interest Rate Setting	High	Low	Median	High	Low	Median	High	Low	Median
Prefecture Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

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

First, we look at Table 6. The first row shows the estimated coefficients for the default score. Looking at columns 1 to 3, all of the estimated coefficients for the default score were significantly positive at the 5% level. This result implied that private banks were more likely to approve the "zero-zero" loan to firms with higher default risk before COVID-19 pandemic. Next, the second row shows the estimated coefficient for interest rate. Looking at columns 1 to 3, the estimated coefficient for interest rate was also significantly positive at the 5% level. This result implied that private banks were more likely to approve the "zero-zero" loan when the interest rate set by prefecture was higher. Then, the third line shows the estimated coefficient for the sales drop dummy variable. Looking at columns 1 to 3, the estimated coefficient for the dummy variable was also significantly positive at the 5% level. This result implied that private banks accepted the "zero-zero" loan when the loan was no-risk for banks.

Next, we look at the estimation results for the case where the cross-term was added. The columns 4 to 6 show the estimation results for that case, and the estimated coefficient for the cross-term of the default score and interest rate was significantly negative at the 5% level for all cases. On the other hand, the cross-terms that included the sales drop dummy

Table 7: Benchmark Result 2: Borrowing

	(1) Bankborrow	(2) Bankborrow	(3) Bankborrow	(4) Bankborrow	(5) Bankborrow	(6) Bankborrow	(7) Bankborrow	(8) Bankborrow	(9) Bankborrow
defaultscore_2019	13777.302***	13777.302***	13777.302***	50801.499***	43097.921**	50468.625***	19257.249	20241.173	19269.242
	(5028.555)	(5028.555)	(5028.555)	(16666.407)	(18454.211)	(18137.620)	(25127.841)	(28206.488)	(27318.813)
interest rate	994454.611**	994454.611**	994454.611**	2043016.851***	1931266.467**	2106022.211***	1039858.163	1120841.792	1059973.944
	(473720.398)	(473720.398)	(473720.398)	(4386.173)	(4480.841)	(4452.975)	(920074.932)	(1087487.161)	(1018992.275)
SalesDropDummy	1130.237**	1130.237**	1130.237**	3115.951	4344.446	3605.473	-21633.975	-13330.995	-21167.244
	(516.183)	(516.183)	(516.183)	(4386.173)	(4480.841)	(4452.975)	(15460.979)	(17135.302)	(16886.875)
defaultscore_2019 * interest rate				-2257094.083**	-1932965.008	-2350272.699**	-136570.291	-218261.262	-138493.647
				(1012133.315)	(1268824.960)	(1178386.059)	(1627645.525)	(2046977.622)	(1874424.991)
defaultscore_2019 * SalesDropDummy				-6632.751	-7232.837	-7149.956	44318.428	29225.755	43832.039
				(8302.937)	(8376.336)	(8333.511)	(31634.777)	(35133.499)	(34547.538)
interest rate * SalesDropDummy				79456.162	19998.763	67556.011	1751579.646*	1381083.268	1850567.851
				(118852.887)	(154490.480)	(139534.508)	(1011404.139)	(1284577.116)	(1183154.842)
defaultscore_2019 * interest rate * SalesDropDummy							-3436100.029*	-2803263.393	-3663521.242
							(2063382.191)	(2626310.016)	(2413544.796)
Sales_2019	21.787	21.787	21.787	-15.268	-9.105	-14.281	-29.809	-25.985	-33.584
	(343.836)	(343.836)	(343.836)	(344.764)	(344.989)	(344.921)	(344.756)	(345.368)	(345.102)
Employees_2019	834.020**	834.020**	834.020**	820.180**	828.410**	822.386**	849.351**	851.067**	852.626**
	(393.281)	(393.281)	(393.281)	(393.339)	(393.631)	(393.485)	(393.731)	(394.293)	(394.046)
Observations	1362	1362	1362	1362	1362	1362	1362	1362	1362
Interest Rate Setting	High	Low	Median	High	Low	Median	High	Low	Median
Prefecture Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

variable were not significant. Also, looking at columns 7 to 9, the estimated coefficients for the interaction terms of interest rate and the sales drop dummy variable were significantly positive in some cases, while the estimated coefficients for the interaction term of all three explanatory variables were all significantly negative.

The higher the interest rate on a loan, as the borrower's interest payments increase, they are more likely to be unable to repay the loan and go bankrupt. Therefore, it is reasonable that banks would be less likely to lend to firms with a high default risk if the interest rate set for each prefecture is high to avoid default risk. If firms with higher default risk also had a large decrease in sales, it would be even more likely that banks would not lend to them.[3] Moreover, due to the design of the "zero-zero" loan policy, firms with 15% or more sales drop received interest payment support. As a result, since banks can certainly earn interest income from loans to such firms, it is thought that banks have incentives to approve loans to such firms if the interest rate is high, unless borrowers' default risk is high. Given these points, the estimation results for the coefficients of the interaction terms suggest that in the "zero-zero" loan policy, banks appropriately screened borrowers to avoid non-performing loan risk and took action to maximize their

[3]In the sample used in this analysis, the ratio of approval for applications was approximately 99%. This implied that there is a possibility that firms did not apply because they thought their applications would not be approved. However, if firms consulted their main bank before applying, it can be said that the banks took appropriate action when lending.

own profits.

Then, we look at Table 7. Looking at the estimation results in columns 1 to 3, we can see that, as in Table 6, the estimated coefficients for the default score, the estimated coefficient for the interest rate, and the estimated coefficient for the sales drop dummy variable were all significantly positive. Next, looking at the estimation results for the cases where the cross-term was added, although the tendency was weaker than in the analysis of acceptance, the estimated coefficients for the cross-term of the default score and the interest rate in columns 4 and 6 were both significantly negative at the 5% level. On the other hand, the cross-terms that included the sales drop dummy variable were not significant. Also, looking at columns 7 to 9, the estimated coefficient for the cross-term of interest rate and the sales drop dummy variable in column 7 was significantly positive, and the estimated coefficients for the cross-terms of all three explanatory variables were all significantly negative. From these results, we confirmed that in terms of the amount of loans, the design of the "zero-zero" loan policy did not cause moral hazard problem in banks' lending behavior.

7 Robustness Check

Here, we use a fixed effects model to estimate as a robustness check. The dependent variable and the main explanatory variables are the same as those used in the benchmark case. In this estimation, we use industry fixed effect and prefecture fixed effect instead of dummy variables. The regression model is as follows.

$$
\begin{aligned}
Y_{ijk,2020} = {} & \beta_1 DefaultScore_{ijk,2019} + \beta_2 IR_{ijk,2020} + \beta_3 SalesDropDummy_{ijk,2020} \\
& + \beta_4 (DefaultScore_{ijk,2019} \times IR_{ijk,2020}) + \beta_5 (DefaultScore_{ijk,2019} \\
& \times SalesDropDummy_{ijk,2020}) + \beta_6 (IR_{ijk,2020} \times SalesDropDummy_{ijk,2020}) \\
& + \beta_7 (DefaultScore_{ijk,2019} \times IR_{ijk,2020} \times SalesDropDummy_{ijk,2020}) + \beta_8 \ln (Sales)_{ijk,2019} \\
& + \beta_9 \ln (Emp)_{ijk,2019} + Industry_j + Prefecture_k + u_{ijk}
\end{aligned}
$$

where $Industry_j$ and $Prefecture_k$ are respectively industry fixed effect and prefecture fixed effect.

Table 8: FE estimation results 1: Approval

	(1) Bankapprove	(2) Bankapprove	(3) Bankapprove	(4) Bankapprove	(5) Bankapprove	(6) Bankapprove	(7) Bankapprove	(8) Bankapprove	(9) Bankapprove
defaultscore_2019	0.613*	0.613*	0.613*	3.218***	3.051***	3.343***	1.136	0.865	1.016
	(0.321)	(0.321)	(0.321)	(1.023)	(1.135)	(1.113)	(1.506)	(1.702)	(1.643)
interest rate	62.414**	62.414**	62.414**	143.018***	147.539***	152.882***	77.733	70.191	75.529
	(31.067)	(31.067)	(31.067)	(43.601)	(49.096)	(47.037)	(55.685)	(66.510)	(61.842)
SalesDropDummy	0.078**	0.078**	0.078**	0.409	0.525*	0.465*	-1.258	-1.192	-1.410
	(0.033)	(0.033)	(0.033)	(0.267)	(0.274)	(0.271)	(0.925)	(1.034)	(1.012)
defaultscore_2019 * interest rate				-154.953**	-162.144**	-173.000**	-16.365	1.941	-8.858
				(61.659)	(78.324)	(72.149)	(96.018)	(123.301)	(111.695)
defaultscore_2019 * SalesDropDummy				-0.564	-0.598	-0.591	2.879	2.958	3.281
				(0.511)	(0.514)	(0.512)	(1.900)	(2.128)	(2.078)
interest rate * SalesDropDummy				-3.739	-11.865	-7.040	108.106*	120.573	127.471*
				(7.596)	(9.867)	(8.922)	(59.933)	(77.539)	(70.503)
defaultscore_2019 * interest rate * SalesDropDummy							-230.422*	-273.626*	-277.206*
							(122.480)	(158.900)	(144.130)
Sales_2019	-0.031	-0.031	-0.031	-0.034	-0.034	-0.034	-0.035	-0.035	-0.035
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Employees_2019	0.025	0.025	0.025	0.024	0.024	0.024	0.026	0.026	0.026
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Observations	1285	1285	1285	1285	1285	1285	1285	1285	1285
Interest Rate Setting	High	Low	Median	High	Low	Median	High	Low	Median
Prefecture FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Table 9: FE estimation results 2: Borrowing

	(1) Bankborrow	(2) Bankborrow	(3) Bankborrow	(4) Bankborrow	(5) Bankborrow	(6) Bankborrow	(7) Bankborrow	(8) Bankborrow	(9) Bankborrow
defaultscore_2019	7323.138**	7323.138**	7323.138**	19199.456*	13148.054	17568.805	7643.740	6717.941	7045.293
	(3289.577)	(3289.577)	(3289.577)	(10522.941)	(11677.480)	(11453.793)	(15512.648)	(17536.956)	(16932.405)
interest rate	465246.998	465246.998	465246.998	764132.177*	616917.935	737258.902	401704.308	389358.390	387429.309
	(318759.456)	(318759.456)	(318759.456)	(448622.780)	(505308.884)	(484097.982)	(573627.513)	(685412.225)	(637364.129)
SalesDropDummy	455.044	455.044	455.044	438.742	583.173	457.780	-8813.688	-4470.392	-8020.123
	(337.125)	(337.125)	(337.125)	(2746.904)	(2818.617)	(2793.315)	(9530.526)	(10659.458)	(10426.630)
defaultscore_2019 * interest rate				-732798.362	-369933.144	-659134.469	36572.768	112810.578	83193.917
				(634423.699)	(806127.671)	(742543.795)	(989121.114)	(1270665.301)	(1151164.239)
defaultscore_2019 * SalesDropDummy				-1983.194	-1842.262	-2046.079	17132.413	8621.902	15469.139
				(5254.688)	(5295.240)	(5272.963)	(19573.120)	(21935.028)	(21413.191)
interest rate * SalesDropDummy				63302.030	56651.156	68285.488	684210.377	446289.348	676610.706
				(78153.118)	(101554.523)	(91822.449)	(617396.770)	(799071.705)	(726625.855)
defaultscore_2019 * interest rate * SalesDropDummy							-1279183.093	-805016.208	-1253656.471
							(1261717.040)	(1637533.912)	(1485446.519)
Sales_2019	207.704	207.704	207.704	200.078	204.175	201.772	195.504	200.027	196.165
	(225.668)	(225.668)	(225.668)	(226.391)	(226.500)	(226.455)	(226.433)	(226.738)	(226.583)
Employees_2019	477.467*	477.467*	477.467*	467.690*	474.793*	469.979*	479.079*	481.006*	480.321*
	(257.174)	(257.174)	(257.174)	(257.618)	(257.778)	(257.702)	(257.859)	(258.180)	(258.028)
Observations	1285	1285	1285	1285	1285	1285	1285	1285	1285
Interest Rate Setting	High	Low	Median	High	Low	Median	High	Low	Median
Prefecture FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Tables 8 and 9 show the estimation results using the fixed effects model. Table 8 shows the results of the estimation for approval and Table 9 shows the results of the estimation for the amount of loan. The specifications of the tables are the same as in the previous section. First, looking at Table 8, the estimated coefficients for the default score, interest rate, and the sales drop dummy variable were respectively significantly positive, which was consistent with the results of the nonlinear regression analysis. In addition, looking

at the results of the interaction terms in columns 4 to 6, the estimated coefficient for the interaction term of the default score and interest rate was significantly negative at the 5% level. Furthermore, looking at columns 7 to 9, the estimated coefficient for the interaction term between interest rate and the sales drop dummy variable was significantly positive in some cases. In contrast, the estimated coefficients for the interaction term of all three explanatory variables were all significantly negative. These results were consistent with the results of the nonlinear regression analysis, and the estimation using the fixed effects model also implied that the in the "zero-zero" loan policy, the banks were likely to take actions to properly screen borrowers to avoid the risk of nonperforming loans and maximize their own profits.

Looking at Table 9, the estimated coefficients for default score were significantly positive and consistent in columns 1 to 3, but the estimated coefficients for interest rate and the sales drop dummy variable and the coefficients for the interaction terms in columns 4 to 9 were all insignificant. Although we did not obtain completely consistent results, these results of the analysis using the fixed effects model also showed that the system design of the "zero-zero" loan policy did not cause moral hazard in banks' lending behavior.

8 Additional Analysis about Amount of Lending

Here, we analyze banks' lending behavior in more detail. Specifically, we limit our sample to firms that actually received the "zero-zero" loan and analyze how the amount of loans provided by private banks to firms differed according to firm characteristics. We use the amount of loan that the approved firm received as the dependent variable. In this analysis, unlike the benchmark analysis, we exclude firms that were not approved from the sample. As explanatory variables, we used the same variables as in the above analysis: the default score for each firm in 2019, the interest rate on loans by prefecture, and the sales drop dummy variable during the pandemic and their interaction terms.

We use the same fixed effect model specification as that explained in the last section to estimate.

Table 10: FE estimation results 3: Borrowing (Only Approved Sample)

	(1) Bankborrow	(2) Bankborrow	(3) Bankborrow	(4) Bankborrow	(5) Bankborrow	(6) Bankborrow	(7) Bankborrow	(8) Bankborrow	(9) Bankborrow
defaultscore_2019	11867.363**	11867.363**	11867.363**	32353.929	26747.649	32126.239	63159.175*	59248.709	64682.120*
	(5607.299)	(5607.299)	(5607.299)	(20371.257)	(22550.777)	(22271.781)	(34569.346)	(38039.645)	(37443.491)
interest rate	287895.302	287895.302	287895.302	764309.373	625627.222	759750.371	1780614.437	1796679.426	1882036.199
	(488649.780)	(488649.780)	(488649.780)	(799374.519)	(900700.360)	(872775.608)	(1219813.676)	(1424639.566)	(1355843.457)
SalesDropDummy	-30.339	-30.339	-30.339	-6571.548	-7217.611	-7126.707	15256.128	15993.209	16435.984
	(555.054)	(555.054)	(555.054)	(5297.592)	(5327.371)	(5329.621)	(20488.670)	(22518.448)	(22429.140)
defaultscore_2019 * interest rate				-1565417.770	-1195401.178	-1573946.163	-3695020.539	-3667205.315	-3932039.971
				(1279991.322)	(1572196.449)	(1485383.864)	(2316568.357)	(2810717.392)	(2638118.675)
defaultscore_2019 * SalesDropDummy				4653.899	2730.204	3659.916	-39780.086	-44554.551	-44254.949
				(10100.016)	(10132.328)	(10098.251)	(41536.647)	(45709.208)	(45439.783)
interest rate * SalesDropDummy				274797.446**	432794.180***	365154.890**	-1239257.818	-1370432.283	-1361194.365
				(125848.684)	(166304.039)	(148572.023)	(1378624.028)	(1707901.409)	(1603144.454)
[1em] defaultscore_2019 * interest rate * SalesDropDummy							3077486.108	3668964.901	3505979.526
							(2790512.249)	(3458500.909)	(3241760.657)
Sales_2019	989.092***	989.092***	989.092***	1014.947***	1041.760***	1028.199***	1034.280***	1071.364***	1054.289***
	(376.448)	(376.448)	(376.448)	(377.046)	(376.552)	(376.901)	(377.371)	(377.536)	(377.607)
Employees_2019	1007.049**	1007.049**	1007.049**	990.588**	1000.608**	993.094**	980.142**	974.772**	974.187**
	(436.295)	(436.295)	(436.295)	(435.349)	(434.700)	(434.942)	(435.357)	(435.326)	(435.218)
Observations	669	669	669	669	669	669	669	669	669
Interest Rate Setting	High	Low	Median	High	Low	Median	High	Low	Median
Prefecture FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses

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

Table 10 shows the estimation results. The specifications of the table are the same as before. Looking at columns 1 to 3, the estimated coefficients for the default score were all significantly positive. From this, we found that banks provided more loans to firms with high default risk before COVID-19. On the other hand, the estimated coefficients for the interest rate and the sales drop dummy variable were not significant. Then, looking at columns 4 to 6, the estimated coefficients for the interaction terms of interest rate and the sales drop dummy variable were both significantly positive. This means that when the loans had both 100% credit guarantee and interest payment support, private banks provided more loans as the interest rate increased. It implied that private banks chose their action to maximize their own profits. The estimated coefficients for the other interaction terms were not significant. In addition, looking at columns 7 to 9, the coefficients for the interaction terms of the three explanatory variables were not significant. Therefore, in the analysis of the amount of loans provided to approved firms, we confirmed that while banks took actions to maximize their own profits by making use of the design of the "zero-zero" loan policy, there was no evidence of moral hazard in their lending behavior.

9 Analysis about Repayment Status

In this section, we conduct a regression analysis of the repayment status of the "zero-zero" loan to identify the characteristics of firms that have not repaid the "zero-zero" loan as scheduled as well as to examine the relationship between borrowers' repayment status and banks' lending behavior. The questionnaire used in this study asks whether or not the firm has finished repaying the "zero-zero" loan. We also asked firms in detail about matters related to repayment of the "zero-zero" loan, such as whether they changed the original repayment terms, whether they used the refinancing program, and whether they took out other loans for the purpose of repayment. Using this information, we examine whether the moral hazard occurred by looking at repayment status.

We use as the dependent variable a binary variable that takes the value 1 if the firm has taken the measures described above among the firms that have not yet repaid their the "zero-zero" loan. If this binary variable is 1, it indicates that the firm has not yet repaid and that the repayment process did not progress as originally planned. We perform this analysis by limiting the sample to firms that actually used the "zero-zero" loan. We use the same explanatory and control variables as in the analysis explained before. Also, we add the amount of loan provided as the control variable since firms are more likely to fail to repay loans as scheduled when the amount of loans is large. We do the estimation by probit model and we use industry and prefecture dummy variables to control for industry and prefecture heterogeneity.

$$
\begin{aligned}
&Pr(Y_{ijk,2024} = 1|X_{ijkt}) \\
&= \Phi\big(\beta_1 DefaultScore_{ijk,2019} + \beta_2 IR_{ijk,2020} + \beta_3 SalesDropDummy_{ijk,2020} \\
&+ \beta_4(DefaultScore_{ijk,2019} \times IR_{ijk,2020}) + \beta_5(DefaultScore_{ijk,2019} \times SalesDropDummy_{ijk,2020}) \\
&+ \beta_6(IR_{ijk,2020} \times SalesDropDummy_{ijk,2020}) + \beta_7(DefaultScore_{ijk,2019} \times IR_{ijk,2020} \\
&\times SalesDropDummy_{ijk,2020}) + \beta_8 \ln(Bankborrow)_{ijk,2019} + \beta_9 \ln(Sales)_{ijk,2019} \\
&+ \beta_{10} \ln(Emp)_{ijk,2019} + \sum_j \gamma_j Industrydummy_{i,j} + \sum_k \delta_k Prefecturedummy_{i,k})
\end{aligned}
$$

Table 11: Estimation Result about Repayment Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Notrepayment	Notrepayment	Notrepayment	Notrepayment	Notrepayment	Notrepayment	Notrepayment	Notrepayment	Notrepayment
defaultscore_2019	5.494***	5.494***	5.494***	3.441	8.180	5.705	-2.321	-5.772	-3.955
	(1.986)	(1.986)	(1.986)	(6.476)	(7.191)	(6.988)	(11.347)	(12.068)	(11.974)
interest rate	636.756**	636.756**	636.756**	722.371**	936.273**	822.088**	523.079	399.952	470.949
	(282.501)	(282.501)	(282.501)	(360.217)	(386.702)	(376.959)	(483.765)	(538.676)	(517.589)
SalesDropDummy	0.164	0.164	0.164	-3.446*	-3.284*	-3.418*	-7.576	-13.809*	-10.561
	(0.189)	(0.189)	(0.189)	(1.848)	(1.897)	(1.873)	(6.958)	(7.657)	(7.492)
defaultscore_2019 * interest rate				-142.001	-524.081	-316.516	265.307	555.149	397.345
				(405.168)	(501.119)	(464.336)	(774.308)	(905.113)	(857.452)
defaultscore_2019 * SalesDropDummy				6.618*	6.615*	6.671*	14.888	27.843*	21.015
				(3.470)	(3.464)	(3.465)	(13.880)	(15.390)	(14.991)
interest rate * SalesDropDummy				19.655	10.357	17.160	307.331	818.579	538.989
				(40.354)	(53.595)	(47.298)	(469.170)	(572.312)	(532.296)
defaultscore_2019 * interest rate * SalesDropDummy							-574.756	-1628.507	-1046.034
							(933.851)	(1149.270)	(1063.150)
bankborrow	0.207*	0.207*	0.207*	0.195*	0.185*	0.190*	0.198*	0.188*	0.193*
	(0.111)	(0.111)	(0.111)	(0.112)	(0.112)	(0.112)	(0.112)	(0.113)	(0.113)
Sales_2019	-0.123	-0.123	-0.123	-0.109	-0.115	-0.112	-0.111	-0.121	-0.116
	(0.123)	(0.123)	(0.123)	(0.125)	(0.125)	(0.125)	(0.125)	(0.125)	(0.125)
Employees_2019	-0.321**	-0.321**	-0.321**	-0.326**	-0.322**	-0.324**	-0.327**	-0.318**	-0.323**
	(0.139)	(0.139)	(0.139)	(0.140)	(0.141)	(0.140)	(0.141)	(0.141)	(0.141)
Observations	486	486	486	486	486	486	486	486	486
Interest Rate Setting	High	Low	Median	High	Low	Median	High	Low	Median
Prefecture Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11 shows the results of the estimation for repayment of the "zero-zero" loan. Looking at columns 1 to 3, the estimated coefficients for the default score were all significantly positive. This suggests that firms with a high default risk before COVID-19 were more likely to take some measures because they were unable to repay their "zero-zero" loan as scheduled. In addition, the estimated coefficients for the interest rate were all significantly positive. This implied that firms with higher interest rates set by prefecture were more likely to take some measures because they were unable to repay their "zero-zero" loan as scheduled. On the other hand, the estimated coefficient for the sales drop dummy variable was not significant, which suggested that whether the loan was a risk-free loan for the bank did not affect whether the loan was repaid on schedule. Looking at columns 4 to 6, the estimated coefficients for most of the interaction terms were not significant, but the interaction term for default risk and the sales drop dummy variable was significantly positive. This result implied that for firms with a high risk of default before COVID-19, firms that had a 15% or greater decrease in sales were more likely to be unable to repay their loans as scheduled. It was very intuitive that firms with a high default risk would have more difficulty repaying loans when they suffered a major shock. However, the coefficients for all other interaction terms, including those in columns 7 to 9, were not significant. In the analysis of lending status, banks were more likely to approve and to lend larger amounts for loans with higher interest rates and 100% credit guarantees. Since the repayment status of such firms was not significantly negative, the

analysis of repayment status also suggested that in the "zero-zero" loan policy, the moral hazard problem of lenders may not have occurred.

10 Conclusion

This study focuses on the "zero-zero" loan policy, which was one of the business support measures implemented by the Japanese government during the COVID-19 shock. For private banks this unprecedentedly generous loan program was a loan with no default risk. As a result, this may have caused a moral hazard problem in the lending behavior of private banks. We examined this point in this study. The estimation results show that, in the case of the "zero-zero" loan, banks took action to maximize profits, while at the same time selecting borrowers appropriately. In more detail, when the loan was 100% credit guaranteed, banks were more likely to approve the loan and provide a larger loan amount if the interest rate was higher in the prefecture. However, this trend decreased as the borrower's default risk increased. In addition, the repayment status of firms that received 100% credit guaranteed loans did not change significantly depending on the interest rate. Therefore, our results suggest that the moral hazard problem of lenders did not occur in the "zero-zero" loan policy.

The contributions of this study are as follows. First, we empirically examined the moral hazard problem in lending behavior, which was one of the problems pointed out in credit guaranteed loans, especially in loans with 100% credit guarantee. This study is a unique empirical study in that it focused on the special interest rate setting in the "zero-zero" loan policy and used it to identify whether moral hazard occurred. Second, our study contributes to the literature on the Japanese government's support measures for firms during COVID-19 shock. Many previous studies have focused on the characteristics of the firms that used the support measures and have suggested negative effects of the support measures. This study contributes to this literature by focusing on particularly the "zero-zero" loan policy and investigating the effects of support measures from the

perspective of lenders' behavior.

On the other hand, although this study found that banks' lending behavior was not strange under the "zero-zero" loan policy, this result does not mean that this loan policy was effective. As of May 2024, when the survey was conducted, the repayment of zero-zero loans was still ongoing, and some firms responded by changing the terms of their loans and so on. Also, this study and previous studies such as Hoshi, Kawaguchi, and Ueda (2023) showed that the "zero-zero" loan was used more by firms with a higher default risk before COVID-19 pandemic. Therefore, it is important to analyze the subsequent performance of firms that used this program. If most of these firms were unable to repay their loans and went bankrupt, this would mean that moral hazard problem may occur because banks would not adequately monitor the borrowers since the loans were risk-free for banks. It is also possible that the borrowers who received the loans caused moral hazard problem. We will be able to analyze these points and evaluate the "zero-zero" loan policy more accurately only after the repayment of the "zero-zero" loan is completely finished. We leave these points for future research.

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A Comparison between Prefectural Interest Rate and Economic Measures

Here, we look at the correlation between the interest rates on the "zero-zero" loan policy set for each prefecture and other economic measures and show that the interest rates on the "zero-zero" loan were determined independently of the economic scale and financial demand of each prefecture. Figures 5 and 6 show the correlation between the Herfindahl-Hirschman Index(HHI) in the deposit market, the number of bank branches per area, the number of bank branches per population, and the interest rate for each prefecture. We used data from the Cabinet Office's System of Natural Accounts for prefectural population figures, data from the Geospatial Information Authority of Japan for prefectural area figures, and data from "Nihon Kinyu Meikan" in 2019 for the number of financial institutions in each prefecture. Table 12 shows the results of the simple regression, and examines whether the correlation is significant. As you can see, there was no significant correlation between the above financial measures and the interest rate on the "zero-zero" loan.

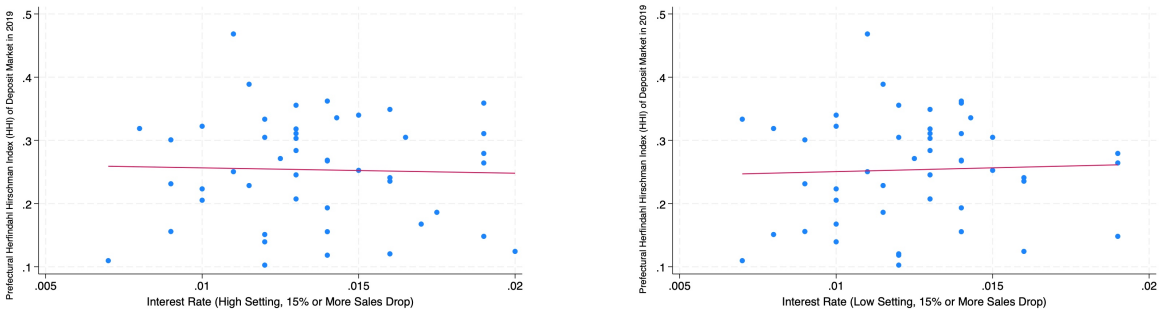

Figure 5: Correlation between Interest Rate and Herfindahl-Hirschman Index

Table 12: simple regression about measures related to financial situation

	(1)	(2)	(3)	(4)	(5)	(6)
	HHI deposit market	HHI deposit market	Banks per area	Banks per area	Banks per capita	Banks per capita
interest rate	-0.850	1.195	13.361	7.407	-0.001	0.002
	(3.976)	(4.400)	(8.851)	(9.985)	(0.002)	(0.003)
Observations	47	47	46	46	47	47
Interest Rate Setting	High	Low	High	Low	High	Low

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Next, Figure 7 shows the correlation between the ratio of secondary industry and

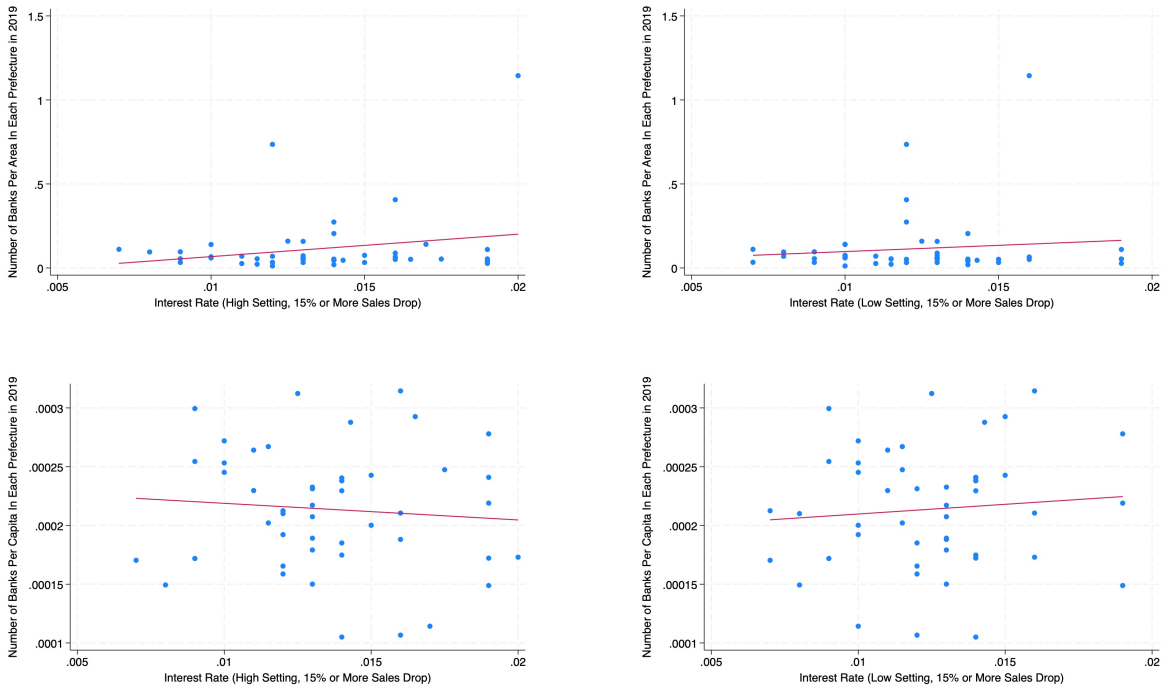

Figure 6: Correlation between Prefectural Interest Rate and Number of Banks

tertiary industry in all industries in each prefecture and the interest rate on the "zero-zero" loan in each prefecture[4]. The ratios for each prefecture are averages for the 10-year period from 2010 to 2019, and are calculated from the full sample of firm-level credit research report produced by Tokyo Shoko Research. Table 13 examines whether the correlation is significant through simple regression analysis. This shows that there was no significant correlation between the industrial ratios for each prefecture and the prefectural interest rate on the "zero-zero" loan.

Table 13: simple regression about industrial ratio

	(1)	(2)	(3)	(4)
	2nd industry share	2nd industry share	3rd industry share	3rd industry share
interest rate	-0.712	3.232	0.481	-3.433
	(3.575)	(3.930)	(3.581)	(3.932)
Observations	47	47	47	47

Standard errors in parentheses

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

Then, Figures 8 and 9 show the correlation between the average sales of firms in each prefecture and the interest rate on the "zero-zero" loan for each prefecture. The average sales for each prefecture are also calculated in the same way as the industrial ratio.

[4]The definition of secondary industry and tertiary industry are based on Japan Standard Industrial Classification.

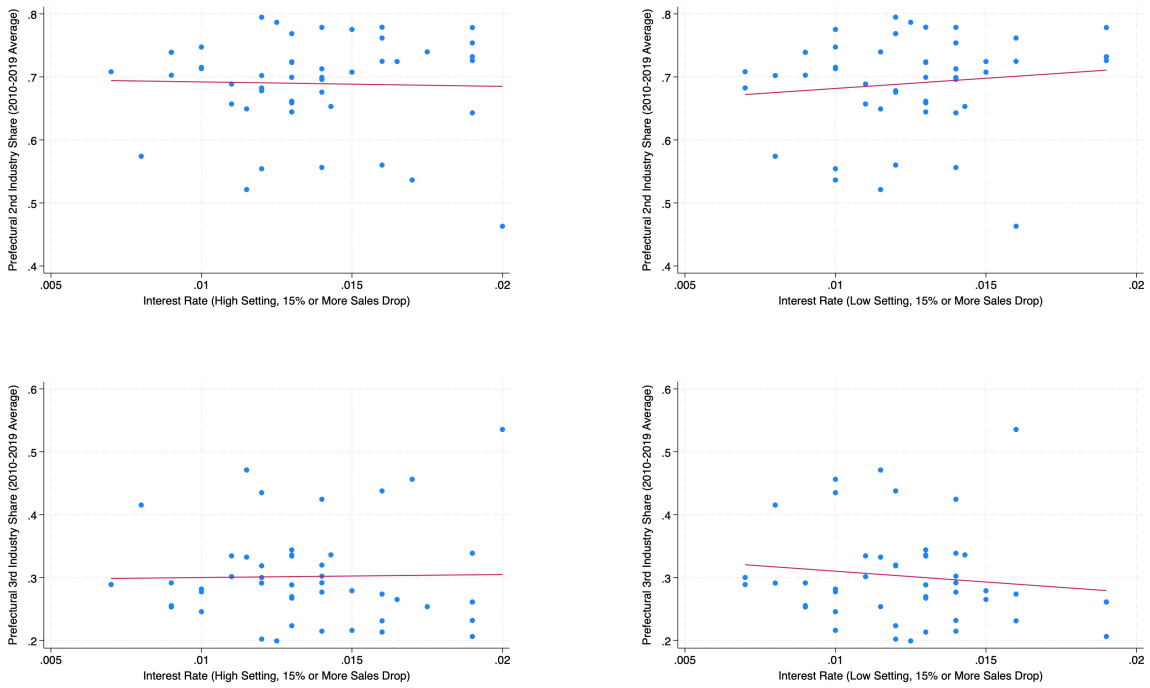

Figure 7: Correlation between Prefectural Interest Rate and Industry Share

Table 14 examines whether the correlation is significant using simple regression analysis. Looking at Figure 8, there is one outlier in the upper right corner, which is a sample of Tokyo. As a result, there appears to be a positive correlation between average sales and interest rates. In fact, looking at the column 1 of Table 14, it is significantly positive. In addition, columns 3 and 4 of Table 14 show whether the correlation is significant when Tokyo is excluded. Looking at this, there was no significant correlation between sales and interest rate on the "zero-zero" loan in each prefecture. Furthermore, columns 5 and 6 of Figure 10 and Table 14 show the correlation between the average EBIT (Earnings Before Interest and Taxes) in each prefecture instead of sales and interest rates, but there was no significant correlation either.

Table 14: simple regression about sales and EBIT

	(1) Sales	(2) Sales	(3) Sales (ex Tokyo)	(4) Sales (ex Tokyo)	(5) EBIT	(6) EBIT
interest rate	10623177.843**	7498035.714	1092060.548	958089.379	98512.942	-54823.658
	(5231617.131)	(5948007.211)	(2793951.725)	(3004622.804)	(255193.871)	(282905.430)
Observations	47	47	47	47	47	47

Standard errors in parentheses

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

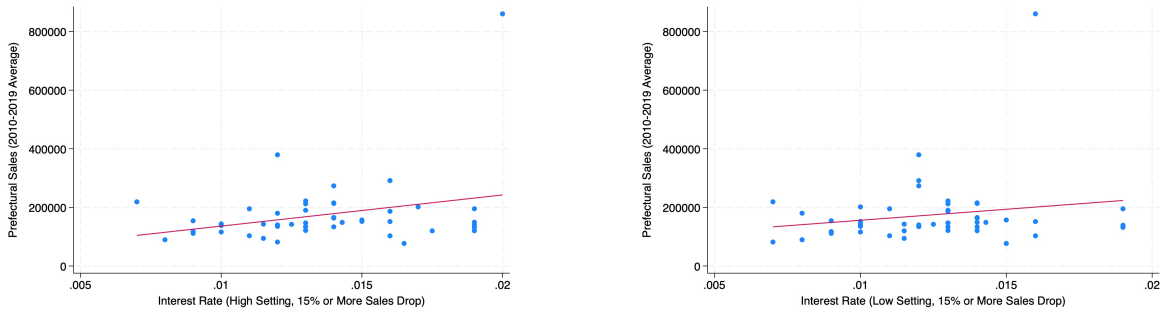

Figure 8: Correlation between Interest Rate and 10 Years Average of Sales

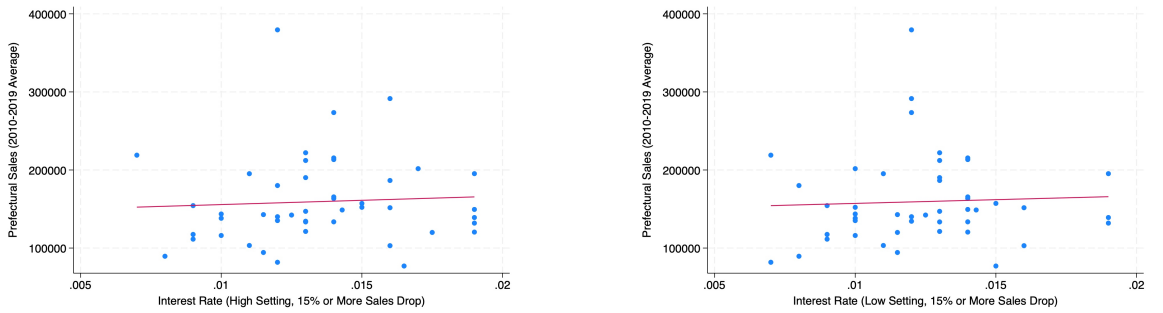

Figure 9: Correlation between Interest Rate and 10 Years Average of Sales (excluding Tokyo)

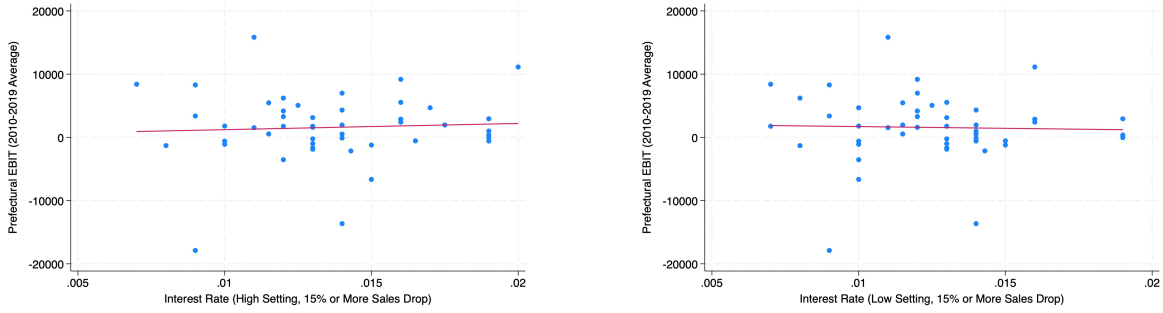

Figure 10: Correlation between Interest Rate and 10 Years Average of EBIT