

Internal Ratings and Loan Contracting: Evidence from a State-owned Bank around a Massive Economic Stimulus Programme

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Abstract

Using a proprietary loan data set, we study how a large state-owned bank uses its internal ratings in loan granting decisions around China's 2008 economic stimulus programme that relies on bank credit for financing. We find that there is little change in the rating process of the bank, and internal ratings remain a valid, albeit weaker, predictor of loan interest rates in the stimulus period. Weakened rating-interest rate relation is concentrated for borrowers from the industries that the stimulus programme focuses on, for state-owned enterprises (SOEs), for bank branches operating in provinces with a low level of credit market marketization, or when the credit rater and loan officer have no collaboration before. We also find that interest rates remain a valid predictor of ex-post loan outcomes in the stimulus period. Overall, there is no evidence that loan decisions of the state-owned bank are severely compromised in the economic stimulus period as speculated by some media. By showing how a state-owned bank maneuvers between supporting government stimulus initiative and maintaining market-based lending, we contribute to the limited literature on the roles of internal ratings in loan contracting decisions, and add to the debate over the roles of state-owned banks.

Keywords: Internal rating; loan; interest rate; state-owned banks; economic stimulus

JEL Code: G24 G28

“But of the four trillion renminbi, only 1.1 trillion is slated to come from the central government's budget. Municipal governments, government-owned policy development banks and commercial banks are expected to deliver most in the form of credit. And this has to cause worry that these new, poorly collateralized loans will end up on the banks' balance sheets. Thus, using the nascent private banking system as a source of countercyclical financing has opened the door to yet another, potentially very serious, accumulation of NPLs.”

- China's Debt Bomb, *Forbes*, May 27, 2009

1. Introduction

Basel II accord recommends that banks use internal ratings to assess the creditworthiness of borrowers and to determine the applicable contract terms (Tracey and Carey, 2000).¹ Despite the importance of internal ratings in loan contracting, it remains unclear how banks set and adjust loan terms such as interest rates according to internal ratings (Claessens, Law and Wang, 2018). We also have limited understanding of how incentives of banks (and bank officers) affect the rating process and loan contracting decisions (Berg, Puri and Rocholl, 2014). Research efforts in this regard are hampered by the confidentiality of banks' internal ratings and thereby the often unavailability of such data to outside researchers.

In this study, using a proprietary data set on internal ratings and loan contracts from a large nationwide Chinese state-owned bank, we contribute to the understanding of how banks assign and use internal ratings in loan contracting, and more importantly, whether rating assignment and usage change during times of economic stimulus and credit expansion that are increasingly common policy responses to an economic crisis in many countries.²

¹ While many borrowers of bank loans do not have a credit rating given by an external credit rating agency (unless they issue bonds), it is customary for a bank to issue its own internal (loan) rating for a borrower.

² By April 2009, the total amount of stimulus plans in different countries added up to USD 2048 billion. These countries include the U.S., China, Japan, Germany, Spain, Saudi Arabia, etc. See GIA Highlights Need to Assess Opportunities from Global Stimulus Packages, available at <https://www.m-brain.com/insights/industries/construction-property-development/gia-highlights-need-to-assess-opportunities-from-global-stimulus-packages/>.

In addition to access to the proprietary Chinese loan data set, using data from China is also interesting for two other reasons. First, when the 2008 global financial crisis unfolded, the Chinese government announced a four-trillion-Renminbi economic stimulus programme (or approximately USD 586 billion) on November 5, 2008 in an attempt to offset tumbling exports and stabilize the economy by boosting investment in infrastructure as well as social welfare projects (e.g., affordable housing). An important way to finance this stimulus programme is bank credit since only about one third of the spending target is financed by the Central government (Naughton, 2009). Bank regulators paved the way for banks to increase lending capacity by cutting the required reserve ratio (RRR) and increasing the country's aggregate loan quota (i.e., maximum lending target) (Cong, Gao, Ponticelli and Yang, 2018). In hindsight, the stimulus programme not only helped improve the resilience of the Chinese economy to the crisis, but also reduced the slowing-down of the global economy; this led the World Bank to subsequently recommend similar stimulus plans to western countries affected by the crisis.³ Nevertheless, it is unclear what impacts the economic stimulus programme engenders on state-owned banks' loan contracting decisions despite anecdotal speculations as shown in the opening quote (Li, 2009). Understanding such impacts (if any) is likely of interest not only to bank regulators and policymakers, but also to the investors of large Chinese banks that are all publicly listed in overseas bourses. For example, bank regulators and investors can understand whether or not banks' lending standard and asset quality are compromised in the stimulus period and policymakers can better assess the cost and benefits of the economic stimulus programme.

Arguably, the launch of the economic stimulus programme represented a shock to the incentives of state-owned, yet also publicly listed, banks in which the government remains as the

³ https://en.wikipedia.org/wiki/Chinese_economic_stimulus_program

single largest shareholder, and to the incentives of bank officers. This setting enables us to test whether banks change the way internal ratings are assigned, and used in setting loan interest rates, and whether the predictive power of interest rates on ex-post loan outcomes changes around the launch of the stimulus programme.

Second, using rating and loan data from a single bank helps mitigate the confounding effects of different bank characteristics (e.g., capital adequacy and liquidity position) on the setting of borrower ratings and loan terms as highlighted in Claessens et al. (2018). This feature enables us to carry out a relatively clean test of the rating-interest rate relation.

Since China's entry into the WTO at the end of 2001, big state-owned Chinese banks have undergone several rounds of reforms in order to shift to market-based operations and more accountability. These reforms include delegating authority and responsibility to individual loan officers, and banks' financial reorganizations, capital injections, and the eventual public listings (Chang, Liao, Yu and Ni, 2014). Qian, Strahan and Yang (2015) find that WTO entry constitutes a shock to loan officers' incentive to produce information, and as a result, bank's internal ratings become a stronger predictor of loan interest rates and loan interest rates better predict loan outcomes after the WTO entry. Our study takes advantage of the 2008 Chinese government's four-trillion-RMB stimulus programme as a response to the global financial crisis as a shock to study whether banks change the way they assign and use internal ratings in setting loan interest rates and whether the power of interest rates as a predictor of ex-post loan outcome changes.

On the one hand, some bank behavioral changes in the stimulus period might be expected given that the government remains as the controlling owner of big banks despite their public listing, and that the government plays an important role in nominating and appointing senior management of banks. It is possible that state-owned banks can, to some extent, cater to their large owner's

preferences (e.g., stabilizing the economy and providing countercyclical bank credits) and support the stimulus programme by extending credit to companies under a loosened lending standard, particularly those borrowers operating in the key industries that the stimulus programme focuses on, borrowers that have the state as a large shareholder, or in loans provided by bank branches operating in provinces with a low level of marketization in credit allocation. On the other hand, we may see no significant changes in the way internal ratings are assigned and used in setting loan interest rates if state-owned banks that have undergone market-based reform operate on the market basis. Indeed, since the 2001 China's entry into the WTO, state-owned banks have become largely market-oriented (Qian et al., 2015). Banks have installed systems and rules to enhance accountability so that bank managers and loan officers have incentives to focus on the performance of bank loans. Therefore, whether there is a significant change in the way banks assign and use internal ratings in setting loan interest rates, and the power of loan interest rates as a predictor of ex-post loan outcomes are empirical issues.

We define the pre-stimulus period as January 1, 2007 (when the internal rating data started) to November 4, 2008 (when the stimulus programme was announced), and the stimulus period as November 5, 2008 to December 31, 2010 (when the stimulus programme ended). Using internal ratings and loan contacts of corporate borrowers,⁴ we obtain three findings. First, there is no evidence that the state-owned bank that we analyze significantly altered its rating methodology over the two years around the stimulus programme. Second, the relation between internal ratings and loan interest rates becomes weaker yet remains statistically significant. Broadly, the weakened rating-interest rate relation is concentrated for borrowers from the industries that the stimulus

⁴ Since local governments are not comparable to companies, we do not include the loans that local governments take out through local government financing vehicles in our analysis, but they are interesting in their own right and can be separately explored (e.g., see Chen, He and Liu, 2017).

programme focuses on, for state-owned enterprises (SOEs), in loans extended by bank branches operating in provinces with a low level of marketization in allocating bank credit, or when the credit rater and loan officer have not collaborated before. Borrowers from the priority investment industries and SOE borrowers play a crucial role in the government's four-trillion stimulus programme and so they are expected to receive more favorable treatment in loan decisions (Liu, Pan and Tian, 2018). The result that the change in the sensitivity of loan interest rates to internal ratings around the stimulus programme also depends on the extent of marketization in the province where a bank branch is located is novel, as it shows there are significant variations in lending practice across different branches within the same bank. If the loan officer and credit rater have no collaboration on loan, internal communication cost is higher and there is less trust between the working pair (Qian et al., 2015), and as a result, internal ratings can be relied on to a lesser extent in determining loan interest rates.

Third, we find no evidence that the power of loan interest rate (or internal ratings) as a predictor of ex-post loan default is significantly compromised. This result may not be surprising given that we previously show that internal ratings remain a valid predictor of loan interest rate. In addition, while ratings' predictive power somewhat weakens for interest rates for borrowers from the stimulus-programme favored priority investment industries (e.g., infrastructure) and SOEs, banks overall should face limited credit risk by lending to those borrowers. This is because infrastructure projects often generate stable cash flows after completion and the state-owned identity of SOEs often provides de facto assurance as to future interest payment and loan repayment given their better access to financing (e.g., Allen, Qian, Tu and Yu, 2019).

Taken together, there is little evidence that lending standard is significantly compromised by the launch of the economic stimulus programme as evidenced by the validity of internal ratings

in predicting interest rates, and interest rates in predicting loan outcomes. These results are likely attributable to the success of the reforms that had aimed to improve market-based operations and loan officer accountability since China's entry into the WTO (Qian et al., 2015). Our results also provide an interesting case to show how a large state-owned bank carefully maneuvered between supporting government initiatives and maintaining market-based operations.

The remainder of this paper is organized as follows. Section 2 discusses the relation with the literature. Section 3 describes the sample and research design. Section 4 provides empirical results. We conclude in Section 5.

2. Relation with the literature

Our study makes four contributions to the banking literature. First, it adds to the limited evidence on how banks use internal ratings in setting loan interest rates (Claessens et al., 2018). Among the limited studies relying on proprietary data, Machauer and Weber (1998) show that poor internal ratings lead to higher interest rates in Germany. Nakamura and Roszbach (2016) find that internal ratings of two Swedish banks contain private information about borrowers especially for borrowers applying for large loans, but surprisingly, internal ratings do not reflect all publicly available information on borrowers' creditworthiness (e.g., that is from credit bureaus). In a European consumer loan setting, Berg et al. (2014) observe that when performance evaluation is based on loan volume, loan officers tend to manipulate the input of hard information needed for the rating system in multiple rating trials which eventually result in inflated ratings and successful loan grants. Chang et al. (2014) find that in China relationship information also matters for large borrowers and helps predict loan default. Qian et al. (2015) document that following China's entry into the WTO in 2001 loan officers are incentivized to produce internal ratings better reflecting borrowers' hard information, and to set loan interest rates more tightly according to internal ratings.

Our study extends this literature by showing that even if banks' internal rating methodology and hence information production remains unchanged, banks (and their loan officers) can still change the way ratings are used in loan contracting decisions under certain circumstances.

Second, our unique data on credit raters and loan officer enable us to identify individuals responsible for the rating assignment and interest rate setting of a loan. We examine how the performance of the previous loans handled by a credit rater or a loan manager affects his or her rating or interest rate setting, and we find evidence that a previous loan default results in more stringent interest rate setting by the officer. This points to bank officers' behavioral response to their previous performance and suggests that accountability is largely functioning. This corroborates our conclusion that the state-owned bank had carefully maneuvered between supporting government initiatives and maintaining market-based operations in the stimulus period. To our knowledge, very few prior studies have the data to show how individual bank officers perform in loan decisions.

Third, we show that even within the same bank, there are interesting variations in lending practice across different geographically located branches, and the lending practice appears to hinge on the extent of local credit market development. China is a large country has significant variations in economic development and extent of marketization across regions. Although China's large banks have undergone market-based operations and strengthened the accountability of bank managers and loan officers for loan outcomes, bank branches need to operate locally. In areas that are distant from the bank's headquarter and have a lower level of marketization, bank branches are subject to the influences of local non-market-based customs of doing business, and banks' internal systems and rules may not be fully enforced. How to minimize the undue local influence on banks' loan decisions is a topic for bank top management and affects the success of large banks.

Finally, our study is related to research on the controversial roles of state-owned banks and the costs and benefits of state banking. While there is abundant evidence pointing to the resource misallocation, lower efficiency, and smaller outreach of state-owned banks (e.g., La Porta, López-Silanes and Shleifer, 2002; Barth, Caprio and Levine, 2001; Sapienza, 2004; Beck, Demirguc-Kunt and Martinez Peria, 2007; Bailey, Huang and Yang, 2011), recent studies (e.g., Micco and Panizza, 2006; Bertay, Demirguc-Kunt and Huizinga, 2012) show that the lending of state-owned banks is less pro-cyclical than lending by private banks, and state-owned banks play a useful role in stabilizing and smoothing credit over the business cycle and periods of financial instability. Cong et al. (2018) and Liu et al. (2018) show that during the 2008 economic stimulus, a large proportion of bank loans was allocated to SOEs that play an important role in the stimulus programme. Ru (2018) finds that extending bank credit to SOEs by state-owned banks have both costs and benefits for non-SOEs: non-SOEs operating in the same industry as bank supported SOEs are crowded out, but non-SOEs operating in the downstream industries of the bank supported SOEs are crowded in. We have a different focus in this paper by studying whether there is a significant change in banks' internal information production, how internal ratings are used in setting loan interest rates, and the predictive power of loan interest rates for loan outcomes during economic stimulus. Nevertheless, our finding that the somewhat weakened relation between internal ratings and loan interest rates during the stimulus period is broadly consistent with the credit-smoothing role of state-owned banks in economic downturns, and adds to the small, yet growing, literature on how state banks react to business cycle fluctuations (Bertay et al., 2012).

3. Data sources and research design

3.1 Data Sources

Our proprietary internal rating and loan data are obtained from a large stated-owned bank that has a nationwide network of branches. We have access to comprehensive corporate loans issued by the bank's branches in 33 provinces/regions in China.

For each corporate loan, we observe borrower characteristics (firm name, industry, the internal rating assigned by the bank's credit rater), loan purpose, loan size, interest rate at origination, whether a loan's interest rate is floating or not, having collateral or not, and loan duration. We also observe ex-post loan outcomes in which loans are classified into 'normal' loans, 'attention' loans, 'sub-standard' loans, 'doubtful' loans, and 'loss-incurring' loans. We classify a loan as abnormal if the loan outcome belongs to one of the last four categories. This definition of 'abnormal loan' is used by bank regulators in China and has a rather low threshold because it does not really correspond to bad loans.

Due to the availability of limited borrow financial information in the loan data set, we focus on listed firms in our sample. We obtain borrow financial characteristics from the CSMAR database (that is available from WRDS) and they are measured in the year before a rating is assigned in rating models or measured in the year before a loan is granted in loan-level interest rate and default models. Descriptions of the variables used in our analyses are contained in Appendix 1.

3.2 Research design

The first research question we examine is whether the 2008 stimulus programme affects credit rater's incentive to produce informative ratings - i.e., whether the links between internal ratings and the hard and soft information about borrowers change around the stimulus programme. We employ the following rating-level model:

$$\begin{aligned}
RATING_{i,t_r} &= \beta_1 \cdot f(\text{borrower characteristics}_{i,t_{r-1}}) \\
&+ \beta_2 \cdot f(\text{borrower characteristics}_{i,t_{r-1}}) * STIMULUS \\
&+ TIME_{FE} + IND_{FE} + Branch\ Region_{FE} + \varepsilon
\end{aligned} \tag{1}$$

Where i indexes borrowers and t indexes years. Borrower characteristics are measured in the fiscal year end right before a rating assignment, indicated by t_{r-1} . The dependent variable is internal rating (*RATING*) ranges from 1 to 15 with 15 indicating the highest credit risk. A higher value of the dependent variable thus means lower level of creditworthiness. The pre-stimulus period is from January 1, 2007 (when internal ratings are introduced) to November 4, 2008 (the announcement day of the stimulus programme), and the stimulus period is from November 5, 2008 to December 31, 2010 (the ending day of stimulus programme). *STIMULUS* equals one for the stimulus period and zero for otherwise. That is, we use a balanced two year window around the launch of the stimulus programme in analysis.

In the above model, we include a full set of interactions between each borrower characteristic (proxying for the hard information about the borrower) so that we can capture whether the credit rater changes the rating standard in the stimulus period. Specifically, for borrower characteristics we include firm size, the cash-to-current liability ratio, the liability-to-asset ratio, asset turnover, return on asset, tangible asset intensity, whether a borrower's previous loan becomes abnormal or not (Qian et al., 2015), and the SOE indicator. Note that, a larger firm size, higher cash ratio, lower liability ratio, higher asset turnover, higher ROA, higher M/B, higher asset tangibility, and the absence of previous abnormal loan outcome are associated with a higher level of creditworthiness, which should be reflected in a lower internal rating.

Chang et al. (2014) report that in China soft information like the past loan relationship between a bank and a borrower also matters even for larger borrowers. We thus include the strength

of the bank's relationship with a borrower, defined as $\text{Log}(\text{total number of previous loans} + 1)$. A stronger relationship helps mitigate information asymmetry and likely leads to a better internal rating. We acknowledge that the coding of this variable, however, is based on the total number of previous loans in the sample since we do not have access to the complete relationship history between the bank and a borrower.

One uniqueness of the loan data is that we can identify the name of credit raters who are responsible for assigning the internal rating of a borrower. We thus also include in the model a dummy variable (*RATER_RECORD*) that equals one if the last loan rated by a credit rater subsequently goes abnormal. If the bank has a functioning system of accountability, we expect that poor prior performance leads the credit rater to become tougher in rating.

Following Dell'Ariccia, Laeven and Suarez (2017), we also include year-quarter fixed effects (i.e., *TIME_{FE}*) to control for the effects of time-varying macroeconomic conditions such as the change in the level of the benchmark interest rate set by the Central bank, and these fixed effects help absorb *STIMULUS*. We also include borrower industry fixed effects defined based on firms' industry codes,⁵ and bank branch region fixed effects in the model.

The second research question we examine is whether the loan officer changes the way internal ratings are used in setting loan interest rates.⁶ We estimate the following loan-level model:

⁵To generate the industry dummies, we use the first digit of the industry code for all industries other than manufacturing firms. For manufacturing industries that have a larger number of firms than other industries, we use the first two digits of the industry code in defining industries. This is a common practice in many studies using Chinese data.

⁶ Another potentially interesting question is whether the bank has changed its internal rating threshold for borrowers that are eligible for loan granting during the stimulus programme. We, however, do not have the data to test this question given that we only observe successful loan grants. Our talks with the bank's managers suggest that there has been no major change in the internal rating threshold for eligible loans around the economic stimulus programme.

$$\begin{aligned}
& LOAN\ INTEREST\ RATE_{i,t_l} \\
& = \beta_1 \cdot RATING_{i,t_l} + \beta_2 \cdot RATING_{i,t_l} * STIMULUS + \beta_3 \\
& \cdot f(\text{loan characteristics}_{i,t_l}) + \beta_4 \cdot f(\text{borrower characteristics}_{i,t_{l-1}}) \\
& + TIME_{FE} + IND_{FE} + Branch\ Region_{FE} + \varepsilon
\end{aligned} \tag{2}$$

where i indexes borrowers and t indexes years. The dependent variable is loan interest rate. We include the same set of borrower characteristics as in Equation (1) and they are measured in the year end before the loan grant date, indicated by t_{l-1} . Loan characteristics are measured at the time of loan grant. A higher value of rating indicates a lower level of creditworthiness.

We also have unique data on the name of loan officers so that we can identify individual officers responsible for setting the interest rate of a loan. We thus also include in the model a dummy variable (*OFFICER RECORD*) that equals one if the last loan handled by a loan officer subsequently goes abnormal. If the bank has a functioning system of accountability, we expect that previous poor loan performance leads the loan officer to become tougher in setting the interest rate of the current loan.

If the bank charges a higher interest rate for a borrower with a lower level of creditworthiness, β_1 is predicted to be positive. The coefficient of interest is β_2 for the interaction term $RATING * STIMULUS$. If the bank gives less weight to internal ratings in setting loan interest rate in the stimulus period, β_2 is predicted to be negative. The loan characteristics we control for include Log (loan amount), Log (loan duration), an indicator for floating interest rate (1/0), an indicator for having collateral (1/0), and loan purpose dummies. In addition, we include borrower characteristics to account for the possibility that the bank's internal rating does not perfectly reflect the hard information about a borrower.

The third research question we examine is whether the 2008 stimulus programme changes the power of loan interest rates as a predictor of ex-post loan outcomes, and we estimate the following loan-level model:

$$\begin{aligned}
 ABNORMAL\ LOAN_i & \\
 &= \beta_1 \cdot INTEREST\ RATE_{i,t_l} + \beta_2 \cdot INTEREST\ RATE_{i,t_l} * STIMULUS + \beta_3 \\
 &\cdot f(borrower\ characteristics_{i,t_{l-1}}) + \beta_4 \cdot f(loan\ characteristics_{i,t_l}) \\
 &+ TIME_{FE} + IND_{FE} + Branch\ Region_{FE} + \varepsilon
 \end{aligned} \tag{3}$$

The dependent variable is an indicator for abnormal loans. We include the same set of borrower characteristics measured in the year end before loan granting as in Equation (2) to account for the possibility that the interest rate charged does not perfectly reflect the hard information about a borrower. The variable of interest is loan interest rates (*INTEREST RATE*). β_1 is predicted to be positive if interest rates are set to reflect borrower creditworthiness. β_2 captures the change in the power of loan interest rates as a predictor of ex-post loan outcomes, and a negative coefficient would indicate that in the stimulus period, loan interest rates become a less accurate predictor of ex-post loan outcome.

4. Results

4.1 Summary statistics

Table 1 presents the summary statistics for the variables used in the rating-level analysis and loan-level analysis. Panel A reports borrowers' financial and non-financial characteristics used in the rating model in the year before the bank assigns an internal rating. Panel B reports the summary statistics for borrowers' financial and non-financial characteristics measured in the fiscal

year end right before loan granting. Panel C reports the summary statistics for the loan characteristics. There are fewer observations for the rating analysis (Panel A) than the observations for the loan-level analysis (Panel B and C) because there can be multiple loans from the same borrower in the same year.

As can be seen from Panel C, the mean of borrower rating is 5.554. On average, a loan is about RMB 42.44 million, and has a duration about 2.3 years (or 28 month), and a borrower pays an interest rate of 5.525%. In addition, 92.3% of the loans are floating-rate loans, 63.0% of loans carry a collateral, and 7.4% of loans become abnormal subsequently.

[\[Insert Table 1 near here\]](#)

4.2 Effects of the economic stimulus on the rating process

Table 2 reports the ordered logit regression of the ordinal dependent variable - internal ratings (*RATING*) - on borrowers' hard and soft information. A higher value of the dependent variable indicates a lower level of creditworthiness. The model controls for borrower industry, rating year-quarter, and bank branch region fixed effects. Standard errors are clustered at the firm level since a firm may have multiple ratings in our sample period.

As can be seen from Table 2, internal ratings are reflective of a borrower's all hard information in the pre-stimulus period as indicated by the regression coefficient of the standalone item of each borrower characteristic. Specifically, larger, more profitable firms, firms that have more cash relative to current liabilities, more tangible assets, less liabilities, higher asset turnover or do not have a previous abnormal loan have better rating as indicated by a lower value of the dependent variable. SOEs, on average, are assigned a better internal rating than non-SOEs, other things being equal. This result is consistent with the view that the state-owned identity may provide some assurance to the lender on future service of interest payment and loan repayment (Allen et

al., 2019). In addition, if the last loan rated by a credit rater goes abnormal, the rater appears to become more stringent in assigning a rating as indicated by the positive and significant coefficient on *RATER RECORD*. This evidence is novel and shows that the bank appears to have a functioning system of accountability. However, soft information about a borrower as proxied by the strength of bank relationship with a borrower is not loaded statistically in our sample.

More importantly, the coefficients of all the interaction terms are statistically insignificant, suggesting that from the pre-stimulus period to the stimulus period, the associations between internal ratings and borrowers' hard and soft information do not experience a significant change. Therefore, we do not find significant evidence that the large state-owned bank loosened its rating standard in the stimulus period.

[\[Insert Table 2 near here\]](#)

To further check the heterogeneities in the effects of the economic stimulus programme on the rating process, we test whether the stimulus programme weakens the relation between borrower characteristics and ratings in the stimulus-favored industries (i.e., priority industries) vs. other industries (columns 1-2), in SOEs based on the ultimate ownership vs. non-SOEs (columns 3-4), or in branches located in provinces with a low level of marketization in credit allocation vs. branches located in provinces with a high level of marketization in credit allocation (columns 5-6). The *PRIORITY* indicator is a dummy variable that equals one if a borrower's industry is one of the following industries supported by the stimulus programme: road transport, urban public transport, port industry, air transport, civil engineering construction, production and supply of electric power and thermal power, railway, shipbuilding, aerospace and power transmission &

distribution.⁷ We obtain the level of marketization in credit allocation in each province from Fan and Wang (2010) that publishes regional marketization indexes in China annually. We define the indicator *HIGH* that equals one if a province in which a bank branch is located has a marketization index in credit allocation that is above the 75th percentile of the index in a year, and zero otherwise.

The results reported in Table 3 are consistent with the baseline findings of Table 2 discussed above: internal ratings are in general informative of a borrower's hard information in the pre-stimulus period, particularly in non-priority industries and non-SOEs. All the coefficients on the interaction terms are statistically insignificant, suggesting that there is no significant evidence that the rating standard or process changed significantly around the launch of the economic stimulus programme even for the borrowers that are SOEs or from the stimulus-favored industries.⁸

The observation of little change in the rating process is understandable given that the bank has a rigorous rating procedure to follow in assigning an internal rating as required by the Basel II Accord and the bank's internal rating procedures are also subject to the regulatory oversight by the China Banking Supervisory Commission. Nevertheless, how do loan officers use the assigned internal ratings in determining loan interest rates in the stimulus period? We shed light on this question in the next section.

[\[Insert Table 3 near here\]](#)

4.3 Effects of the stimulus on the relation between internal ratings and loan interest rates

⁷ The classification of priority investment industries follows the definition of the National Development and Reform Commission (NDRC).

⁸ We note that in the model for the subsample on provinces with a high marketization index in credit allocation, certain rating determinants (e.g., total liability ratio) are not loaded possibly due to the small sample size.

Table 4 reports the regressions of loan interest rates on internal ratings. The dependent variable is *INTEREST RATE* (%), which is the loan interest rate at loan origination. The variable of interest is *RATING* for which a higher value indicates a lower level of creditworthiness. Borrower characteristics are measured at the fiscal year end before loan granting.

Several interesting observations emerge. First, across all model specifications, we find that in the pre-stimulus period the association between internal ratings and interest rates is positive and significant at the 0.01 level, suggesting that creditworthiness lowers loan interest rate. The interaction term *RATING*STIMULUS* are negatively loaded in all models, suggesting that internal ratings become a weaker predictor of loan interest rates in the stimulus period. The results suggest that loan officers give less weight to internal ratings in determining loan interest rates in the stimulus period. The result holds no matter we control for loan characteristics and/or firm characteristics or not.

To evaluate the magnitude of the effect, using the point estimate in column 5, one-standard-deviation increase in the internal rating increases the interest rates by about 34 basis points (= $0.151 * 2.254 * 100$) in the pre-stimulus period. In contrast, in the stimulus period, one-standard-deviation increase in the internal rating can only lead to an increase in interest rates by about 17 basis points (= $(0.151 - 0.077) * 2.254 * 100$). However, it is also important to note that internal ratings remain a significant predictor of interest rates even in the stimulus period as indicated by the *p*-values of the tests of coefficient combination ($\beta_1 + \beta_2$) reported at the bottom of Table 4.

Interestingly, *OFFICER RECORD* is positively loaded, suggesting that if the previous loan handled by a loan officer goes abnormal ex post, the loan officer is tougher in setting the interest rate of the current loan. It appears that the bank has a functioning system of accountability.

Moreover, by comparing column 4 and 5, we confirm that further adding borrowers' hard information to the interest rate model only slightly increases the model's explanatory power, suggesting that internal ratings have captured most of the hard information about borrowers. Overall, the above evidence suggests that the relation between internal ratings and loan interest rates becomes weaker in the stimulus period, suggesting loan officers' somewhat attenuated incentive to carefully factor internal ratings in setting loan interest rates during the stimulus period.

[\[Insert Table 4 near here\]](#)

To further check the heterogeneities in the effects of the economic stimulus programme on the relation between internal ratings and loan interest rates, we conduct split-sample analyses based on stimulus-favored industries (i.e., priority industries) vs. other industries (columns 1-2), SOEs vs. non-SOEs based on the ultimate owner (columns 3-4), branches located in provinces with a low level of marketization in credit allocation vs. branches located in provinces with a high level of marketization in credit allocation (columns 5-6), or the collaboration experience between the loan officer and the credit rater within the bank (columns 7-8). We then re-estimate Equation (2) for these subsamples and the results are reported in Table 5.

Across all model specifications, we find a positive and statistically significant relation between internal ratings and loan interest rates in the pre-stimulus period (i.e., β_1). Importantly, as indicated by the negative and statistically significant coefficients on the interaction terms (i.e., β_2) in column 1 and 3, in the stimulus period internal ratings are given less weight in setting interest rates for borrowers from the priority industries or for SOEs. Borrowers in the priority investment industries and SOE borrowers play a crucial role in the government's four-trillion stimulus programme (Liu et al., 2018), and therefore they are expected to be treated more leniently in loan

contracting. In contrast, as shown in columns 2 and 4, the coefficients of the interaction term *RATING*STIMULUS*, albeit negative, are not statistically significant.

The results reported in columns 5 and 6 suggest that the weakened relation between internal ratings and loan interest rates are concentrated in bank branches located in provinces that have a low level of marketization in credit allocation. The results are interesting, as they show that even within the same bank, there are variations in lending practice across different branches located in different geographical areas, and the lending practice hinges on the extent of local credit market development. It is possible that in provinces that have a low level of marketization in credit allocation, loan decisions of local bank branches are subject to the intervention of non-market forces.⁹

More previous collaborations between the loan officer and credit rater help lower internal communication cost and develop more trust between the working pair, thereby facilitating the use of internal ratings in setting loan interest rates (Qian et al., 2015). Consistent with this view, the negative and statistically significant coefficient on the interaction term in column 7 shows that when the loan officer and credit rater have not collaborated before, the loan officer tends to give less weight to the internal rating assigned by the credit rater in setting loan interest rates during the economic stimulus. However, even in this case, internal rating remains a valid predictor of loan interest rate as indicated by the significant combination of regression coefficients $\beta_1 + \beta_2$. In contrast, as shown in column 8, the coefficient of the interaction term *RATING*STIMULUS* is not statistically significant. These different patterns, however, are not statistically significant as indicated by the test of the difference in the coefficients of the interaction terms between column 7 and 8 reported in the lower section of Table 5.

⁹ Though β_1 in column 6 is smaller than that in column 5, the difference is not statistically significant in an unreported test of difference with a p -value about 0.20.

To sum up, we find that in the stimulus period, internal ratings become a weaker predictor of loan interest rates, and the weakened relation is concentrated in industries supported by the stimulus programme, SOEs borrowers, in loans provided by bank branches operating in provinces with a low level of marketization in credit allocation, or when internal communication between the credit rater and loan officer is higher (as proxied by a new pair). Our results show that even though banks' rating methodology remains the same, the way internal ratings are used in setting loan interest rates may be at times changed, for example, during the economic stimulus or credit expansion period. It is, however, important to note that internal ratings remain a significant and valid predictor of loan interest rates even in the stimulus period as indicated by the positive and significant combined regression coefficients $(\beta_1 + \beta_2)$ in all columns reported at the bottom of Table 5. Our results suggest that the large state-owned bank has carefully maneuvered between supporting government initiatives and maintaining market-based operations to keep its asset quality.

[\[Insert Table 5 near here\]](#)

4.4 Effects of the stimulus on the relation between loan interest rates and ex-post loan outcomes

We have shown that on average there is little change in the bank's internal rating standard in the period of the economic stimulus programme, but the bank's loan officers give less weight to internal ratings in setting loan interest rates in the stimulus period for borrowers from the priority investment industries, being SOEs, or in loans provided by bank branches operating in provinces with a low level of marketization in allocating bank credit. In this section, we follow Qian et al. (2015) to test whether loan interest rates predict ex-post loan outcomes, and how this predictive power changes from the pre-stimulus period to the stimulus period.

Table 6 reports the OLS results from estimating a linear probability regression of loan outcomes on loan interest rates.¹⁰ The dependent variable is *ABNORMAL LOAN*, which is an indicator for abnormal loans. The variables of interest are *INTEREST RATE* and the interaction term *INTEREST RATE*STIMULUS*.

In column 1, we start by examining the average effect of loan interest rates on abnormal loan outcome. Loan interest rates are a good predictor of abnormal loans: loans charging lower interest rates (and hence indicating a higher level of creditworthiness) are less likely to become abnormal ex post as indicated by the positive and statistically significant β_1 . In column 2, we add the interaction term *INTEREST RATE*STIMULUS* to test whether the power of loan interest rates as a predictor of abnormal loan outcomes changes around the stimulus programme. β_2 is positively signed and statistically insignificant, and so there is no evidence that the launch of the economic stimulus programme attenuates the predictive power of loan interest rates on abnormal loan outcomes. In the rest of the columns of Table 6, we add loan characteristics, a borrower's previous loan performance, a loan officer's previous loan performance, soft and hard information about the borrower as controls on the stepwise basis. The results on loan interest rate and its interaction term with *STIMULUS* remain similar to those in column 2.

Results on several control variables deserve a discussion. The coefficient of $\log(1 + \textit{STRENGTH})$ is negative and statistically significant in the full model reported in column 6, suggesting that a borrower with more prior business relationship with the bank is less likely to have its loan become abnormal subsequently. It is plausible that prior lending relationship may help reduce the information asymmetry about the borrower and/or the borrower is unwilling to

¹⁰ We estimate a linear probability model instead of a Probit model to avoid the problem of incidental coefficient estimate in Probit models with a large number of fixed effects (Wooldridge, 2010).

ruin its reputation built through repeated business relationships with the bank. In addition, large, profitable borrowers or those that have higher tangible asset intensity are less likely to have abnormal loans. Interestingly, firms with a higher asset turnover are more likely to report abnormal loans, perhaps because such firms may have a smaller asset base and fewer tangible assets.

We also test the combination of $(\beta_1 + \beta_2)$ and find that they are positive and statistically significant as indicated by the p -values reported at the bottom of Table 6. Therefore, loan interest rates remain a significant predictor of ex-post abnormal loans in the stimulus period. This result may not be surprising given that we previously show that internal ratings remain a valid predictor of loan interest rates. While ratings' predictive power somewhat weakens for interest rates for borrowers from the stimulus-programme favored priority investment industries (e.g., infrastructure) and SOEs, banks face rather limited credit risk because infrastructure projects often generate stable cash flows after completion and the state-owned identity of SOEs often provides some assurance as to future interest payment and loan repayment.¹¹

[\[Insert Table 6 near here\]](#)

In Table 7, we verify that there is no change in the predictive power of internal ratings on ex-post abnormal loan outcomes. This is expected as we do not find significant change in the bank's rating process around the economic stimulus programme. In unreported results, we also check the heterogeneities in the effects of the stimulus programme on the relation between internal ratings and loan outcomes for borrower from the priority investment industries vs. non-priority

¹¹ We also check the heterogeneities in the effects of the stimulus programme on the relation between loan interest rates and loan outcomes for borrowers from the priority investment industries vs. non-priority investment industries, for SOEs borrowers vs. non-SOE borrowers, and loans granted by bank branches located in provinces with a high level of marketization in credit allocation vs. those branches located in provinces with a low level of marketization in credit allocation. All the interaction terms between *INTEREST_RATE* and *STIMULUS* are not statistically significant. Results are not reported for brevity.

investment industries, and for SOEs borrowers vs. non-SOE borrowers. All the interaction terms between *RATING* and *STIMULUS* are not statistically significant.

[\[Insert Table 7 near here\]](#)

Taken together all the results reported in Tables 4-7, it appears that the bank's information production through internal ratings is not significantly affected by the stimulus programme; while there is some evidence that loan officers give less weight to internal ratings in setting loan interest rates for SOEs, borrowers from the stimulus supported industries, and in bank branches operating in a low level of marketization in credit allocation, internal ratings remain a valid predictor of loan interest rates, and loan interest rates remain a valid predictor of ex-post loan outcomes.

5. Conclusion

In this study, using a proprietary data set on bank internal ratings and loan contracts from a large nationwide Chinese state-owned bank over the two years around China's 2008 four-trillion economic stimulus programme, we show that there is no significant change in the bank's internal rating methodology; loan interest rates, however, become less sensitive to internal ratings in the stimulus period. Broadly, these patterns are concentrated in borrowers from the industries that the stimulus programme focuses on, in borrowers being state-owned enterprises (SOEs), in loans provided by bank branches operating in provinces with a low level of marketization in credit allocation, or when the credit rater and loan officer have not collaborated before.

Importantly, even in the stimulus period, the state-owned bank's internal loan ratings continue to be a valid predictor of loan interest rates and loan interest rates remain a significant predictor of ex-post abnormal loan outcomes. These patterns may be attributable to the success of the series of reform that aimed to improve market-based operations and loan officer accountability

since China's entry into the WTO (Qian et al., 2015). Our results suggest that the large state-owned bank has carefully maneuvered between supporting government initiatives and maintaining market-based operations to keep its asset quality. Overall, the effect of the economic stimulus programme on the operation of the state-owned bank appears moderate in our sample. Therefore, we find no evidence that bank lending in the stimulus period constitutes a debt bomb as speculated by some media.

Our study contributes to the limited research on how banks assign and use internal ratings in loan contracting, especially in non-normal periods such as economic stimulus and quantitative easing. Our findings also add to the debate over the costs and benefits of state-owned banks and government credit. We also provide novel evidence on bank officers' incentives: credit raters and loan officers appear to be responsive to their prior poor loan performance becoming stricter in rating and setting loan interest rates, and their collaboration experience reduces internal communication costs and thereby helps increase the weight of internal ratings in loan contracting.

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Table 1 Summary statistics

This table presents summary statistics for the variables used in the rating process and loan-level analysis. Panel A reports the summary statistics for borrowers' financial and non-financial characteristics in the year before being assigned an internal rating by the bank. Panel B reports the summary statistics for borrowers' financial and non-financial characteristics in the year before loan granting. Panel C reports the summary statistics for the loan characteristics used in the loan-level analysis.

Panel A: borrower characteristics measured in the year before rating assignment

| Variable | N | Mean | SD | P25 | P50 | P75 |
|-------------------|------|--------|-------|--------|--------|--------|
| RATING | 1456 | 5.554 | 1.864 | 4 | 5 | 7 |
| log(ASSET) | 1456 | 22.047 | 1.136 | 21.268 | 21.920 | 22.734 |
| CASH | 1456 | 0.403 | 0.430 | 0.176 | 0.280 | 0.440 |
| LIABILITY | 1456 | 0.568 | 0.164 | 0.451 | 0.589 | 0.690 |
| TURNOVER | 1456 | 0.723 | 0.457 | 0.403 | 0.630 | 0.900 |
| ROA | 1456 | 0.067 | 0.063 | 0.035 | 0.059 | 0.094 |
| TANGIBILITY | 1456 | 0.293 | 0.180 | 0.150 | 0.265 | 0.426 |
| SOE | 1456 | 0.480 | 0.163 | 0.362 | 0.477 | 0.608 |
| PREVIOUS ABNORMAL | 1460 | 0.075 | 0.263 | 0 | 0 | 0 |
| STRENGTH | 1460 | 6.991 | 7.522 | 2 | 5 | 9 |
| log(1+STRENGTH) | 1460 | 1.674 | 0.941 | 1.099 | 1.792 | 2.303 |
| RATER RECORD | 1460 | 0.210 | 0.408 | 0 | 0 | 0 |

Panel B: borrower characteristics measured in the year before loan granting

| Variable | N | Mean | SD | P25 | P50 | P75 |
|-------------------|------|--------|-------|--------|--------|--------|
| RATING | 3370 | 5.739 | 2.254 | 4 | 5 | 7 |
| log(ASSET) | 3370 | 22.313 | 1.117 | 21.494 | 22.212 | 22.993 |
| CASH | 3370 | 0.338 | 0.292 | 0.160 | 0.254 | 0.419 |
| LIABILITY | 3370 | 0.615 | 0.163 | 0.495 | 0.630 | 0.725 |
| TURNOVER | 3370 | 0.692 | 0.443 | 0.387 | 0.613 | 0.861 |
| ROA | 3370 | 0.057 | 0.064 | 0.029 | 0.054 | 0.085 |
| TANGIBILITY | 3370 | 0.320 | 0.186 | 0.175 | 0.305 | 0.461 |
| SOE | 3272 | 0.122 | 0.181 | 0.009 | 0.086 | 0.220 |
| PREVIOUS ABNORMAL | 3370 | 0.062 | 0.242 | 0 | 0 | 0 |
| STRENGTH | 3370 | 8.246 | 8.025 | 3 | 6 | 11 |
| log(1+STRENGTH) | 3370 | 1.856 | 0.908 | 1.386 | 1.946 | 2.485 |
| OFFICER RECORD | 3370 | 0.046 | 0.210 | 0 | 0 | 0 |

Panel C: loan characteristics

| Variable | N | Mean | SD | P25 | P50 | P75 |
|-------------------|------|--------|--------|--------|--------|--------|
| INTEREST RATE (%) | 3370 | 5.525 | 0.995 | 5.045 | 5.350 | 5.895 |
| AMOUNT (million) | 3370 | 42.439 | 52.204 | 12 | 28.5 | 50 |
| log(AMOUNT) | 3370 | 17.012 | 1.121 | 16.300 | 17.165 | 17.728 |
| DURATION (month) | 3370 | 28.054 | 39.133 | 12 | 12 | 24 |
| log(DURATION) | 3370 | 2.827 | 0.887 | 2.440 | 2.482 | 3.175 |
| FLOATING | 3370 | 0.923 | 0.267 | 1 | 1 | 1 |
| COLLATERAL | 3370 | 0.630 | 0.483 | 0 | 1 | 1 |
| ABNORMAL LOAN | 3370 | 0.074 | 0.262 | 0 | 0 | 0 |

Table 2 Effects of the economic stimulus on the rating process

This table reports the estimates of ordered logit regressions of borrower ratings on firm characteristics. The dependent variable is RATING, which ranges from 1 to 15 with 15 indicating the highest credit risk. A higher value of the dependent variable indicates a lower level of creditworthiness. The pre-stimulus period is from 2007/01/01 (when the borrower rating data started) to 2008/11/04, and the stimulus period is from 2008/11/05 (when the stimulus programme was announced) to 2010/12/31 (when the stimulus programme ended). STIMULUS equals 1 for the stimulus period and 0 for otherwise. The independent variables are measured in the year end before the rating. Standard errors are clustered at the borrower level. *T*-values are reported in parentheses. *, **, and *** denote statistical significance level at the 10%, 5%, and 1% level, respectively.

| | Y = RATING | | | |
|----------------------------|------------------------|-----------------------|-----------------------|-----------------------|
| | 1 | 2 | 3 | 4 |
| log(ASSET) | -0.734*** (-10.151) | -0.694*** (-9.871) | -0.696*** (-9.889) | -0.697*** (-9.895) |
| log(ASSET)*STIMULUS | 0.007 (0.286) | -0.006 (-0.218) | -0.007 (-0.262) | -0.004 (-0.171) |
| CASH | -0.437** (-2.287) | -0.478** (-2.503) | -0.474** (-2.491) | -0.488** (-2.535) |
| CASH*STIMULUS | -0.192 (-0.798) | -0.099 (-0.413) | -0.106 (-0.440) | -0.087 (-0.361) |
| LIABILITY | 3.432*** (4.997) | 3.090*** (4.483) | 3.063*** (4.419) | 3.124*** (4.545) |
| LIABILITY*STIMULUS | -0.115 (-0.164) | 0.167 (0.235) | 0.089 (0.122) | 0.057 (0.079) |
| TURNOVER | -1.360*** (-7.407) | -1.467*** (-8.038) | -1.467*** (-8.024) | -1.446*** (-7.871) |
| TURNOVER*STIMULUS | -0.088 (-0.468) | -0.013 (-0.068) | -0.016 (-0.084) | -0.031 (-0.158) |
| ROA | -10.257*** (-6.733) | -9.638*** (-6.373) | -9.579*** (-6.278) | -9.509*** (-6.180) |
| ROA*STIMULUS | 2.111 (1.192) | 1.883 (1.019) | 1.941 (1.041) | 1.860 (0.992) |
| TANGIBILITY | -1.402*** (-3.254) | -1.532*** (-3.528) | -1.531*** (-3.524) | -1.555*** (-3.573) |
| TANGIBILITY *STIMULUS | 0.212 (0.424) | 0.424 (0.827) | 0.418 (0.812) | 0.451 (0.874) |
| SOE | -0.393** (-2.433) | -0.432*** (-2.653) | -0.432*** (-2.653) | -0.444*** (-2.726) |
| SOE*STIMULUS | -0.104 (-0.557) | -0.082 (-0.430) | -0.082 (-0.431) | -0.073 (-0.383) |
| PREVIOUS_ABNORMAL | | 1.360*** (4.043) | 1.348*** (3.984) | 1.294*** (3.738) |
| PREVIOUS_ABNORMAL*STIMULUS | | 0.062 (0.144) | 0.053 (0.124) | 0.097 (0.223) |
| log(1+STRENGTH) | | | 0.034 (0.478) | 0.022 (0.311) |
| log(1+STRENGTH)*STIMULUS | | | 0.049 (0.514) | 0.055 (0.554) |
| RATER_RECORD | | | | 0.353* (1.921) |
| RATER_RECORD*STIMULUS | | | | -0.268 (-1.119) |
| FE-Region | Y | Y | Y | Y |
| FE-Industry | Y | Y | Y | Y |
| FE-Year-Quarter | Y | Y | Y | Y |
| Clustered by firm | Y | Y | Y | Y |
| Number of observations | 1,460 | 1,460 | 1,460 | 1,460 |
| Pseudo R2 | 0.122 | 0.127 | 0.130 | 0.131 |

Table 3 Heterogeneity in the rating process

This table shows the heterogeneity in the effects of the economic stimulus programme on the rating process using ordered logit regressions. We test whether the stimulus weakens the relation between borrower characteristics and internal ratings in stimulus-favored industries (i.e., priority industries) (columns 1–2), in SOEs vs. non-SOEs based on the ultimate owner (columns 3–4), and in bank branches located in provinces with a low level of marketization in credit allocation vs. a high level of marketization in credit allocation (columns 5–6). The dependent variable is RATING. A higher value of RATING indicates a lower level of creditworthiness. The pre-stimulus period is from 2007/01/01 to 2008/11/04, and the post-stimulus period is from 2008/11/05 to 2010/12/31. STIMULUS equals one for the post-stimulus period and zero for otherwise. The independent variables are measured in the year before the rating. Standard errors are clustered at the firm level. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

| | Y = RATING | | | | | |
|----------------------------|------------------------|-----------------------|-----------------------------|-----------------------|-----------------------|------------------------|
| | <i>Industry</i> | | <i>Ultimate Shareholder</i> | | <i>Marketization</i> | |
| | PRIORITY | NON-PRIORITY | SOEs | NON-SOEs | LOW | HIGH |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| log(ASSET) | -0.866*** (-5.864) | -0.664*** (-7.799) | -0.785*** (-8.058) | -0.587*** (-5.288) | -0.700*** (-8.795) | -0.594*** (-4.267) |
| log(ASSET)*STIMULUS | -0.050 (-0.994) | -0.009 (-0.284) | -0.003 (-0.092) | 0.002 (0.054) | 0.043 (1.378) | -0.090 (-1.282) |
| CASH | -0.693 (-1.520) | -0.487** (-2.229) | -0.921* (-1.833) | -0.496* (-1.917) | -0.588*** (-3.229) | 0.251 (0.575) |
| CASH*STIMULUS | -0.332 (-0.604) | 0.023 (0.082) | -0.190 (-0.344) | 0.120 (0.381) | -0.152 (-0.575) | -0.476 (-0.944) |
| LIABILITY | 1.654 (1.185) | 3.290*** (4.246) | 3.682*** (4.022) | 2.155* (1.896) | 2.873*** (3.815) | 2.614 (1.415) |
| LIABILITY*STIMULUS | 1.350 (0.874) | 0.248 (0.296) | -0.648 (-0.689) | 0.773 (0.558) | -1.062 (-1.162) | 2.167 (1.136) |
| TURNOVER | -2.437*** (-5.013) | -1.304*** (-6.314) | -1.360*** (-5.678) | -1.656*** (-5.971) | -1.282*** (-7.005) | -2.334*** (-4.992) |
| TURNOVER*STIMULUS | -0.040 (-0.064) | -0.151 (-0.679) | 0.015 (0.061) | -0.058 (-0.166) | -0.189 (-0.828) | 0.593 (1.157) |
| ROA | -13.515*** (-4.057) | -9.191*** (-5.002) | -10.312*** (-4.584) | -9.198*** (-4.161) | -8.088*** (-4.568) | -11.382*** (-2.676) |
| ROA*STIMULUS | 4.844 (1.087) | 1.565 (0.725) | 2.791 (1.033) | 0.557 (0.204) | 0.440 (0.184) | 1.866 (0.407) |
| TANGIBILITY | -1.580** (-2.137) | -1.756*** (-3.132) | -1.424*** (-2.780) | -1.688** (-2.083) | -1.380*** (-2.887) | -2.608** (-2.448) |
| TANGIBILITY *STIMULUS | -0.400 (-0.446) | 0.836 (1.262) | 0.668 (1.108) | 0.138 (0.136) | 0.453 (0.683) | 1.577 (1.253) |
| SOE | -0.077 (-0.179) | -0.530*** (-2.938) | | | -0.363** (-2.071) | 0.108 (0.290) |
| SOE*STIMULUS | -0.425 (-0.933) | 0.044 (0.198) | | | -0.274 (-1.112) | -0.464 (-1.137) |
| PREVIOUS_ABNORMAL | 0.387 (0.705) | 1.562*** (3.937) | 0.933** (2.482) | 1.685** (2.190) | 1.029*** (2.774) | 2.381*** (2.589) |
| PREVIOUS_ABNORMAL*STIMULUS | -0.813 (-0.852) | 0.159 (0.321) | 0.130 (0.270) | 0.120 (0.133) | 0.003 (0.005) | -1.479 (-1.601) |
| log(1+STRENGTH) | -0.035 (-0.207) | -0.005 (-0.060) | -0.114 (-1.283) | 0.252** (2.119) | 0.069 (0.849) | 0.128 (0.620) |
| log(1+STRENGTH)*STIMULUS | 0.171 (0.712) | 0.043 (0.397) | 0.174 (1.464) | -0.183 (-1.045) | 0.070 (0.538) | -0.177 (-0.738) |
| RATER_RECORD | -0.491 (-1.559) | 0.655*** (2.784) | 0.515** (2.206) | 0.278 (1.014) | 0.924* (1.789) | 1.814 (1.038) |
| RATER_RECORD*STIMULUS | 0.106 (0.268) | -0.391 (-1.253) | -0.413 (-1.323) | -0.177 (-0.458) | -0.238 (-0.260) | 0.145 (0.082) |
| FE-Region | Y | Y | Y | Y | Y | Y |
| FE-Industry | Y | Y | Y | Y | Y | Y |
| FE-Year-Quarter | Y | Y | Y | Y | Y | Y |
| Clustered by firm | Y | Y | Y | Y | Y | Y |
| Number of obs | 331 | 1,129 | 887 | 573 | 1,023 | 438 |
| Pseudo R ² | 0.129 | 0.139 | 0.131 | 0.139 | 0.111 | 0.169 |

Table 4 Effect of the stimulus on the relation between borrower ratings and loan interest rates

This table reports the OLS results from regressing loan interest rates on borrower ratings. The dependent variable is INTEREST RATE (%), which is the loan interest rate at loan origination. The variable of interest is RATING, which ranges from 1 to 15 with 15 indicating the highest credit risk. A higher value of RATING indicates a lower level of creditworthiness. The pre-stimulus period is from 2007/01/01 (when the borrower rating data started) to 2008/11/04, and the stimulus period is from 2008/11/05 (when the stimulus programme was announced) to 2010/12/31 (when the stimulus programme ended). STIMULUS equals one for the stimulus period and zero for otherwise. The independent variables are measured in the year end before loan grant. Standard errors are clustered at the firm level. *, **, and *** denote statistical significance level at the 10%, 5%, and 1% level, respectively.

| | Y = INTEREST RATE (%) | | | | |
|---------------------------------------|-----------------------|----------------------|----------------------|----------------------|-----------------------|
| | 1 | 2 | 3 | 4 | 5 |
| RATING (β_1) | 0.204*** (5.223) | 0.205*** (5.056) | 0.191*** (4.786) | 0.182*** (4.575) | 0.151*** (4.003) |
| RATING*STIMULUS (β_2) | -0.083** (-2.533) | -0.084** (-2.557) | -0.081** (-2.452) | -0.079** (-2.353) | -0.077** (-2.491) |
| log(AMOUNT) | | 0.041 (0.982) | 0.038 (0.912) | 0.038 (0.922) | 0.104** (2.470) |
| log(DURATION) | | 0.344*** (3.618) | 0.356*** (3.801) | 0.356*** (3.816) | 0.373*** (4.356) |
| FLOATING | | 0.362** (2.306) | 0.350** (2.163) | 0.354** (2.193) | 0.277* (1.762) |
| COLLATERAL | | 0.193*** (2.644) | 0.189*** (2.636) | 0.183** (2.532) | 0.110 (1.412) |
| PREVIOUS_ABNORMAL | | | 0.322*** (3.196) | 0.221*** (2.639) | 0.250*** (3.072) |
| log(1+STRENGTH) | | | -0.042 (-1.214) | -0.041 (-1.169) | 0.010 (0.286) |
| OFFICER_RECORD | | | | 0.274*** (3.116) | 0.338*** (3.950) |
| log(TA) | | | | | -0.224*** (-4.152) |
| CASH | | | | | -0.161 (-1.609) |
| LIABILITY | | | | | -0.339 (-1.280) |
| TURNOVER | | | | | -0.207** (-2.466) |
| ROA | | | | | -0.459 (-0.863) |
| TANGIBILITY | | | | | -0.609** (-2.387) |
| SOE | | | | | 0.078 (1.343) |
| $\beta_1 + \beta_2$ | 0.121 | 0.121 | 0.110 | 0.103 | 0.074 |
| Test of $\beta_1 + \beta_2$ (p-value) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Clustered by firm | Y | Y | Y | Y | Y |
| FE-Region | Y | Y | Y | Y | Y |
| FE-Industry | Y | Y | Y | Y | Y |
| FE-Year-Quarter | Y | Y | Y | Y | Y |
| Loan purpose FE | Y | Y | Y | Y | Y |
| Number of observations | 3,370 | 3,370 | 3,370 | 3,370 | 3,370 |
| Adjusted R ² | 0.442 | 0.477 | 0.482 | 0.484 | 0.523 |

Table 5 Heterogeneity in the effects of the economic stimulus on the relation between ratings and interest rates

This table shows the heterogeneity in the effects of the economic stimulus programme on the relation between internal ratings and loan interest rates. We test whether the stimulus weakens the relation between ratings and interest rates in stimulus-favoured industries (i.e., priority industries) (columns 1–2), in SOEs vs. non-SOEs (columns 3–4), bank branches in low-marketization provinces vs high-marketization provinces (column 5–6), and in new working pairs of credit raters and loan officers vs. old working pairs (columns 7–8). The dependent variable is INTEREST RATE (%), which is the loan interest rate at loan origination. The variable of interest is RATING. A higher value of the dependent variable indicates a lower level of creditworthiness. The pre-stimulus period is from 2007/01/01 to 2008/11/04, and the stimulus period is from 2008/11/05 to 2010/12/31. STIMULUS equals one for the stimulus period and zero for otherwise. NEW PAIR equals 1 if the loan officer and the credit rater have not collaborated on loans before, and zero for otherwise. The independent variables are measured in the year end before loan granting. Standard errors are clustered at the firm level. *, **, and *** denote statistical significance level at the 10%, 5%, and 1% level, respectively.

| | Y = INTEREST RATE (%) | | | | | | | |
|---------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Industry | | Ultimate Shareholder | | Marketization | | Rater - Loan Manager | |
| | PRIORIT Y | NON- PRIORIT Y | SOE | NON- SOE | LOW | HIGH | NEW PAIR | OLD PAIR |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| RATING (β_1) | 0.228*** (4.056) | 0.100*** (3.168) | 0.199*** (3.771) | 0.062** (2.218) | 0.204*** (5.161) | 0.057** (2.006) | 0.137*** (3.887) | 0.096** (2.581) |
| RATING*STIMULUS (β_2) | -0.127*** (-2.840) | -0.042 (-1.536) | -0.101*** (-2.767) | -0.025 (-0.980) | -0.111*** (-3.571) | -0.025 (-0.847) | -0.072** (-2.203) | -0.034 (-1.067) |
| log(AMOUNT) | 0.098** (2.184) | 0.077 (1.640) | 0.141*** (2.675) | 0.020 (0.482) | 0.131** (2.480) | 0.006 (0.144) | 0.071 (1.496) | 0.099** (2.088) |
| log(DURATION) | 0.146 (1.314) | 0.530*** (5.182) | 0.401*** (3.235) | 0.292*** (3.003) | 0.383*** (3.141) | 0.420*** (6.118) | 0.239** (2.284) | 0.409*** (4.069) |
| FLOATING | -0.320 (-1.568) | 0.391* (1.786) | 0.191 (0.989) | 0.426*** (3.681) | 0.240 (1.344) | 0.415*** (3.285) | 0.439** (2.089) | 0.190 (1.185) |
| COLLATERAL | -0.199 (-1.086) | 0.222*** (3.004) | -0.143 (-1.208) | 0.360*** (4.669) | -0.030 (-0.275) | 0.366*** (3.865) | 0.106 (1.279) | 0.194** (2.299) |
| PREVIOUS_ABNORMAL | 0.177* (1.662) | 0.199** (2.020) | 0.209* (1.786) | 0.301*** (3.381) | -0.292*** (-3.991) | -0.166*** (-4.047) | 0.366*** (2.864) | 0.303*** (2.984) |
| log(1+STRENGTH) | -0.192*** (-2.776) | 0.062* (1.845) | -0.019 (-0.415) | 0.049 (1.002) | -0.068 (-0.514) | 0.011 (0.087) | -0.006 (-0.137) | 0.002 (0.052) |
| OFFICER RECORD | 0.388*** (2.995) | 0.303*** (3.072) | 0.455*** (3.025) | 0.267*** (3.254) | -0.153 (-0.415) | 0.224 (0.723) | 0.279** (2.117) | 0.070 (1.158) |
| log(TA) | -0.254*** (-2.715) | -0.198*** (-4.024) | -0.269*** (-3.477) | -0.230*** (-3.757) | -0.230* (-1.852) | -0.100 (-1.302) | -0.224*** (-3.691) | -0.209*** (-3.481) |
| CASH | -0.016 (-0.090) | -0.086 (-0.873) | -0.204 (-1.207) | 0.042 (0.374) | -0.821 (-1.153) | 0.169 (0.309) | 0.042 (0.396) | -0.237* (-1.793) |
| LIABILITY | 0.622 (1.350) | -0.302 (-1.182) | -0.568 (-1.476) | 0.200 (0.631) | -0.225 (-0.691) | -0.516** (-2.289) | 0.041 (0.139) | -0.466 (-1.574) |
| TURNOVER | -0.600*** (-2.645) | -0.149* (-1.667) | -0.151 (-1.475) | -0.124 (-1.418) | 0.076 (0.995) | 0.037 (0.447) | -0.253** (-2.568) | -0.178* (-1.830) |
| ROA | 1.852* (1.892) | -1.039* (-1.944) | -1.152 (-1.280) | 0.584 (0.989) | 0.310*** (2.854) | 0.385** (2.597) | -0.624 (-0.947) | -1.243* (-1.929) |
| TANGIBILITY | -0.404 (-1.004) | -0.257 (-0.946) | -0.867** (-2.383) | -0.286 (-1.163) | -0.020 (-0.479) | 0.011 (0.312) | -0.537** (-2.352) | -0.525* (-1.742) |
| SOE | -0.087 (-0.845) | 0.111* (1.916) | | | 0.002 (0.036) | 0.274** (2.246) | 0.115 (1.501) | 0.083 (1.226) |
| $\beta_1 + \beta_2$ | 0.101 | 0.058 | 0.098 | 0.037 | 0.093 | 0.032 | 0.065 | 0.062 |
| Test of $\beta_1 + \beta_2$ (p-value) | 0.001 | 0.009 | 0.000 | 0.085 | 0.000 | 0.083 | 0.016 | 0.008 |
| Diff of β_2 (p-value) | 0.098 | | 0.087 | | 0.031 | | 0.177 | |
| Clustered by firm | Y | Y | Y | Y | Y | Y | Y | Y |
| FE-Region | Y | Y | Y | Y | Y | Y | Y | Y |
| FE-Industry | Y | Y | Y | Y | Y | Y | Y | Y |
| FE-Year-Quarter | Y | Y | Y | Y | Y | Y | Y | Y |
| Loan purpose FE | Y | Y | Y | Y | Y | Y | Y | Y |
| Number of obs | 872 | 2,494 | 1,765 | 1,602 | 2,019 | 1,346 | 1,100 | 2,268 |
| Adjusted R2 | 0.738 | 0.574 | 0.582 | 0.623 | 0.579 | 0.655 | 0.538 | 0.587 |

Table 6 Effect of the economic stimulus on the relation between loan interest rates and loan outcomes

This table reports the results from regressing abnormal loan outcomes on interest rates with a linear probability model. The dependent variable is ABNORMAL LOAN that equals one if a loan becomes abnormal subsequently and zero for otherwise. The variable of interest is INTEREST RATE (%), which is the loan interest rate at loan origination. The pre-stimulus period is from 2007/01/01 (when the borrower rating data started) to 2008/11/04, and the stimulus period is from 2008/11/05 (when the stimulus programme was announced) to 2010/12/31 (when the stimulus programme ended). STIMULUS equals one for the stimulus period and zero for otherwise. The independent variables are measured in the year end before loan granting. Standard errors are clustered at the firm level. *, **, and *** denote statistical significance level at the 10%, 5%, and 1% level, respectively.

| | Y = ABNORMAL_LOAN | | | | | |
|---------------------------------------|---------------------|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| INTEREST RATE (β_1) | 0.050*** (4.708) | 0.047*** (4.417) | 0.051*** (4.688) | 0.041*** (4.477) | 0.041*** (4.473) | 0.034*** (3.913) |
| INTEREST RATE*STIMULUS (β_2) | | 0.005 (0.734) | 0.007 (1.018) | 0.002 (0.275) | 0.002 (0.275) | -0.000 (-0.041) |
| log(AMOUNT) | | | 0.008 (1.234) | 0.006 (0.996) | 0.006 (0.995) | 0.005 (0.708) |
| log(DURATION) | | | -0.075*** (-3.633) | -0.059*** (-2.973) | -0.059*** (-2.971) | -0.055*** (-2.860) |
| FLOATING | | | -0.016 (-0.571) | -0.010 (-0.417) | -0.010 (-0.416) | -0.015 (-0.649) |
| COLLATERAL | | | 0.044** (2.448) | 0.019 (1.227) | 0.019 (1.219) | 0.005 (0.342) |
| PREVIOUS_ABNORMAL | | | | 0.423*** (6.148) | 0.420*** (5.306) | 0.399*** (5.911) |
| log(1+STRENGTH) | | | | -0.004 (-0.507) | -0.004 (-0.506) | -0.014* (-1.835) |
| OFFICER RECORD | | | | | 0.005 (0.067) | 0.005 (0.089) |
| log(TA) | | | | | | -0.061*** (-3.878) |
| CASH | | | | | | -0.012 (-0.959) |
| LIABILITY | | | | | | -0.018 (-0.736) |
| TURNOVER | | | | | | 0.156* (1.866) |
| ROA | | | | | | -0.039** (-2.073) |
| TANGIBILITY | | | | | | -0.559*** (-3.338) |
| SOE | | | | | | 0.019 (0.357) |
| $\beta_1 + \beta_2$ | / | 0.052 | 0.058 | 0.043 | 0.043 | 0.034 |
| Test of $\beta_1 + \beta_2$ (p-value) | / | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| FE-Region | Y | Y | Y | Y | Y | Y |
| FE-Industry | Y | Y | Y | Y | Y | Y |
| FE-Year-Quarter | Y | Y | Y | Y | Y | Y |
| Loan purpose FE | Y | Y | Y | Y | Y | Y |
| Number of obs | 3,387 | 3,387 | 3,370 | 3,370 | 3,370 | 3,370 |
| Adjusted R ² | 0.382 | 0.382 | 0.387 | 0.496 | 0.496 | 0.532 |

Table 7 Effect of the economic stimulus programme on the relation between ratings and loan outcomes

This table reports the results from regressing abnormal loan outcomes on internal ratings with a linear probability model. The dependent variable is ABNORMAL LOAN that equals one if a loan becomes abnormal subsequently and zero for otherwise. The variable of interest is RATING, which ranges from 1 to 15 with 15 indicating the highest credit risk. A higher value of RATING indicates a lower level of creditworthiness. The pre-stimulus period is from 2007/01/01 (when the borrower rating data started) to 2008/11/04, and the stimulus period is from 2008/11/05 (when the stimulus programme was announced) to 2010/12/31 (when the stimulus programme ended). STIMULUS equals one for the stimulus period and zero for otherwise. The independent variables are measured in the year end before loan granting. Standard errors are clustered at the firm level. *, **, and *** denote statistical significance level at the 10%, 5%, and 1% level, respectively.

| | Y = ABNORMAL LOAN | | | | | |
|---------------------------------------|---------------------|---------------------|----------------------|---------------------|---------------------|-----------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| RATING (β_1) | 0.062*** (8.502) | 0.062*** (6.402) | 0.061*** (6.193) | 0.048*** (6.244) | 0.049*** (6.255) | 0.044*** (5.573) |
| RATING*STIMULUS (β_2) | | -0.000 (-0.039) | -0.000 (-0.052) | -0.000 (-0.032) | -0.000 (-0.058) | -0.001 (-0.202) |
| log(AMOUNT) | | | 0.004 (0.741) | 0.003 (0.707) | 0.003 (0.711) | 0.003 (0.571) |
| log(DURATION) | | | -0.032** (-1.967) | -0.027* (-1.701) | -0.027* (-1.699) | -0.029* (-1.750) |
| FLOATING | | | -0.017 (-0.676) | -0.014 (-0.647) | -0.014 (-0.657) | -0.014 (-0.630) |
| COLLATERAL | | | 0.021 (1.307) | 0.006 (0.392) | 0.006 (0.410) | 0.002 (0.128) |
| PREVIOUS_ABNORMAL | | | | 0.335*** (6.094) | 0.346*** (6.096) | 0.342*** (6.170) |
| log(1+STRENGTH) | | | | -0.009 (-1.314) | -0.009 (-1.328) | -0.013* (-1.826) |
| OFFICER RECORD | | | | | -0.018 (-0.356) | -0.014 (-0.273) |
| log(TA) | | | | | | -0.040*** (-2.763) |
| CASH | | | | | | -0.002 (-0.168) |
| LIABILITY | | | | | | 0.014 (0.620) |
| TURNOVER | | | | | | 0.069 (0.856) |
| ROA | | | | | | -0.000 (-0.002) |
| TANGIBILITY | | | | | | -0.368** (-2.432) |
| SOE | | | | | | 0.035 (0.716) |
| $\beta_1 + \beta_2$ | / | 0.062 | 0.061 | 0.048 | 0.049 | 0.043 |
| Test of $\beta_1 + \beta_2$ (p-value) | / | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| FE-Industry | Y | Y | Y | Y | Y | Y |
| FE-Year-Quarter | Y | Y | Y | Y | Y | Y |
| FE-Region | Y | Y | Y | Y | Y | Y |
| Loan purpose FE | Y | Y | Y | Y | Y | Y |
| Number of obs | 3,387 | 3,387 | 3,370 | 3,370 | 3,370 | 3,370 |
| Adjusted R ² | 0.506 | 0.506 | 0.495 | 0.561 | 0.561 | 0.571 |

APPENDIX 1: Variable Definitions

| Variable | Name | Details |
|---------------------------------|--|---|
| STIMULUS | Stimulus programme indicator (1/0) | The pre-stimulus period is from 2007/01/01 (when the borrower rating data started) to 2008/11/05 (when the stimulus programme was announced), and the stimulus period is from 2008/11/05 to 2010/12/31 (when the stimulus programme ended). STIMULUS equals 1 for the post-stimulus period and 0 for otherwise. |
| <i>Loan characteristics</i> | | |
| RATING | Internal rating | The internal rating is given by the bank's credit rater to a borrower, which ranges from 1 to 15 with 15 indicating the highest credit risk. |
| INTEREST RATE (%) | Loan interest rate (%) | Interest rate at loan origination. |
| log(AMOUNT) | Log(Loan amount) | The log of actual loan size in million RMB. |
| log(DURATION) | Log(Loan duration) | The log of loan period in months. |
| FLOATING | Floating indicator (1/0) | A dummy variable that equals one if the loan interest rate is a floating rate, and zero otherwise. |
| COLLATERAL | Collateral indicator (1/0) | A dummy variable that equals one if a loan is collateralized, and zero otherwise. |
| LOAN PURPOSE | Loan purposes | Dummy variables that equal one for normal working capital, long-term working capital, and others, respectively. |
| PREVIOUS ABNORMAL | Previous abnormal loan indicator (1/0) | A dummy variable that equals one if a borrower's previous loan became abnormal, and zero otherwise. |
| log(1+STRENGTH) | The logarithm of the strength of the bank's relationship with a borrower | Log (1 + total number of previous loans) |
| <i>Borrower characteristics</i> | | |
| log(ASSET) | Log (assets) | Log (total assets), and the data are from CSMAR. |
| CASH | Cash to current liabilities ratio | Cash and cash equivalents / current liabilities, and the data are from CSMAR. |
| LIABILITY | Total liabilities ratio | Total liabilities / Total assets, and the data are from CSMAR. |

| | | |
|--|---|---|
| TURNOVER | Total asset turnover ratio | Sales income / total assets, and the data are from CSMAR. |
| ROA | Return on asset | (Total profits + financial expenses) / total assets in the beginning of the year, and the data are from CSMAR. |
| TANGIBILITY | Tangible assets ratio | Net fixed assets/total assets, and the data are from CSMAR. |
| SOE | SOE indicator (1/0) | A dummy variable that equals one if the borrower is a SOE, and zero otherwise. Information on SOEs is from loan data, or from CSMAR when it is missing in loan data. |
| PRIORITY | Priority industry indicator (1/0) | A dummy variable that equals one if the industry is among the stimulus programme supported industries including road transport, urban public transport, port industry, air transport, civil engineering construction, production and supply of electric power and thermal power, railway, shipbuilding, aerospace and power transmission & distribution. Source: the National Development and Reform Commission (NDRC). |
| HIGH MARKETIZATION | Credit allocation marketization indicator (1/0) | A dummy variable that equals one if the bank branch is located in a province with a high marketization index on credit allocation (over the 75 th percentile of the index). The ranking was based on Fan Gang's credit market development marketization index. |
| ABNORMAL LOAN | Abnormal loan indicator (1/0) | A dummy variable that equals one if its ex-post loan outcome belongs to 'special attention', 'substandard', 'doubtful', or 'loss-incurring', and zero for otherwise. |
| <i>Other Information Characteristics</i> | | |
| OFFICER RECORD | Loan officer's previous abnormal loan indicator (1/0) | A dummy variable that equals one if the previous loan handled by a loan officer goes abnormal, and zero for otherwise. |
| RATER RECORD | Credit rater's previous abnormal loan indicator (1/0) | A dummy variable that equals one if the previous loan rated by a credit rater goes abnormal, and zero for otherwise. |
| NEW PAIR | Working relationship indicator (1/0) | A dummy variable that equals one if the loan officer and the credit rater have not worked on loan before, and zero for otherwise. |