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Struggle for survival in credit crunch: The effect of interest rate deregulation in China

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ABSTRACT

This study investigates how interest rate deregulation affects firms' financing choice between bank debt and public debt. Our analysis exploits China's 2013 bank interest rate floor deregulation as an exogenous shock to the supply of bank credit. Using a difference-in-difference design, we find that firms with higher default risk substitute away from bank loan and switch to public debt after the 2013 deregulation. However, this substitution to public debt is limited, leading to a dramatic decline in debt ratio. Our result also demonstrates that the effect on firms' public debt financing is more pronounced for firms with better information environments, suggesting that good information environment is an important prerequisite for making the switch. This switching, contradicting to traditional financing framework that high-risk firms prefer bank loans, inevitably is costly. Compared with low-risk firms, bonds issued by high-risk firms have significantly higher spreads, a higher likelihood of being secured, and a higher tendency of including an interest-adjusted clause. More importantly, we also document that high-risk firms subsequently improve their information transparency after the interest rate deregulation. Our findings highlight the role of interest rate deregulation in firms' financing choice and illustrate that firms incur high switching costs when their choice deviates from the optimal financing choice.

1. Introduction

The choice between bank debt and public debt is an important topic in finance, as both bank loans and public debt are major sources of corporate financing. Even though both are vital sources of debt financing, there is still heterogeneity between them which has been recognized by quite a few theoretical papers (Bolton & Freixas, 2000; DeMarzo & Fishman, 2007; Diamond, 1991; Diamond, 1993) and empirical papers (Almazan & Suarez, 2003; Bharath, Sunder, & Sunder, 2008; Cantillo & Wright, 2000; Chen, Ma, & Wu, 2019; Denis & Mihov, 2003; Li, Lin, & Zhan, 2018; Liberti & Sturgess, 2018; Lin, 2016; Lin, Ma, Malatesta, & Xuan, 2013; Meneghetti, 2012; Sakai, Uesugi, & Watanabe, 2010). Taken as a whole, bank lenders have superiority in assessing private information, monitoring moral hazard, renegotiating as well as reducing the public disclosure-related cost, while the public lenders have different advantages, such as saving intermediation costs, monitoring costs for quality firms, and requiring less control over borrowers' investment decision.

Understandably, firms with different characteristics may make a different choice among these two patterns. Theoretically, high-risk firms benefit from using bank loans for banks' better capacity to evaluate and for firms' higher reputation acquisition, lower

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renegotiation cost, and lower disclosure; low-risk firms, however, favor public debt for avoiding intermediation cost, monitoring cost, and bank's control over firms' investment project (Berlin & Loeys, 1988; Chemmanur & Fulghieri, 1994; Dhaliwal, Khurana, & Pereira, 2011; Diamond, 1991; Houston & James, 1996; Krishnaswami, Spindt, & Subramaniam, 1999; Li et al., 2018; Ma, Stice, & Williams, 2019; Rajan, 1992). Specifically, the findings of Chemmanur and Fulghieri (1994) suggest that firms in financial difficulties favor bank debt over bonds because banks are better able to assess their financial situation. Diamond (1991) and Ma et al. (2019) assume that firms that benefit from the screening and monitoring skills of banks could acquire a reputation by taking on costly bank debt. When confronted with insolvent firms, Chemmanur and Fulghieri (1994) believe that banks will renegotiate rather than liquidate, which is advantageous to insolvent firms. On top of that, borrowing from private lenders is optimal when public disclosure is costly for some firms, such as those in poor information environments (Krishnaswami et al., 1999), and those with fear of the leakages of proprietary information (Dhaliwal et al., 2011). However, low-risk firms assign less value than high-risk firms to the bank loan's evaluation skills and monitoring role, since they have already owned good reputations and are less likely to run into inefficient liquidation. What's more, the cost of bank loan is higher than public debt, owing to the intermediation cost involved (Li et al., 2018) and the premium paid for the bank's monitoring role (Berlin & Loeys, 1988). Alternatively, public lenders have less oversight and control over a firm's investments than bank lenders, so low-risk firms prefer bond financing over bank loans (Houston & James, 1996; Rajan, 1992).

However, this traditional financing framework can be broken into certain scenarios. As summarized in Becker and Ivashina (2014), when the supply of bank credit is constrained, some firms that could have gotten access to bank loan have to switch to bond. For example, at times when bank lending standards get tighter, monetary policy unexpectedly tightens or the non-performing loan (the loan loss provision) of banks increases, the accessibility of bank loan for firms reduces, and the substitution of bank loans with bonds occurs. Fernández, González, and Suárez (2018) also find that the financial crisis will prompt firms reliant on bank loans to replace bank debt with non-bank debt. Goel and Zemel (2018) argue that since the cost of bank loan relative to bond increases during the crisis, some firms shift from bank loan to bonds and they suffer less in output, investment, and employment than others. In this paper, we observe that the 2013 deregulation adversely affects the willingness of the bank to lend to high-risk firms. Building on these studies, we cast new light on the relationship between the interest rate deregulation shock and the high-risk firm's financing choice.

Lenders' earnings are mainly embodied in interest. In a perfect loan contract, the borrower's risk is proportional to the interest rate, which indicates that high-risk borrowers have to pay a higher interest rate in equilibrium, while low-risk borrowers could take advantage of lower loan interest. However, in an economy where the adjustment of interest rate is limited, this equilibrium may be broken. Imaginably, when there is a lower limit for interest rate, low-risk firms have less propensity to choose bank loan since banks can't reduce the interest rate at will and low-risk firms can't get the loans at an extremely low cost. After the 2013 deregulation, the optimal equilibrium can be achieved in the credit market, where banks compete for low-risk firms at a lower interest rate. Remarkably, it will lead to the situation that the low-risk firms get more bank loans, while the high-risk firms get less. To raise new financing, high-risk firms may turn to other financing channels. In this paper, we empirically examine the influence of China's 2013 interest rate floor deregulation on high-risk firms' financing choice between bank debt and public debt.

It's worth mentioning that, on one hand, the interest rate deregulation is exogenous to firms' financing behaviors, since it's independent of any firm idiosyncrasy or specific problem. In effect, it's put forward for the building of a market-oriented interest rate formation mechanism and is regarded as a significant component of China's financial reform. As Qian, Strahan, and Yang (2015) and Chen et al. (2019) point out, the implementation of this reform is not triggered by any specific problems and it is implemented during a period of stable economic growth and there was no obvious credit demand shock around the event.

On the other hand, the interest rate deregulation would have a huge impact on firms' financing behaviors since bank credit is the most significant financing resource in China. Although this reform does not officially identify which firm would be affected, we regard firms with high default risk as most impacted by this reform. This is because banks usually treat a firm's default risk as the most important indicator to make their lending decisions.

Based on these, we classify the sample into a treatment group and a control group according to the firms' risk level. Using a DID design, we compare the change in public debt between the treatment group and the control group. We focus on A-share listed firms between 2009 and 2016, using 2009–2012 as the pre-period and 2013–2016 as the post-period. Our findings indicate that firms with higher default risk have fewer bank loans, and they significantly increase their use of public debt financing after the 2013 deregulation and this result holds up to a variety of robustness checks. However, this substitution to public debt is limited, leading to a dramatic decline in the debt ratio. We also find that the effect of interest rate deregulation on firms' bond financing is more pronounced for those with better information environments, suggesting that a good information environment is an important prerequisite for making the switch.

Just as mentioned before, some adjustments around credit supply will result in non-optimal financing choices. Specifically, high-risk firms should have preferred bank loans over bonds, however, they move away from bank loan financing and toward public debt, which can be regarded as a non-optimal financing choice (Chemmanur & Fulghieri, 1994; Lin et al., 2013). What's the outcome of choosing a non-optimal financing choice? Based on 1639 bond samples issued from 2009 to 2016, we find that compared with low-risk firms, bonds issued by high-risk firms have higher spreads, a higher likelihood of being secured, and a higher tendency of including an interest-adjusted clause. Thus, we conclude that firms incur high switching costs when their choice deviates from the optimal financing choice. Finally, we also document that high-risk firms subsequently improve their information transparency after the reform, which indicates that high-risk firms initiatively improve their information environment to facilitate their follow-up financing.

Our research contributes to the existing literature in the following respects. Firstly, a rising number of studies are exploring the factors that influence a firm's decision to borrow from banks or issue public debt. The internal factors shown to influence this choice include size, cash available (Cantillo & Wright, 2000), leverage (Almazan & Suarez, 2003), age (Sakai et al., 2010), state ownership (Pessarossi & Weill, 2013), the amount issued (Liberti & Sturgess, 2018), credit quality (Diamond, 1991; Denis & Mihov, 2003;

Bharath., Sunder, & Sunder, 2008), internal control quality (Arena & Howe, 2009), collateral value (Lin, 2016), managerial incentives (Meneghetti, 2012) and ownership structure (Lin et al., 2013), etc. Regarding the external factors, the information environment (Dhaliwal et al., 2011; Krishnaswami et al., 1999; Li et al., 2018), tough lending standards, contractionary monetary policy (Becker & Ivashina, 2014), economic crisis (Goel & Zemel, 2018), and market competition for products (Boubaker, Saffar, & Sassi, 2018) are important drivers of the switch between bank loans and public debt. In this study, we extend this research by giving unique evidence that this reform, through affecting the availability of bank loans, alters a firm's financing choice between bank debt and public debt.

Secondly, this research prompts new thinking for the matching of firm risk and financing choice. Theoretically, high-risk firms prefer bank loans over bonds, however, an unexpected shock in credit supply might distort this matching relation and result in a non-optimal financing choice. Our results show that when the interest rate floor deregulation breaks the original credit supply equilibrium, high-risk firms move away from bank loans and toward public debt. This choice obviously shifts away from the optimal financing choice suggested by prior literature (Becker & Ivashina, 2014; Bolton & Freixas, 2000; Chemmanur & Fulghieri, 1994; Denis & Mihov, 2003; Goel & Zemel, 2018; Petersen & Rajan, 1994), and therefore, those high-risk firms incur a higher cost. Accounting for the direct and indirect costs of public debt financing, such as higher spread and stricter nonprice contract terms, supports our inference and suggests that this switching is quite costly.

Thirdly, our paper also adds to the studies on the real outcome affected by financial exogenous shocks. The majority of research finds that financial exogenous shocks have influences on the firms' performance. The financial crisis, according to Kestens, Van Cauwenberge, and Bauwhede (2012), has a negative impact on business profitability. Goel and Zemel (2018) document that notwithstanding higher debt costs incur during economic recessions, firms that transition from loans to bonds have no major reductions in output, investment, and employment when compared to firms that issued bonds or loans predominantly. However, there are also some different conclusions, for example, Chava and Purnanandam (2011) and Chodorow-Reich (2014) show that during the downturn in bank credit supply, firms that have access to bond issuance see a drop in valuation, capital expenditure, and employment. We give a supplement to the understanding of the consequence of financial exogenous shock. Principally, we show that the switch from bank loan to public debt driven by the interest rate floor deregulation not only imposes higher spreads but also increases the constraints on high-risk firms in the form of non-price clauses. To alleviate the suffering, high-risk firms are encouraged to improve information quality.

2. Institutional background, related literature, and hypotheses

Interest rate liberalization, originating in western countries in the 1980s, is regarded as a significant reform in financial markets. Not only can it adjust supply-demand relations for capital in the credit market, but it also helps to match interest rates with credit risk so as to reduce credit market frictions. However, there also exist some problems during this process, such as greater fluctuation of interest rate and fiercer competition among banks (Barajas, Steiner, & Salazar, 2000). In order to decrease the financial risk that comes with it, China's regulators advance the interest rate deregulation over a period of 20 years in a progressive way. The People's Bank of China (PBOC) abolished the interest rate limitations on interbank lending in June 1996, marking the start of China's interest rate deregulation. In Oct 2004, the PBOC liberalized its control over the ceiling on bank lending interest rates but still maintains control over the floor limit. It means that banks are entitled to loan funds to high-risk firms at a higher interest rate as risk compensation, while they are not permitted to lend at lower interest rates to low-risk firms. This situation has changed since repeated interest rate cuts happened in 2012. Subsequently, the PBOC announced the elimination of the bank lending interest rate floor in July 2013. This reform authorizes banks to set their own interest rates without lower limits. These significant changes facilitate banks to drive down prices and widen their appeal to low-risk customers. In this background, low-risk firms with strong bargaining power have more alternatives with respect to choosing lending institutions, thereby intensifying the competition of banks (Barajas et al., 2000). The low-interest rate also brings more low-risk firms piling into the credit market and they would get more access to bank loans. Supposed that banks are only authorized certain line of credit, the availability of high-risk firms' credit reduces.

As previously discussed, bank lenders have a huge edge over public debtors in terms of access to private information (Chemmanur & Fulghieri, 1994; Fama, 1985), monitoring efficiency (Diamond, 1984; Boyd & Prescott, 1986; Berlin & Loeys, 1988; Diamond, 1991; Ma, Stice, & William, 2019), the efficiency of liquidation and renegotiation in financial distress (Chemmanur & Fulghieri, 1994; Gertner & Scharfstein, 1991), and lower disclosure-related cost (Dhaliwal et al., 2011; Krishnaswami et al., 1999). Banks have a long-term engagement in the debt market and a strong ability to identify risk, therefore they are willing to make an effort in the evaluation of the borrowers' position, even the firms in financial trouble. However, fragmented ownership of public bondholders exacerbates free-rider problems and reduces the incentive for individual bondholders to participate in costly monitoring (Berlin & Loeys, 1988; Diamond, 1984; Houston & James, 1996; Li et al., 2018).

From the borrower's point of view, a bank lender is a good helper, especially for firms with high risk. The reason for a firm plunging into financial trouble could be that it is underperforming, or it could be due to other objective causes that have nothing to do with how the firm operates. If the latter, the firm may be still with promising potential and deserve continuing financing support. However, evaluating the firms' position properly requires a high capacity to obtain information and even more effort to distinguish them. Fittingly, the ability of banks could help to evaluate the high default risk firm's financial position more accurately and make it stand a better chance of getting financial funds. Consequently, firms in poor financial positions prefer to obtain loans over issuing bonds (Bolton & Freixas, 2000; Chemmanur & Fulghieri, 1994; Denis & Mihov, 2003).

Nevertheless, this tradeoff might be broken due to the interest rate floor deregulation. The PBOC announced the elimination of the bank lending interest rate floor on July 20, 2013. It means that the space for financial institutions and borrowers to negotiate pricing will be further expanded, which facilitates financial institutions to adopt differentiated pricing strategies. In this context, this reform

breaks the original credit supply equilibrium and commercial banks are willing to provide more credit for low-risk firms because of the lower non-performing loan ratio.[1]

On the contrary, the 2013 deregulation will cause high-risk firms to be confronted with reduced bank loans. On one hand, bank competition for low-risk borrowing firms could be boosted following the reform. Firms with lower default risk have greater bargaining power in acquiring loans and be able to acquire loans at cheaper interest rates. On the other hand, the lower interest rates further stimulate low-risk firms to enter the credit market and even demand more bank credits in excess of their own needs. Therefore, we expect that high-risk firms will obtain fewer bank loans after the 2013 deregulation and switch more to public debt in response. Based on the preceding analysis, we formulate the following hypothesis:

Hypothesis 1. High-risk firms rely more on public debt and less on bank loan after the removal of the bank lending interest rate floor.

It is worth noting that this switching is not as easy as we think and it may even impose a higher cost on high-risk firms. On the base of the previous analyses, we should be aware that bank loans are supposed to be a more appropriate financing choice for high-risk firms because banks tend to understand firms in financial distress more compared to public debt. Due to the 2013 deregulation, we expect that the financing choice of the high-risk firms is forced to make an adjustment, switching from bank loans to public debt. Obviously, this switching is a shift away from the optimal financing choice suggested by Bolton and Freixas's (2000) framework, where high-risk firms should have preferred bank loans over bonds. Understandably, with a non-optimal financing framework, high-risk firms may pay price for it.

As suggested by the literature, banks can gain better access to borrowers' private information and prospects that are not otherwise publicly available and at a lower cost (Fama, 1985). Lower information costs could be translated into lower prices for the services (Fama, 1985). In the contrast, bondholders, a dispersed group of investors are significantly more reliant on information from publicly available sources which is often fragmentary, and in the meanwhile, it indicates that the cost of obtaining information is more expensive for public bondholders than for banks. As a result, public debt involves high information costs that make it an uneconomical way of financing, especially for high-risk firms. From this perspective, it provides evidence that switching to public debt, away from optimal choice, should be costly for high-risk firms.

From another point of view, bank lenders have a greater advantage in terms of supervisory efficiency compared to public debt and can be helpful to lower a firm's debt agency cost (Berlin & Loeys, 1988; Boyd & Prescott, 1986; Diamond, 1984). In comparison, public bondholders, a dispersed group of investors, only have limited information and are in shortage of supervision motivation. They usually have trouble restraining the moral hazard behaviors of high-risk firms. It can be implied that public bondholders' monitoring managerial actions have little effect on reducing agency costs compared to bank lenders. Consequently, it's reasonable that firms at a high level of risk are supposed to take bank loans as a better choice but not public debt. Considering that, switching from bank loan to public debt may lead to a higher cost. Based on the discussion above, we propose our hypothesis as follows:

Hypothesis 2. Compared with low-risk firms, high-risk firms incur a higher cost of public debt financing after the 2013 deregulation.

3. Data and methodology

3.1. Sample selection

In this paper, we utilize a unique financial regulation change in China: the removal of the bank lending interest rate floor, which came into effect in July 2013, as a quasi-natural experiment to explore how interest rate floor deregulation shapes firms' financing choice.[2] Our sample consists of all A-share listed firms from 2009 to 2016. We exclude financial firms and ST firms. We also eliminate firm-years that have non-positive shareholders' equity or that are missing necessary data used in this paper. In addition, to ensure that

[1] It should be noted that even though loan contracts to low-risk firms entail some extent of profit concessions by banks, they are still the customers that banks chase. From the bank's point of view, having healthy and sustainable profitability is critical to preserving the stability of the banking system (García-Herrero, Gaviláb, & Santabárbara, 2009). Accordingly, risk control ability is an essential facet of bank performance evaluation, where banks are obliged to account for lending risks when making lending decisions. Moreover, in practice, a bank's ability to manage risk will have an impact on its profitability, for instance, a bank with poor asset quality limits its profitability because it restricts the bank's pool of loanable resources. More importantly, the banking system in China has long been a pathway to transfer substantial savings for achieving public policy objectives (García-Herrero et al., 2009). Besides, the banks have high barriers to competition, as evidenced by the persistence of their high profitability (García-Herrero et al., 2009), implying that their profitability is subject to government intervention to some extent. When considering the trade-off between risk and return, banks often tend to pursue profit maximization within a certain risk profile. The contracts with high-quality firms are usually a long-term source of quality profits for them, even if they are thin but healthy and sustainable. What's more, the number of quality customers is also an important aspect of banks' performance assessment as well as a support for their competitive advantage. Therefore, quality firms are usually the customers that banks are eager to secure. In addition, stable and safe interest income can provide banks with a capital base, hence banks are more than willing to pursue a quality customer despite the squeeze on interest income, whereas more consideration needs to be given to credit risk for high-risk firms. We thank the anonymous reviewers for their constructive comments.

[2] In fact, the interest rate deregulation includes two events, the removal of the interest rate ceiling, effective in 2004, and the removal of the interest rate floor, effective in 2013. The reason why we just focus on the latter is that public debt financing is not popular in the early stages. For example, the first corporate bond was issued in 2007 and until 2010, the corporate bond was gradually becoming an important financing resource for firms. Combing our research questions, we solely focus on the deregulation of the interest rate floor.

firms have data for the period before and after the reform both, we exclude firms that are only available in the pre-event or post-event periods. After these exclusions, our final sample includes 14,331 firm-years, which is used to examine firms' financing choice. As for bond regression, the basic unit of the empirical analysis is a bond, and the types of bonds covering from corporate bond, enterprise bond, medium-term note (MTN), and short-term commercial paper (SCP). We apply the same filter as before and we are left with 1639 bonds, of which 444 bonds are initiated before the 2013 deregulation and 1195 are initiated after the deregulation. The issue dates of these bonds range from 2009 to 2016. The financial data comes from CSMAR database and the bond issuance information is obtained from iFinD database. All continuous variables are winsorized at the 1% and 99% levels to reduce the impact of outliers.

3.2. Research design

As a preliminary test, we first examine the influence of the 2013 deregulation on bank loan availability. Since many studies use the Z-score defined by Altman (1968), which is normally seen as "the most widely used financial distress measure" (Ashbaugh-Skaife, Collins, & Kinney Jr, 2007), we also use this indicator to capture firm's default risk. We classify our sample into treatment and control groups based on the industry median value of Z-score before the deregulation. *Treat* is a dummy variable, which equals one if a firm's average Z-score before the 2013 deregulation is below industry median value, and zero otherwise. The main empirical model is as follows:

$$Loan = \beta_0 + \beta_1 Treat \times Post + \beta_2 Size + \beta_3 Lev + \beta_4 Roa + \beta_5 Tobin^{'}s\ Q + \beta_6 Growth + \beta_7 Tangibility + \beta_8 Loss + \beta_9 Vol\_Stock + \beta_{10} SOE + \beta_{11} TC + Firm\ fixed\ effects + Year\ fixed\ effects + \varepsilon \quad (1)$$

where *Loan* is bank debt financing, which equals the sum of short-term and long-term loans divided by firm assets. *Post* is a dummy variable that equals one if an observation falls in the post-period (i.e., 2013–2016), and zero otherwise. Following prior literature (Chen et al., 2019; Li et al., 2018), we include firm controls in the model, such as firm size (*Size*), leverage (*Lev*), return on asset (*Roa*), investment opportunity (*Tobin's Q*), sales growth (*Growth*), firm tangible assets (*Tangibility*), earning loss (*Loss*), volatility of stock return (*Vol_Stock*), and state ownership (*SOE*). Chen et al. (2019) find that after the 2013 deregulation, bank credit and trade credit can substitute for one another, thus we control for firm's trade credit (*TC*). We also include firm- and year-fixed effects in the model. Appendix A contains detailed variable definitions.

The coefficient on the interaction term, β_1, captures the change in bank loans for our high-risk firms relative to the change for our low-risk firms subsequent to the interest rate deregulation. In all analyses, we report heteroskedasticity-consistent standard errors clustered at the firm level.

We further implement a DID methodology to explore the impact of the 2013 deregulation on public debt financing. The model is as follows:

$$Bond = \alpha_0 + \alpha_1 Treat \times Post + \alpha_2 Size + \alpha_3 Lev + \alpha_4 Roa + \alpha_5 Tobin^{'}s\ Q + \alpha_6 Growth + \alpha_7 Tangibility + \alpha_8 Loss + \alpha_9 Vol\_Stock + \beta_{10} SOE + \beta_{11} TC + Firm\ fixed\ effects + Year\ fixed\ effects + \varepsilon \quad (2)$$

where *Bond* is public debt financing, which equals bonds payable divided by firm assets. Other variables are the same as Eq. 1. The coefficient on the interaction term, α_1, captures the change in public debt financing for high-risk firms relative to the change for low-risk firms subsequent to the 2013 deregulation. From our previous discussion, we expect a positive coefficient on α_1, which indicates that high-risk firms would rely on more public debt financing when faced with reduced bank loans.

3.3. Summary statistics

Panel A of Table 1 reports the results of the descriptive statistics. From this table, we find that during this period, the mean bank loan financing is 0.159 and the mean bond financing is 0.016, which indicates that compared with bond financing, firms prefer borrowing from banks. It seems reasonable since bank loans continue to be the primary source of funding for Chinese firms. The mean value of *Treat* represents that the proportion of the treatment samples to the total samples is 51.1%. As for firm characteristics, the average *Roa* is 3.8%, the average *Tobin's Q* is 2.4 and the average *Growth* is 21%. State-owned firms comprise 47% of the sample. The average value of *Lev* indicates that debt accounts for 45% of total assets on average. Turning to bond characteristics, the average *Spread* equals 1.82%. The average offering amount is approximately 0.49 billion RMB, with an average maturity of 3.71 years. *Put* has a mean value of 0.25, implying that a put option is available on 25% of bond issuance. 15% of bonds on average are secured. The mean value of *Rate* shows that, on average, bonds' credit rating is assigned to AA+. Panel B of Table 1 shows the industry distribution of our total sample and treatment sample. The majority of our sample is in the manufacturing industry, which accounts for more than 59% of the total sample. The education industry has the smallest share, which only constitutes about 0.23% of the total sample. The treatment firm-years have a similar distribution.

Table 1
Summary statistics.

Panel A: Main variables						
Variable	N	Mean	Std. Dev.	Min	Median	Max
Loan	14,331	0.159	0.143	0.000	0.134	0.579
Bond	14,331	0.016	0.039	0.000	0.000	0.176
Treat	14,331	0.511	0.500	0.000	1.000	1.000
Post	14,331	0.555	0.497	0.000	1.000	1.000
Firm characteristics						
Size	14,331	22.071	1.279	19.551	21.897	25.949
Lev	14,331	0.450	0.212	0.049	0.450	0.894
Roa	14,331	0.038	0.052	−0.151	0.033	0.206
Tobin's Q	14,331	2.434	1.682	0.960	1.872	10.697
Growth	14,331	0.210	0.582	−0.541	0.108	4.330
Tangibility	14,331	0.934	0.081	0.536	0.959	1.000
Loss	14,331	0.089	0.285	0.000	0.000	1.000
Vol_Stock	14,331	0.051	0.044	0.006	0.033	0.172
SOE	14,331	0.468	0.499	0.000	0.000	1.000
TC	14,331	0.499	0.555	0.028	0.335	3.589
Bond characteristics						
Spread	1639	1.824	1.132	0.070	1.630	5.040
BondAmt (RMB)	1639	4.87×10^8	7.87×10^8	1.50×10^7	1.50×10^8	4.00×10^9
Maturity (Year)	1639	3.711	2.283	0.230	3.000	10.000
Put	1639	0.251	0.434	0.000	0.000	1.000
Collateral	1639	0.151	0.358	0.000	0.000	1.000
Rate	1639	2.932	0.920	1.000	3.000	4.000

Panel B: Distribution by industry				
Industry	Overall		Treat	
	N	Percentage	N	Percentage
Agriculture	216	1.51%	107	1.46%
Mining and quarrying	436	3.04%	222	3.03%
Manufacturing	8481	59.18%	4359	59.56%
Utilities	602	4.20%	302	4.13%
Construction	377	2.63%	198	2.71%
Wholesale and retail trades	959	6.69%	475	6.49%
Transport, storage, and postal services	514	3.59%	253	3.46%
Accommodation and catering	60	0.42%	31	0.42%
Information transfer, software and information technology services	877	6.12%	450	6.15%
Real estate	856	5.97%	434	5.93%
Leasing and commercial services	210	1.47%	107	1.46%
Scientific research and polytechnic services	99	0.69%	45	0.61%
Administration of water, environment, and public facilities	202	1.41%	115	1.57%
Education	33	0.23%	12	0.16%
Heal care and social work	69	0.48%	35	0.48%
Culture, sports and entertainment	213	1.49%	113	1.54%
Public administration, social insurance, and social organizations	127	0.89%	61	0.83%
Total	14,331	100.00%	7319	100.00%

This table offers the descriptive statistics for the main variables used in the analysis and shows our whole sample and treatment sample by industry from 2009 to 2016. Appendix A contains detailed definitions of variables.

4. Empirical results

4.1. The effect of the removal of interest rate floor on bank debt and public debt

As a preliminary test, we are supposed that the elimination of the interest rate floor results in a change in bank lending behavior, with commercial banks being more inclined to extend more credit to low-risk firms rather than high-risk firms. In Table 2, column (1) analyzes the bank loans with *Treat* × *Post* as the only independent variable, and the regression in column (2) additionally includes firm factors and year-fixed effects. We find that the coefficients on *Treat* × *Post* are significantly negative in both columns. These results imply that, in comparison to low-risk firms, high-risk firms experience a decline in bank loan availability after the reform. This effect is also economically significant, with *Loan* decreasing by 9.4% after the reform, as shown in column (2).[3]

Next, we investigate how those high-risk firms respond when faced with reduced bank loans. Column (3) and (4) in Table 2 present

[3] 9.4% = −0.015/0.159, where −0.015 is β_1 in column (2) of Table 2, and 0.159 is the mean *Loan* for the firms in Panel A of Table 1.

Table 2
The removal of interest rate floor and debt financing: bank debt vs. public debt.

	Loan		*Bond*	
	(1)	(2)	(3)	(4)
Treat×Post	−0.033***	−0.015***	0.011***	0.005***
	(−10.155)	(−4.587)	(9.271)	(3.063)
Size		0.013***		0.008***
		(3.176)		(7.080)
Lev		0.485***		0.035***
		(33.641)		(8.289)
Roa		−0.109***		−0.029***
		(−4.614)		(−3.228)
Tobin's Q		−0.003***		−0.001*
		(−2.914)		(−1.843)
Growth		−0.008***		−0.004***
		(−5.314)		(−7.752)
Tangibility		−0.015		0.009
		(−0.753)		(1.336)
Vol_Stock		0.001		−0.001
		(0.048)		(−0.063)
Loss		0.004		0.000
		(1.185)		(0.063)
SOE		−0.015		0.006*
		(−1.557)		(1.750)
TC		−0.035***		−0.008***
		(−8.481)		(−5.274)
Constant	0.168***	−0.273***	0.013***	−0.193***
	(191.921)	(−2.722)	(38.412)	(−6.919)
Year FE	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	14,331	14,331	14,331	14,331
Adjust R^2	0.731	0.840	0.443	0.476

This table offers the results of the tests on how interest rate deregulation affects firms' financing choice. In columns (1)–(2), the dependent variable is *Loan*; in columns (3)–(4), the dependent variable is *Bond*. Appendix A contains detailed definitions of variables. *t*-statistics based on robust standard errors clustered by firm are shown in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

our results. The result indicates that high-risk firms experience a significant increase in public debt financing subsequent to the interest rate floor deregulation. This change is also economically significant, with *Bond* increasing by 31.3% after the 2013 deregulation, which is shown in column (4).[4]

The results also show that larger firms and firms with high leverage (*Lev*) are more likely to access bank loans and public debt. In addition, firms with sound financial performance (*Roa*), higher Tobin's Q, and higher growth opportunities (*Growth*) have lower bank loans and public debt. Interestingly, we also find a negative (and significant) coefficient for *TC*, which is consistent with the notion that trade credits can substitute bank loans in most cases (Chen et al., 2019) and as a form of internal financing, trade credit is complementary to external financing (Choi & Kim, 2005).

4.2. Validity and robustness checks

4.2.1. Event study

Parallel trend assumption is the most important prerequisite for DID analysis. It requires a similar trend in loan and bond variables for the treatment and control groups in the period prior to the event, which means that prior to the exogenous shock the estimator should be insignificant. Following the method of Gao and Zhang (2019), we verify the assumption in an event study framework. Specifically, we modified Eq. 1 and Eq. 2 to include indicators for pre- and post-event periods:

$$Loan = \beta_0 + \sum_{k=-3}^{3} \delta_k Treat \times Year_k + \beta_2 Size + \beta_3 Lev + \beta_4 Roa + \beta_5 Tobin's\ Q + \beta_6 Growth + \beta_7 Tangibility + \beta_8 Loss + \beta_9 Vol\_Stock + \beta_{10} SOE + \beta_{11} TC + Firm\ fixed\ effects + Year\ fixed\ effects + \varepsilon \quad (3)$$

$$Bond = \alpha_0 + \sum_{k=-3}^{3} \pi_k Treat \times Year_k + \alpha_2 Size + \alpha_3 Lev + \alpha_4 Roa + \alpha_5 Tobin's\ Q + \alpha_6 Growth + \alpha_7 Tangibility + \alpha_8 Loss + \alpha_9 Vol\_Stock + \alpha_{10} SOE + \alpha_{11} TC + Firm\ fixed\ effects + Year\ fixed\ effects + \varepsilon \quad (4)$$

[4] 31.3% = 0.005/0.016, where 0.005 is α_1 in column (4) of Table 2, and 0.016 is the mean *Bond* for the firms in Panel A of Table 1.

where $Year_k$ is an indicator for being k years from the year of adoption (k = 0 is the year of the 2013 interest rate deregulation). The baseline year 2009 (k = −4) is omitted. Conceptually, the coefficients of interest δ_k and π_k identify whether there is any difference in the bank and loan trends between the treatment and control groups prior to the interest rate deregulation. If the parallel trend assumption of our model is not violated, we would find δ_k and π_k (k = −3, −2, −1) to be statistically indifferent from zero. Further, the impact of the interest rate deregulation starts to show up following the year of adoption (k = 0), then δ_k (k = 0, 1, 2, 3) should be negative significantly and π_k (k = 0, 1, 2, 3) should be positive significantly.

We visualize the regression results in Fig. 1, where we plot the estimates of the interaction terms along with the 95% confidence interval, and the estimated effects can also be seen in Table 3. On the whole, the pre-event indicators are insignificant, suggesting that the treatment firms and control firms have a similar trend both in loan and bond prior to the interest rate deregulation. These results support the parallel trend assumption in our DID analyses. Moreover, after the 2013 interest rate reform, the coefficients become statistically significant. It indicates that the interest rate floor deregulation has a significant negative influence on the bank loan for high-risk firms, while the effect on the bond is significantly positive, which suggests a causal effect.

4.2.2. Placebo test

To mitigate the bias caused by omitted variables, we conduct a placebo test by randomly assigning treatment firms, and the similar practice is also adopted by prior literature (Gao & Zhang, 2019).

Specifically, there are 1026 high-risk firms from 2060 firms in the sample. We randomly select 1026 high-risk firms from the total 2060 firms and assign them as treatment firms, with the remaining being control firms; then we construct a fake treatment variable, i.e., $Treat_{false}$ and a fake interaction term $Treat_{false} \times Post$. In order to avoid being disturbed by any rare event, we repeat this process 500 times.

As is shown in Fig. 2, the average values are nearly zero (i.e., 0.0001407 for bank loan and 0.0000144 for bond), indicating that the false interaction terms, $Treat_{false} \times Post$ equal zero. What's more, we also plot the distribution of 500 estimated coefficients whose associated *p*-values are also shown in the figures. The distribution centers in both are extremely close to zero and most of the estimates' *p*-values are larger than 0.1. Furthermore, our true estimates (from column (2) and column (4) of Table 2, separately) are clear outliers in the placebo test. Therefore, these results show that our findings are not severely biased due to missing variables.

4.2.3. Alternative samples

To assess the robustness of our results, we re-run our analyses in alternative samples: (1) a modified sample constructed by matching each treatment firm-year with control firm-year based on propensity scores. Specifically, we following Chen et al. (2019) employ a logit model to estimate the probabilities of being a treatment firm on the same control variables as those in the baseline regression. We then use the propensity scores from this logit estimation and perform the matching (stratified by year and industry). As for the matching procedure, we adopt nearest-neighbor matching with non-replacement to match each of the observations from the treatment group within a caliper of 0.01, and we further remove observations from the treatment (control) group whose propensity scores do not fall within the common range of the two groups.

To verify the reliability of our matching procedure, we apply a balance test to check whether the treatment group has similar covariates to the matched control group. Results in Appendix B demonstrate that there is no significant difference between the two groups for most of the covariates and PSM matching significantly reduces the discrepancies between the two groups. Thus, we document that the results in general support the validity of our matching procedure;

(2) A newly-matched sample based on *Size*, *Tobin's Q*, and *Roa*, which is suggested by Li et al. (2018). Specifically, we require our treatment and control firms to be matched by industry and year. We further require them to be of the same *Size*, *Tobin's Q* and *Roa* tercile, and the deviation from the treatment firms should be within 30%. Then, we retain the five with the greatest similarity to the treatment firm by calculating the differences in those three characteristics of the treatment and control firms. We re-estimate the baseline regression with this matched sample;

(3) A modified sample that deletes the event year 2013 to avoid some confounding effects. In order to study a consistent period before and after the deregulation, we use 2010–2012 as the pre-period and 2014–2016 as the post-period.

According to our knowledge, there are two events that occurred during our sample period: the first lifting of the ceiling of deposit rates and the complete removal of the ceiling of deposit rates, which were launched in 2012 and 2015, respectively. To mitigate confounding effects contemporaneous to this interest rate deregulation reform, we further exclude two event years (i.e., 2012 and 2015);

(4) A restricted sample with firms available for bond issuance. In consideration of whether firms have qualifications to issue bonds would also interfere with our results, we exclude some firms that may have limited access to bond markets.[5]

[5] Referring to the relevant regulations of China Securities Regulatory and People's Bank of China, as well as the Securities Law and the Company Law, we restrict our sample by the criteria of firm profitability, long-term solvency, and net assets. Specifically, we define firms that have qualifications to issue bonds if they satisfy those requirements: 1) the firm's net profit is greater than 0 in the last three years; 2) the firm's asset-liability ratio is not higher than 85%; 3) the net assets of the firm is not less than 30 million yuan. Furthermore, we use stricter requirements to define firms that have qualifications to issue bonds if they satisfy those requirements: 1) the firm's average net profit in the last three years is greater than the industry median for annual interest on bonds; 2) firms' asset-liability ratio is not higher than 80%; 3) the net assets of the firm is not less than the annual industry median (in which case the minimum net assets are still higher than 30 million yuan). The qualification requirements from relevant regulations can be obtained by email contact with the author. We thank the anonymous reviewers for their constructive comments.

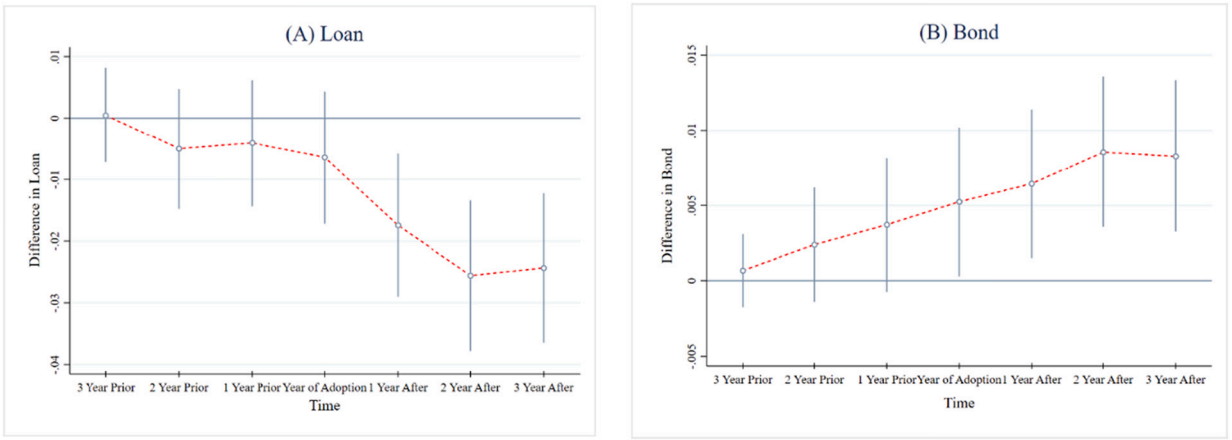

Fig. 1. Event study: Testing the parallel trend assumption.
This figure presents the event study results of interest rate deregulation and firms' financing choice. X axis is the time relative to the year of adoption. Y axis in Pic. A is the difference in *Loan* and in Pic. B is the difference in *Bond*. The red dashed lines indicate the differences in bank loan financing and the differences in bond financing as compared to the baseline year 2009. The vertical bars represent the 95% confidence intervals.

We find that no matter which alternative sample is used, the coefficient on *Treat* × *Post* in Table 4 continues to be significantly negative when the dependent variable is *Loan* and significantly positive when the dependent variable is *Bond*.

4.2.4. Dosage effect

As inspired by Campello and Larrain (2016), we remodel treatment and control groups to test the "dosage effects" of this regulation change. By comparing outcomes across different partitions of average Z-score before the deregulation, we expect that when the distance between treatment and control groups in the average Z-score distribution gets farther (closer), the difference in outcomes gets larger (smaller).In the first alternative classification, we classify the sectors as treatment group whose average Z-score before deregulation is in the lower third and the sectors as the control group whose average Z-score before the deregulation is in the upper third. In the second alternative classification, we classify the sectors as the treatment whose average Z-score before deregulation is in the lower third and the sectors as the control whose average Z-score before deregulation is in the middle third.

Table 5 reports the results. For ease of comparison, columns (1)–(2) redisplay the results for our benchmark classification. As illustrated in Table 5, columns (3)–(4) report the results for the first alternative classification. The estimations show that the effect is stronger in magnitude in the first alternative classification than in the benchmark classification. Columns (5)–(6) report the results for the second alternative classification. We find that the coefficients of all *Treat* × *Post* are statistically significant, and as expected, the effect is stronger in magnitude in the first alternative classification. In summary, the findings support the "dosage effects" that when the distance between treatment and control groups gets closer within the average Z-score distribution, the difference in outcomes gets smaller in a sensible fashion. This means that our results are robust to how we partition treatment group for testing.

4.2.5. Further robustness checks

Firstly, we use alternative proxies for bank debt and public debt financing. *LogLoan* is the natural logarithm of one plus the sum of short-term loans and long-term loans, and *LogBond* is the natural logarithm of one plus the bonds payable. Moreover, we use the items from the cash flow statement to construct cash flow indexes related to bank loan and bond financing. $Loan\_{CF}$ is the natural logarithm of one plus the cash received from the borrowings. $Bond\_{CF}$ is the natural logarithm of one plus the cash received from the issuance of bonds.[6]

Secondly, we use alternative indicators to measure firm's default risk. Those indicators are *DTD* (Distance-To-Default), *PD* (Probability of Default), *O-score*, and β, respectively. As indicated by prior literature, Merton's (1974) model is a classical model to forecast default.[7] We, therefore, adopt Merton's *DTD* to measure firm's default risk. Moreover, we use another important metric for firm's forward default probability (Duan, Sun, & Wang, 2012), *PD*, provided by the National University of Singapore-Credit Research Institute (NUS-CRI), which denotes the probability of a firm defaulting in the next 12 months.[8] Furthermore, we use an alternative accounting-based indicator, *O-score*, as a measure of firm default risk (Ohlson, 1980). In addition, β is an important index representing

[6] We thank the anonymous reviewers for their constructive comments.

[7] Some literature even provides another modified model, such as KMV-Merton model on the basis of the standard Merton model. Using KMV-Merton model to measure firm's default risk, we find the main results still remain (available upon request). We thank the anonymous reviewers for their constructive comments.

[8] The CRI database, a Credit Research Initiative started by National University of Singapore, is available at: http://nuscri.org. Un-tabulated results show that the results are still robust when we alternatively use 24-month, 36-month probability of default data (*PD*) to measure default risk.

Table 3
Event study.

	Loan	*Bond*
	(1)	(2)
Treat×*Year*$_{-3}$	0.000	0.001
	(0.124)	(0.545)
Treat×*Year*$_{-2}$	−0.005	0.002
	(−1.008)	(1.241)
Treat×*Year*$_{-1}$	−0.004	0.004
	(−0.782)	(1.636)
Treat×*Year*$_{0}$	−0.006	0.005**
	(−1.171)	(2.073)
Treat×*Year*$_{1}$	−0.017***	0.006**
	(−2.951)	(2.552)
Treat×*Year*$_{2}$	−0.026***	0.009***
	(−4.117)	(3.363)
Treat×*Year*$_{3}$	−0.024***	0.008***
	(−3.951)	(3.234)
Size	0.013***	0.008***
	(2.998)	(7.179)
Lev	0.482***	0.035***
	(33.252)	(8.187)
Roa	−0.105***	−0.029***
	(−4.472)	(−3.303)
Tobin's Q	−0.003***	−0.001*
	(−3.110)	(−1.764)
Growth	−0.008***	−0.004***
	(−5.324)	(−7.726)
Tangibility	−0.015	0.009
	(−0.740)	(1.345)
Vol_Stock	0.003	−0.001
	(0.113)	(−0.066)
Loss	0.004	0.000
	(1.289)	(0.007)
SOE	−0.015	0.006*
	(−1.616)	(1.787)
TC	−0.035***	−0.008***
	(−8.485)	(−5.253)
Constant	−0.295***	−0.191***
	(−2.820)	(−6.552)
Year FE	Yes	Yes
Firm FE	Yes	Yes
Observations	14,331	14,331
Adjust R^2	0.840	0.476

This table offers the results of the event study. In column (1), the dependent variable is *Loan*; in column (2), the dependent variable is *Bond*. The indicator variables, $Year_k$ (k = −3, −2, −1, 0, 1, 2, 3), flag years 2010–2016, respectively. The year 2009 (k = −4) is the baseline year. Others are same to the note of Table 2.

the possibility of the firm going bankrupt. Higher values of *DTD*, *PD*, *O-score*, and β imply a greater risk of bankruptcy and default for the firm.

Last but not least, equity financing is another important financing method aside from debt financing. To control for the effect of equity financing, we additionally construct two variables, one is *Equity_stock* which is the difference between owners' equity and retained earnings divided by total firm assets and another one is *Equity_flow* which equals the natural logarithm of one plus the cash received from absorption of equity investments.

In Table 6, we find all are in line with our expectations. In sum, the effect of interest rate floor deregulation on firms' financing choice is robust to a variety of robustness checks.

4.3. The effect of the removal of the interest rate floor on the debt level

In this paper, we find that high-risk firms significantly increase public debt financing when faced with reduced bank loans. Here, we are interested in exploring whether the increased amount of public debt can fully recover reduced bank loans for high-risk firms. As previous literature documented, bonds and loans are not completely interchangeable sources of credit since they are systematically different from each other (Bolton & Freixas, 2000; Denis & Mihov, 2003; Diamond, 1991; Faulkender & Petersen, 2006; Goel & Zemel, 2018). We therefore speculate firms' substitution toward bond is limited.

Specifically, we examine how debt level changes after the reform. We employ the same model as Eq. 1 but with *Debtlev* and $\triangle$*Debtlev* as dependent variables, respectively. *Debtlev* is the sum of bank loan financing (*Loan*) and public debt financing (*Bond*).

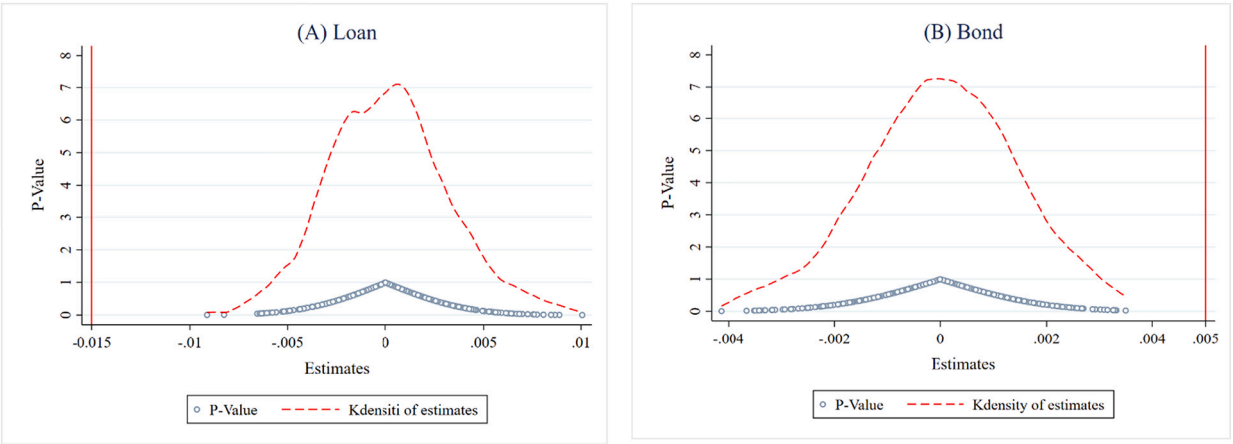

Fig. 2. Placebo test.
These figures present the results of the placebo test. We randomly assign treatment firms, construct a fake treatment variable *Treat*$_{false}$ and a fake interaction term *Treat*$_{false}$ × *Post* and run the regressions for *Loan* and *Bond* respectively. After repeating these processes 500 times, we acquire 500 estimates of *Treat*$_{false}$ × *Post*. The X-axis presents the estimated coefficients and the Y-axis presents the p-values of the false interaction term respectively. The red dashed curve is the kernel density distribution of the estimates, whereas the blue dots are associated p-values. The red solid line is the true estimate from column (2) and column (4) of Table 2.

Table 4
Alternative samples.

	Loan					
	PSM	Matched sample	Delete 2013	Excluding confounding events	Restricted sample 1	Restricted sample 2
	(1)	(2)	(3)	(4)	(5)	(6)
Treat×*Post*	−0.015***	−0.013***	−0.020***	−0.013***	−0.012***	−0.015***
	(−2.673)	(−3.934)	(−5.183)	(−3.348)	(−3.304)	(−3.040)
Constant	−0.536***	−0.233**	−0.240**	−0.274**	−0.147	0.153
	(−3.224)	(−2.364)	(−2.302)	(−2.527)	(−1.227)	(0.736)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4146	13,431	12,279	10,325	8347	3787
Adjust R^2	0.798	0.846	0.831	0.829	0.836	0.854
	Bond					
	PSM	Matched sample	Delete 2013	Excluding confounding events	Restricted sample 1	Restricted sample 2
	(7)	(8)	(9)	(10)	(11)	(12)
Treat×*Post*	0.006*	0.005***	0.006***	0.006***	0.006***	0.007*
	(1.942)	(2.835)	(3.173)	(2.811)	(2.946)	(1.844)
Constant	−0.217***	−0.200***	−0.210***	−0.200***	−0.268***	−0.254**
	(−3.606)	(−6.706)	(−7.207)	(−6.479)	(−5.941)	(−2.439)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4146	13,431	12,279	10,325	8347	3787
Adjust R^2	0.452	0.476	0.450	0.415	0.477	0.501

This table offers the results of the tests in alternative samples. In columns (1)–(6), the dependent variable is *Loan*; in columns (7)–(12), the dependent variable is *Bond*. Others are same to the note of Table 2.

△*Debtlev* is the difference between *Debtlev* in the next period and *Debtlev* in the current period. Columns (1) and (2) of Table 7 report the results. We find that the coefficients we are interested in are significantly negative in both columns, indicating that the increased amount of public debt cannot fully recover reduced bank loans for high-risk firms. This finding sounds quite reasonable since bank loan is still the common funding source for Chinese firms. Additionally, we also explore how the interest rate floor deregulation affects firm's leverage level for high-risk firms. We use *Lev* and △*Lev* as dependent variables, respectively. Columns (3) and (4) of Table 7 show the empirical results and we find a consistent result that leverage level for high-risk firms significantly decreases after the reform.

Table 5
Dosage effects.

	Loan	*Bond*	*Loan*	*Bond*	*Loan*	*Bond*
	(1)	(2)	(3)	(4)	(5)	(6)
$Treat_{m1\text{-}m2} \times Post$	−0.015***	0.005***				
	(−4.587)	(3.063)				
$Treat_{c1\text{-}c3} \times Post$			−0.020***	0.006***		
			(−4.958)	(3.000)		
$Treat_{c1\text{-}c2} \times Post$					−0.008**	0.005**
					(−1.997)	(2.213)
Size	0.013***	0.008***	0.011**	0.009***	0.014**	0.010***
	(3.176)	(7.080)	(2.170)	(6.876)	(2.516)	(6.446)
Lev	0.485***	0.035***	0.476***	0.028***	0.507***	0.036***
	(33.641)	(8.289)	(26.173)	(5.660)	(29.345)	(7.131)
Roa	−0.109***	−0.029***	−0.090***	−0.032***	−0.128***	−0.038***
	(−4.614)	(−3.228)	(−3.225)	(−3.230)	(−4.133)	(−3.209)
Tobin's Q	−0.003***	−0.001*	−0.002**	−0.000	−0.004***	−0.001
	(−2.914)	(−1.843)	(−2.191)	(−0.642)	(−2.893)	(−1.348)
Growth	−0.008***	−0.004***	−0.005***	−0.004***	−0.010***	−0.004***
	(−5.314)	(−7.752)	(−3.372)	(−7.073)	(−5.080)	(−6.429)
Tangibility	−0.015	0.009	−0.001	0.010	−0.036	0.002
	(−0.753)	(1.336)	(−0.034)	(1.244)	(−1.140)	(0.212)
Vol_Stock	0.001	−0.001	−0.027	−0.010	0.010	0.011
	(0.048)	(−0.063)	(−0.836)	(−0.676)	(0.285)	(0.643)
Loss	0.004	0.000	0.005	−0.001	0.000	−0.001
	(1.185)	(0.063)	(1.534)	(−0.464)	(0.072)	(−0.485)
SOE	−0.015	0.006*	−0.010	0.000	−0.009	0.008*
	(−1.557)	(1.750)	(−0.822)	(0.112)	(−0.840)	(1.853)
TC	−0.035***	−0.008***	−0.028***	−0.008***	−0.041***	−0.010***
	(−8.481)	(−5.274)	(−6.177)	(−4.680)	(−7.656)	(−5.957)
Constant	−0.273***	−0.193***	−0.233**	−0.213***	−0.276**	−0.233***
	(−2.722)	(−6.919)	(−1.964)	(−6.534)	(−2.018)	(−6.083)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,331	14,331	9536	9536	9577	9577
Adjust R^2	0.840	0.476	0.857	0.499	0.821	0.482

This table offers the results of dosage effects. In columns (1), (3), and (5), the dependent variable is *Loan*; in columns (2), (4), and (6), the dependent variable is *Bond*. Others are same to the note of Table 2.

In sum, we demonstrate that this substitution to public debt is limited, leading to a dramatic decline in debt ratio.

4.4. The moderating effect of information asymmetry

Having established a causal relationship between interest rate floor deregulation and a firm's financing choice, in this subsection, we aim to further understand how interest rate floor deregulation affects firms' financing choice differently in the cross-section. A lot of literature provides evidence that banks are less sensitive to information asymmetry since they have access to private information. In contrast, bondholders are more sensitive to information asymmetry because the dispersed ownership of public bondholders reduces the individual bondholder's incentive to participate in private information gathering and makes them rely more on information from publicly available sources.

We specifically explore the cross-sectional variation in terms of firms' information asymmetry. Since bondholders are more sensitive to information asymmetry, it is reasonable to assume that firms with less information asymmetry can make debt switch more swiftly. To test this conjecture, according to Lang, Lins, and Miller (2004) and Li et al. (2018), we use analyst coverage (*Coverage*) to denote firm's information asymmetry. *Coverage* is defined as the natural logarithm of one plus the number of analysts following a firm each year. Lang et al. (2004) find that analysts value a firm by searching information across internal and external sources, which helps to increase the firm's transparency. As an information intermediary, analysts' reports make the information more accessible to unsophisticated investors and help them get a better knowledge of the firm (Chang, Dasgupta, & Hilary, 2006). Therefore, a firm with a high *Coverage* ratio is considered less information asymmetry.

Additionally, we use accounting quality (*AQ*) as the proxy for information asymmetry. As acknowledged, accounting information plays a significant role in communication between the firm and the outside. Higher-quality accounting information is associated with better financial reporting and lower information asymmetry. Essentially, good accounting quality is helpful to reduce adverse selection and information risk (Easley, Hvidkjaer, & O'Hara, 2002). We measure accounting quality according to Dechow and Dichev (2002). Large accrual variation unexplained by cashflows represents the poor accounting quality of the firm. Thus, a lower value indicates higher accounting quality and less information asymmetry the firm has.

We divide the sample into two subsets: the lower information asymmetry with the *Coverage* ratio above the mean of the same year and industry, and the higher information asymmetry subset with the *Coverage* ratio below the mean. We re-estimate Eq. 1 with the two

Table 6
Further robustness checks.

	Loan							
	LogLoan	*Loan_CF*	*DTD*	*PD*	*O-score*	*β*	Control *Equity_stock*	Control *Equity_flow*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	−0.978***	−0.645***	−0.012***	−0.013***	−0.011***	−0.008**	−0.013***	−0.015***
	(−4.367)	(−3.079)	(−3.795)	(−3.894)	(−3.119)	(−2.512)	(−3.948)	(−4.563)
Constant	−17.551***	−23.248***	−0.303***	−0.270***	−0.297***	−0.294***	−0.146	−0.262**
	(−3.822)	(−5.529)	(−3.020)	(−2.582)	(−2.862)	(−2.916)	(−1.393)	(−2.551)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,331	14,331	14,321	13,318	13,399	14,331	14,318	14,321
Adjust R^2	0.687	0.654	0.840	0.843	0.837	0.839	0.841	0.840

	Bond							
	LogBond	*Bond_CF*	*DTD*	*PD*	*O-score*	*β*	Control *Equity_stock*	Control *Equity_flow*
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Treat×Post	1.575***	0.656***	0.004**	0.004**	0.004**	0.004***	0.005***	0.005***
	(5.160)	(2.926)	(2.504)	(2.545)	(2.464)	(2.583)	(3.022)	(3.047)
Constant	−59.711***	−49.094***	−0.183***	−0.164***	−0.196***	−0.188***	−0.192***	−0.200***
	(−9.928)	(−10.301)	(−6.593)	(−5.754)	(−6.870)	(−6.782)	(−6.338)	(−6.981)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,331	14,331	14,321	13,318	13,399	14,331	14,318	14,321
Adjust R^2	0.587	0.327	0.476	0.458	0.472	0.476	0.476	0.477

This table offers the results of the robustness checks. In column (1) and column (9), the dependent variable is *LogLoan* and *LogBond* respectively; in column (2) and column (10), the dependent variable is *Loan_CF* and *Bond_CF* respectively; in columns (3)–(8), the dependent variable is *Loan*; in columns (11)–(16), the dependent variable is *Bond*. Others are same to the note of Table 2.

subsets separately. Columns (1) and (2) in Table 8 examine the effect of analyst coverage on the relation between the interest rate floor deregulation and firms' bank loan availability. The coefficient of *Treat* × *Post* in columns (1) and (2) are −0.017, and − 0.010, respectively. We also test the difference in the coefficients on *Treat* × *Post* across the different subsamples. The test indicates that there is no statistical difference between the high- and low-information asymmetry subsamples for bank financing choice. It is consistent with our conjecture that commercial banks are less sensitive to information asymmetry when providing loans. Columns (5) and (6) in Table 8 examine the effect of analyst coverage on the relation between the removal of interest rate floor and firms' public debt financing. The coefficient of *Treat* × *Post* in columns (5) and (6) are 0.008, and 0.001, respectively. We also test the difference in the coefficients on *Treat* × *Post* across the different subsamples. The test indicates the effect of interest rate floor deregulation on firms' bond financing is more pronounced for firms with lower information asymmetry. It is consistent with our conjecture that firms with lower information asymmetry can make debt switch more swiftly. In columns (3)–(4) and columns (7)–(8) in Table 8, we also use accounting quality to measure information asymmetry and get a consistent result.

In summary, we find that when facing interest rate floor deregulation, firm's substitution toward bonds is conditional and firms with a good information environment are an important prerequisite for making the debt switch.

5. What's the consequence of choosing a non-optimal financing choice?

Theoretically, high-risk firms should have preferred bank loans over bonds, while in our regressions, we find that they shy away from bank loan and switch to public debt. Obviously, its choice can be regarded as a non-optimal financing choice. Therefore, we are interested to investigate what's the outcome of choosing a non-optimal financing choice.

In this part, we employ a DID methodology to explore how the costs of public debt change after the interest rate floor reform between the treatment and control groups. The model is as follows:

$$\begin{aligned} Bond\ terms = {} & \gamma_0 + \gamma_1 Treat + \gamma_2 Treat \times Post + \gamma_3 Size + \gamma_4 Lev + \gamma_5 Roa + \gamma_6 Tobin`s\ Q + \gamma_7 Growth + \gamma_8 Tangibility + \gamma_9 Loss \\ & + \gamma_{10} Vol\_Stock + \gamma_{11} SOE + \gamma_{12} LogBondAmt + \gamma_{13} LogMaturity + \gamma_{14} Collateral + \gamma_{15} Put + \gamma_{16} Rate + Year\ fixed\ effects \\ & + Industry\ fixed\ effects + Type\ fixed\ effects + \varepsilon \end{aligned} \tag{5}$$

where *Bond terms* denotes the costs of public debt borne by firms. Except for controlling firm characteristics, we also control public debt characteristics, such as public debt offering amount, public debt maturity, collateral, put option, and credit ratings. Additionally, we control public debt type because different types of public debt are perceived to have different levels of risk (Graham, Li, & Qiu,

Table 7
The effect of the removal of interest rate floor on debt level.

	Debtlev	△*Debtlev*	*Lev*	△*Lev*
	(1)	(2)	(3)	(4)
Treat×*Post*	−0.010***	−0.023***	−0.035***	−0.018***
	(−3.175)	(−8.928)	(−6.848)	(−6.104)
Size	0.021***	0.006**	0.068***	−0.014***
	(5.115)	(2.305)	(10.922)	(−4.781)
Lev	0.522***	−0.238***		
	(36.004)	(−24.982)		
Roa	−0.138***	0.043*	−0.491***	0.116***
	(−5.958)	(1.755)	(−12.451)	(4.041)
Tobin's Q	−0.003***	0.001**	0.010***	−0.004***
	(−3.610)	(1.965)	(6.578)	(−4.106)
Growth	−0.011***	0.004***	0.014***	−0.006***
	(−7.673)	(3.036)	(6.186)	(−3.568)
Tangibility	−0.006	−0.001	0.077**	−0.016
	(−0.300)	(−0.041)	(2.112)	(−0.764)
Vol_Stock	0.006	0.031	0.046	−0.014
	(0.227)	(1.049)	(1.010)	(−0.396)
Loss	0.004	−0.011***	0.031***	−0.016***
	(1.282)	(−3.071)	(7.098)	(−4.089)
SOE	−0.008	0.009	0.029*	0.002
	(−0.860)	(1.259)	(1.857)	(0.186)
TC	−0.042***	0.021***	0.053***	−0.021***
	(−10.371)	(7.682)	(9.824)	(−6.784)
Constant	−0.460***	−0.045	−1.144***	0.352***
	(−4.644)	(−0.712)	(−7.758)	(4.849)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	14,331	14,081	14,331	14,298
Adjust R^2	0.862	0.036	0.838	0.001

This table offers the results of the tests on how interest rate deregulation affects firms' debt level. In columns (1)–(2), the dependent variable is *Debtlev*, △*Debtlev*, respectively; in columns (3)–(4), the dependent variable is *Lev*, △*Lev*, respectively. Others are same to the note of Table 2.

2008).

Since financing costs play an extremely significant role in public debt contracts, we first investigate how bank interest rate deregulation makes a difference in firms' bond spread.[9] Following Reisel (2014) and Gong, Xu, and Gong (2018), we calculate bond spread by subtracting bond yields at the issuance date from Treasure bond yields of equivalent maturity. As indicated in column (1) in Table 9, we find that the coefficient on *Treat* × *Post* is positive and statistically significant, implying that the price of public debt significantly increases for high-risk firms after the 2013 deregulation. This change is also economically significant, with *Spread* increasing by 22.5% for each issuance subsequent to the reform, which is shown in column (1).[10] The descriptive results show that the average value of *Spread* is 1.82%, and the mean bond amount is 487 million RMB. Thus, on average, the 2013 interest rate floor deregulation can make a high-risk firm pay an extra annual interest cost of 1.99 million RMB (487×1.82%×22.5% = 1.99) for each issuance.

It is worth noting that except for direct financing cost shown as the bond spread, the tighter non-price contract term potentially leads to increased costs borne by high-risk firms, like occupying additional resources that result from providing collateral, possibly paying more interest costs to comply with interest-adjusted clause, etc. As inspired, we then study whether interest rate deregulation has effects beyond increasing the price of public debt.

The results of the impact of the elimination of the interest rate floor on the possibility of utilizing security for the bond are shown in Column (2) of Table 9. The explained variable, *Collateral* is a dummy variable indicating whether a bond is collateralized or not. We employ a Probit model to estimate the regression result. In column (2), the coefficient on *Treat* × *Post* is 0.675 and is statistically significant. It indicates that the collateral requirement of the bond issued by high-risk firms is significantly more after the 2013 deregulation compared to low-risk firms.

Column (3) of Table 9 shows the results estimating the effect of the elimination of the interest rate floor on the likelihood of adopting an interest-adjusted clause for the bond. The explained variable, *Adjust* equals one if a new bond issue contains an interest-adjusted clause, and zero otherwise. We employ a Probit model to estimate. The interest-adjusted clause can be classified as an option clause, which allows issuers to have the right to adjust coupon rate at a certain time. Through checking our data, we find that the overwhelming majority of bonds with interest-adjusted clauses can be identified as interest-upward clause, which clearly specifies the

[9] It should be noted that the regression sample is quite different from what is used in previous regressions. In this regression, we just focus on individual bonds that are issued during 2009–2016 so that we can obtain each bond's detailed information, such as bond spread, bond maturity, collateral, etc. Using this way can help us accurately measure whether firm's public debt costs increase or not.

[10] 22.5% = 0.411/1.824, where 0.411 is γ_3 in column (1) in Tables 8, and 1.824 is the mean *Spread* for the bond samples in Panel A of Table 1.

Table 8
Cross-sectional analysis.

	Loan				*Bond*			
	High coverage	Low coverage	High accounting quality	Low accounting quality	High coverage	Low coverage	High accounting quality	Low accounting quality
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat×Post	−0.017***	−0.010*	−0.011***	−0.019***	0.008***	0.001	0.006***	0.001
	(−3.545)	(−1.816)	(−2.712)	(−2.847)	(3.085)	(0.325)	(2.843)	(0.309)
Size	−0.005	0.027***	0.012**	0.016**	0.009***	0.006***	0.009***	0.007***
	(−0.933)	(3.979)	(2.082)	(2.424)	(3.780)	(3.364)	(4.978)	(3.793)
Lev	0.522***	0.482***	0.520***	0.450***	0.069***	0.018***	0.041***	0.027***
	(27.962)	(22.461)	(32.334)	(16.604)	(7.662)	(3.208)	(6.132)	(4.182)
Roa	−0.155***	−0.037	−0.160***	−0.088**	−0.044**	−0.008	−0.035**	−0.030**
	(−4.649)	(−1.016)	(−4.030)	(−1.995)	(−2.336)	(−0.682)	(−2.112)	(−2.194)
Tobin's Q	−0.001	−0.002	−0.000	−0.004**	−0.000	−0.001**	−0.001*	−0.000
	(−1.169)	(−1.358)	(−0.209)	(−2.557)	(−0.321)	(−2.104)	(−1.738)	(−0.417)
Growth	−0.010***	−0.006**	−0.008***	−0.008***	−0.005***	−0.003***	−0.004***	−0.003***
	(−3.989)	(−2.034)	(−3.300)	(−2.836)	(−4.813)	(−4.261)	(−5.023)	(−4.138)
Tangibility	−0.027	−0.017	−0.004	−0.014	0.011	0.014	0.004	0.009
	(−0.954)	(−0.480)	(−0.146)	(−0.339)	(0.908)	(1.551)	(0.432)	(0.648)
Vol_Stock	−0.042	0.016	−0.010	0.049	−0.006	0.024	0.014	−0.031
	(−1.128)	(0.366)	(−0.294)	(0.860)	(−0.254)	(1.217)	(0.771)	(−1.212)
Loss	0.001	0.007*	0.013**	0.008	−0.001	0.002	−0.001	0.001
	(0.233)	(1.835)	(2.352)	(1.469)	(−0.187)	(1.494)	(−0.360)	(0.361)
SOE	−0.015	−0.016	−0.012	−0.009	0.008	0.004	0.012**	0.003
	(−1.032)	(−1.263)	(−0.918)	(−0.561)	(1.023)	(0.789)	(2.030)	(0.735)
TC	−0.037***	−0.030***	−0.039***	−0.037***	−0.013***	−0.005**	−0.010***	−0.006***
	(−6.977)	(−5.354)	(−7.666)	(−5.366)	(−5.410)	(−2.275)	(−4.209)	(−3.145)
Constant	0.117	−0.557***	−0.275**	−0.312*	−0.235***	−0.149***	−0.219***	−0.171***
	(0.890)	(−3.500)	(−2.025)	(−1.945)	(−3.961)	(−3.365)	(−4.847)	(−3.431)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7266	6433	8879	5239	7266	6433	8879	5239
Adjust R^2	0.865	0.838	0.860	0.831	0.479	0.505	0.487	0.514
P-value	0.111		0.311		0.015		0.031	

This table offers the results of the cross-sectional analysis. The analysis compares the financing choice of firms with low information asymmetry and high information asymmetry, based on the analyst coverage (*Coverage*) or accounting quality (*AQ*). In columns (1)–(4), the dependent variable is *Loan*; and in columns (5)–(8), the dependent variable is *Bond*. Others are same to the note of Table 2.

direction of interest adjustment. It seems quite reasonable that this interest-adjusted clause is always combined with *Put* option so that bondholders can sell the bond back to issuers if issuers do not raise the coupon rate. In short, complying with the interest-adjusted (upward) clause means issuers have a high probability to pay more interest costs. From this perspective, the interest-adjusted clause can be regarded as a potential cost for issuers. In column (3), we find a positive and statistically significant coefficient for *Treat* × *Post*. The result demonstrates that following the 2013 interest rate reform, the interest-adjusted clause of bonds issued by high-risk firms is much more than that of low-risk firms.

So far, we find that the economic effect of this reform on the effective cost of public debt is likely to be substantially greater than that implied by the bond spread increase alone. Taken together, this finding suggests that high-risk firms incur high switching costs when their choice deviates from the optimal financing choice.

6. What happens to high-risk firms subsequent to the interest rate floor deregulation?

The aforementioned analysis implies that even though high-risk firms can obtain financing from the bond market to alleviate the dilemma of reduced bank loans, they have to bear higher costs of public debt than their low-risk counterparts. Naturally, we would like to investigate what high-risk firms will next do when facing higher financing costs. Prior literature provides ample evidence, such as Bharath et al. (2008), Gong et al. (2018) that higher information quality can significantly decrease the interest costs of public debt. Besides, a firm with high information quality may signal to the market that it has good credibility and reputation, which is beneficial for its follow-up financing (Gong et al., 2018). Hence, if a firm's information environment plays a role in reducing financing costs and improving financing capacity as prior literature suggested, we expect that high-risk firms would initiatively improve firms accounting information quality to facilitate their follow-up financing.

We use two variables, *C-score* and *G-score* in the next period to proxy for firms' accounting information quality. *C-score* is an indicator that is based on Khan and Watts' (2009) model and reflects the incremental timeliness of the firm's bad news. The larger *C-score*, the higher quality of accounting information. *G-score* is an indicator constructed by Khan and Watts' (2009) regression and we could specify the timeliness of the good news according to it. The lower *G-score*, the higher quality of accounting information. In Table 10, the result in column (1) demonstrates that high-risk firms reflect bad news in a more timely manner after the reform; and the result in column (2) suggests that high-risk firms reflect good news in a less timely manner after the reform. In sum, our results

Table 9
The removal of interest rate floor and public debt contracting terms.

	Spread	*Collateral*	*Adjust*
	(1)	(2)	(3)
Treat×Post	0.411***	0.675**	1.181***
	(3.214)	(2.434)	(3.789)
Treat	−0.166	−0.067	−1.113***
	(−1.457)	(−0.300)	(−4.576)
Size	0.042	−0.492***	−0.212*
	(1.147)	(−4.998)	(−1.890)
Lev	0.628**	1.626**	2.024**
	(2.284)	(2.376)	(2.557)
Roa	−2.065*	−3.227	0.072
	(−1.718)	(−1.256)	(0.029)
Tobin's Q	−0.129**	−0.076	−0.211
	(−2.274)	(−0.535)	(−1.537)
Growth	0.005	0.511**	−0.115
	(0.049)	(2.034)	(−0.345)
Tangibility	−0.407	−0.214	−1.565**
	(−1.129)	(−0.174)	(−2.233)
Vol_Stock	0.541	−12.457***	−0.574
	(0.585)	(−4.150)	(−0.178)
Loss	0.195	−0.028	−0.834***
	(1.300)	(−0.097)	(−3.074)
SOE	−0.364***	0.156	−0.248
	(−4.430)	(0.865)	(−1.300)
LogBondAmt	−0.124***	−0.020	0.429***
	(−4.818)	(−0.305)	(6.387)
LogMaturity	0.007	0.651**	0.562
	(0.061)	(2.262)	(1.521)
Collateral	0.263***		−0.205
	(3.072)		(−1.054)
Put	−0.040	−0.726***	3.939***
	(−0.429)	(−4.546)	(12.130)
Rate	−0.419***	0.788***	0.026
	(−7.945)	(7.066)	(0.183)
Constant	5.560***	10.234***	−5.481**
	(5.226)	(4.415)	(−2.136)
Year FE	Yes	Yes	Yes
Type FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	1639	1639	1639
Adjust R^2/ Pseudo R^2	0.450	0.471	0.716

This table offers the results of the tests on how interest rate deregulation affects public debt contracting terms. In column (1), the dependent variable is *Spread*. In column (2), the dependent variable is *Collateral*. In column (3), the dependent variable is *Adjust*. *t*-statistics (or *z*-statistics) based on robust standard errors clustered by firm are shown in parentheses. Others are same to the note of Table 2.

demonstrate that following the interest rate floor deregulation, high-risk firms tend to improve firm's accounting information quality.

7. Conclusions

In this paper, we examine how interest rate floor deregulation shapes firms' financing choice. Our analysis exploits China's 2013 bank interest rate floor deregulation as an exogenous shock in credit supply reform. Specifically, we examine with respect to how exogenous decreases in the accessibility of bank loans to high-risk firms due to the interest rate floor deregulation influence their use of public debt financing. The empirical results demonstrate that firms with higher default risk significantly increase their use of public debt financing after the 2013 deregulation.

However, this substitution to public debt is limited, leading to a dramatic decline in debt ratio. We also find that the effect of the reform on firms' bond financing is more pronounced for firms with lower information asymmetry, such as those with more initial analysts and higher accounting quality. The results imply that a good information environment is an important prerequisite for making the switch.

Additionally, we find that high-risk firms switching to public debt financing obviously deviate from the optimal financing choice. Hence, this switching is costly: compared with low-risk firms, bonds issued by high-risk firms have significantly higher spreads, a higher likelihood of being secured, and a higher tendency of including an interest-adjusted clause. Finally, we document that high-risk firms would initiatively improve firms accounting information quality after the reform to facilitate their follow-up financing.

Using the unique interest rate floor deregulation event in China, our study adds to the growing literature on the determinant of

Table 10
The removal of the interest rate floor and accounting information quality.

	C-score	*G-score*
	(1)	(2)
Treat×Post	0.003**	−0.004***
	(2.089)	(−16.246)
Size	0.013***	−0.000
	(8.979)	(−1.076)
Lev	0.024***	0.001
	(4.505)	(1.119)
Roa	−0.022*	−0.002
	(−1.766)	(−0.777)
Tobin's Q	0.001**	0.001***
	(2.330)	(11.896)
Growth	−0.000	0.000
	(−0.178)	(1.246)
Tangibility	0.030***	−0.001
	(3.896)	(−0.260)
Vol_Stock	−0.050***	0.008*
	(−3.260)	(1.912)
Loss	−0.000	−0.001
	(−0.174)	(−1.400)
SOE	0.004	−0.002*
	(1.507)	(−1.897)
TC	0.001	0.000
	(0.748)	(1.035)
Constant	−0.298***	0.019**
	(−9.108)	(2.165)
Year FE	Yes	Yes
Firm FE	Yes	Yes
Observations	12,386	12,386
Adjust R^2	0.514	0.687

This table offers the results of the tests on how interest rate deregulation affects firms' financial information quality. In column (1), the dependent variable is *C-score* in the next period. In column (2), the dependent variable is *G-score* in the next period. Others are same to the note of Table 2.

financing choice between bank debt and public debt by identifying a new factor, interest rate floor deregulation. We focus on the firm's financing choice and provide new evidence on the matching of firm risk and financing choice. We show that when interest rate floor deregulation occurs, high-risk firms switch from their optimal financing choice (bank debt) to their sub-optimal choice (public debt). However, this change increases costs for them. We also extend prior studies on the real outcome affected by the financial exogenous shocks. We find that burdened with the high cost and contract constraints, high-risk firms are encouraged to improve the information quality to facilitate their financing. Our findings also have important policy implications for policymakers, regulators, and financial institutions. It provides a more comprehensive and systematic reference for China's interest rate liberalization reform and a series of financial market reforms.

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Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

Appendix A. Variable definitions

Variable	Definition
Bond	Bonds payable divided by total firm assets.
Loan	The sum of short-term loans and long-term loans divided by total firm assets.
Treat	Dummy variable that equals one if a firm's average *Z*-score before the 2013 deregulation is below industry median value, and zero otherwise. According to Altman (1968), Z-score is calculated as 0.012 × working capital divided by total assets +0.014 × retained earnings divided by total assets +0.033 × earnings before interest and taxes divided by total assets +0.006 × market value of equity divided by book value of total liability +0.999 × sales divided by total assets.
Post	Dummy variable that equals one if an observation falls in the post-period (i.e., 2013–2016), and zero otherwise.
Firm characteristics:	
Size	The natural logarithm of firm assets.
Lev	Total liability divided by total assets.
Roa	Net income divided by total assets.
Tobin's Q	Market value of firm's assets divided by book value of firm's assets.
Growth	Sales growth rate.
Tangibility	Total tangible assets divided by total assets.
Loss	Dummy variable that equals one if a firm's earning is negative, and zero otherwise.
Vol_Stock	Annualized standard deviation of daily stock returns.
SOE	Dummy variable that equals one if a firm is state-owned, and zero otherwise.
TC	The sum of accounts payable, notes payable and accounts received in advance divided by operating costs.
Bond Characteristics:	
Spread	Bond yields at the issuance date minus Treasure bond yields of comparable maturity.
BondAmt	The amount of bond offering (measured in RMB).
LogBondAmt	The natural logarithm of *BondAmt* plus one.
Maturity	The maturity of bonds in year.
LogMaturity	The natural logarithm of *Maturity* plus one.
Collateral	Dummy variable that equals one if bond is secured with collateral, and zero otherwise.
Put	Dummy variable that equals one if a new bond issue has a put option, and zero otherwise.
Rate	Our paper only contains bonds with credit rating ranging from AA- to AAA. We assign AA-, AA, AA+, AAA to 1,2,3,4, respectively.
Type	Dummy variable that equals one if the bond belongs to a certain class of bonds, and zero otherwise. Specifically, the types of bond in the whole sample include corporate bond, enterprise bond, medium term note (MTN) and short-term commercial paper (SCP).
Other variables:	
Coverage	The natural logarithm of one plus the number of analysts following a firm each year.
AQ	The standard deviation of the residuals from the Dechow and Dichev (2002) model.

Appendix B. Validity of the PSM method

Test of the balance assumption.

Variable	The covariate means		The difference between the two groups		
	Treat = 1	*Treat* = 0	% reduct |bias|	% bias	difference (*T*)
Size	22.089	22.074	98.3	1.2	0.41
Lev	0.445	0.453	96.4	−4.8	−1.64
Roa	0.036	0.037	94.0	−3.3	−1.12
Tobin's Q	2.353	2.484	86.4	−8.1	−2.72
Growth	0.212	0.219	87.8	−1.1	−0.35
Tangibility	0.932	0.930	77.5	3.6	1.14
Vol_Stock	0.058	0.057	47.4	1.6	0.47
Loss	0.087	0.074	78.6	4.6	1.54
SOE	0.395	0.425	86.7	−6.4	−2.02
TC	0.491	0.516	71.5	−4.6	−1.49

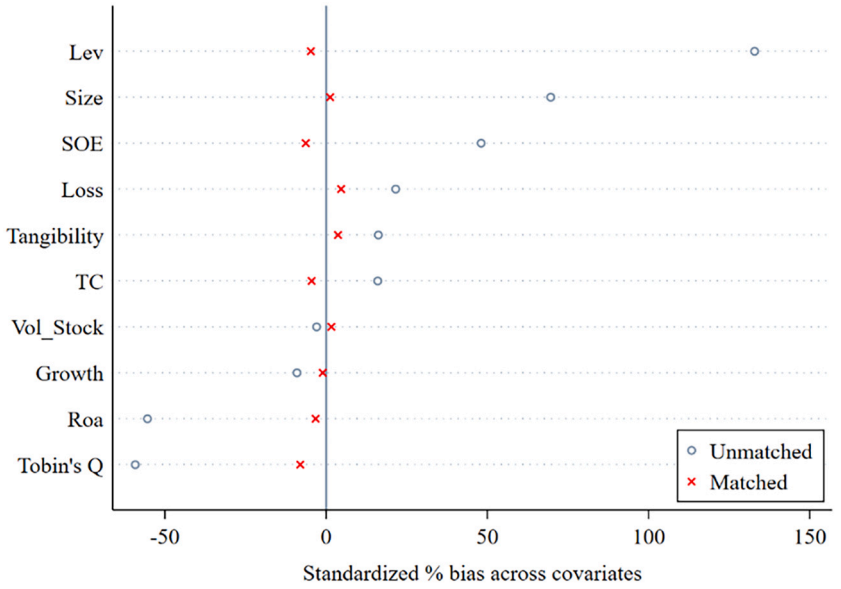

Fig. B.1. Standardized % bias across covariates.

References

Almazan, A., & Suarez, J. (2003). Managerial compensation and the market reaction to bank loans. *Review of Financial Studies, 16*(1), 237–261. https://doi.org/10.1093/rfs/16.1.0237

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance, 23*(4), 589–609. https://doi.org/10.1111/j.1540-6261.1968.tb00843.x

Arena, M. P., & Howe, J. S. (2009). Takeover exposure, agency, and the choice between private and public debt. *Journal of Financial Research, 32*(2), 199–230. https://doi.org/10.1111/j.1475-6803.2009.01248.x

Ashbaugh-Skaife, H., Collins, D. W., & Kinney, W. R., Jr. (2007). The discovery and reporting of internal control deficiencies prior to SOX-mandated audits. *Journal of Accounting and Economics, 44*(1–2), 166–192. https://doi.org/10.1016/j.jacceco.2006.10.001

Barajas, A., Steiner, R., & Salazar, N. (2000). The impact of liberalization and foreign investment in Colombia's financial sector. *Journal of Development Economics, 63*(1), 157–196. https://doi.org/10.1016/S0304-3878(00)00104-8

Becker, B., & Ivashina, V. (2014). Cyclicality of credit supply: Firm level evidence. *Journal of Monetary Economics, 62*(C), 76–93. https://doi.org/10.1016/j.jmoneco.2013.10.002

Berlin, M., & Loeys, J. (1988). Bond covenants and delegated monitoring. *Journal of Finance, 43*(2), 397–412. https://doi.org/10.1111/j.1540-6261.1988.tb03946.x

Bharath, S. T., Sunder, J., & Sunder, S. V. (2008). Accounting quality and debt contracting. *Accounting Review, 83*(1), 1–28. https://doi.org/10.2308/accr.2008.83.1.1

Bolton, P., & Freixas, X. (2000). Equity, bonds, and bank debt: Capital structure and financial market equilibrium under asymmetric information. *Journal of Political Economy, 108*(2), 324–351. https://doi.org/10.1086/262121

Boubaker, S., Saffar, W., & Sassi, S. (2018). Product market competition and debt choice. *Journal of Corporate Finance, 49*, 204–224. https://doi.org/10.1016/j.jcorpfin.2018.01.007

Boyd, J. H., & Prescott, E. C. (1986). Financial intermediary-coalitions. *Journal of Economic Theory, 38*(2), 211–232. https://doi.org/10.1016/0022-0531(86)90115-8

Campello, M., & Larrain, M. (2016). Enlarging the contracting space: Collateral menus, access to credit, and economic activity. *Review of Financial Studies, 29*(2), 349–383. https://doi.org/10.1093/rfs/hhv069

Cantillo, M., & Wright, J. (2000). How do firms choose their lenders? An empirical investigation. *Review of Financial Studies, 13*(1), 155–189. https://doi.org/10.1093/rfs/13.1.155

Chang, X., Dasgupta, S., & Hilary, G. (2006). Analyst coverage and financing decisions. *Journal of Finance, 61*(6), 3009–3048. https://doi.org/10.1111/j.1540-6261.2006.01010.x

Chava, S., & Purnanandam, A. (2011). The effect of banking crisis on bank-dependent borrowers. *Journal of Financial Economics, 99*(1), 116–135. https://doi.org/10.1016/j.jfineco.2010.08.006

Chemmanur, T. J., & Fulghieri, P. (1994). Reputation, renegotiation, and the choice between bank loans and publicly traded debt. *Review of Financial Studies, 7*(3), 475–506. https://doi.org/10.1093/rfs/7.3.475

Chen, S., Ma, H., & Wu, Q. (2019). Bank credit and trade credit: Evidence from natural experiments. *Journal of Banking and Finance, 108*, Article 105616. https://doi.org/10.1016/j.jbankfin.2019.105616

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008-9 financial crisis. *Quarterly Journal of Economics, 129*(1), 1–59. https://doi.org/10.1093/qje/qjt031

Choi, W. G., & Kim, Y. (2005). Trade credit and the effect of macro-financial shocks: Evidence from U.S. panel data. *Journal of Financial and Quantitative Analysis, 40*(4), 897–925. https://doi.org/10.1017/S0022109000002027

Dechow, P. M., & Dichev, I. D. (2002). The quality of accruals and earnings: The role of accrual estimation errors. *Accounting Review, 77*, 35–39. https://doi.org/10.2308/accr.2002.77.s-1.35

DeMarzo, P. M., & Fishman, M. J. (2007). Optimal long-term financial contracting. *Review of Financial Studies, 20*(6), 2079–2128. https://doi.org/10.1093/rfs/hhm031

Denis, D. J., & Mihov, V. T. (2003). The choice among bank debt, non-bank private debt, and public debt: Evidence from new corporate borrowings. *Journal of Financial Economics, 70*(1), 3–28. https://doi.org/10.1016/S0304-405X(03)00140-5

Dhaliwal, D. S., Khurana, I. K., & Pereira, R. (2011). Firm disclosure policy and the choice between private and public debt. *Contemporary Accounting Research, 28*(1), 293–330. https://doi.org/10.1111/j.1911-3846.2010.01039.x

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies, 51*(3), 393–414. https://doi.org/10.2307/2297430
Diamond, D. W. (1991). Monitoring and reputation: The choice between bank loans and directly placed debt. *Journal of Political Economy, 99*(4), 689–721. https://doi.org/10.1086/261775
Diamond, D. W. (1993). Seniority and maturity of debt contracts. *Journal of Financial Economics, 33*(3), 341–368. https://doi.org/10.1016/0304-405X(93)90011-Y
Duan, J.-C., Sun, J., & Wang, T. (2012). Multiperiod corporate default prediction-a forward intensity approach. *Journal of Econometrics, 170*(1), 191–209. https://doi.org/10.1016/j.jeconom.2012.05.002
Easley, D., Hvidkjaer, S., & O'Hara, M. (2002). Is information risk a determinant of asset returns? *Journal of Finance, 57*(5), 2185–2221. https://doi.org/10.1111/1540-6261.00493
Fama, E. F. (1985). What's different about banks? *Journal of Monetary Economics, 15*(1), 29–39. https://doi.org/10.1016/0304-3932(85)90051-0
Faulkender, M., & Petersen, M. A. (2006). Does the source of capital affect capital structure? *Review of Financial Studies, 19*(1), 45–79. https://doi.org/10.1093/rfs/hhj003
Fernández, A. I., González, F., & Suárez, N. (2018). Bank supply shocks and the substitution between bank and nonbank debt. *Journal of Corporate Finance, 48*, 122–147. https://doi.org/10.1016/j.jcorpfin.2017.10.010
Gao, H., & Zhang, J. (2019). SOX section 404 and corporate innovation. *Journal of Financial and Quantitative Analysis, 54*(2), 759–787. https://doi.org/10.1017/S0022109018000844
García-Herrero, A., Gavilláb, S., & Santabárbara, D. (2009). What explains the low profitability of Chinese banks? *Journal of Banking and Finance, 33*(11), 2080–2092. https://doi.org/10.1016/j.jbankfin.2009.05.005
Gertner, R., & Scharfstein, D. (1991). A theory of workouts and the effects of reorganization law. *Journal of Finance, 46*(4), 1189–1222. https://doi.org/10.2307/2328856
Goel, M., & Zemel, M. (2018). Switching to bonds when loans are scarce: Evidence from four US crises. *Journal of Corporate Finance, 52*, 1–27. https://doi.org/10.1016/j.jcorpfin.2018.05.006
Gong, G., Xu, S., & Gong, X. (2018). On the value of corporate social responsibility disclosure: An empirical investigation of corporate bond issues in China. *Journal of Business Ethics, 150*(1), 227–258. https://doi.org/10.1007/s10551-016-3193-8
Graham, J. R., Li, S., & Qiu, J. (2008). Corporate misreporting and bank loan contracting. *Journal of Financial Economics, 89*(1), 44–61. https://doi.org/10.1016/j.jfineco.2007.08.005
Houston, J., & James, C. (1996). Bank information monopolies and the mix of private and public debt claims. *Journal of Finance, 51*(5), 1863–1889. https://doi.org/10.1111/j.1540-6261.1996.tb05229.x
Kestens, K., Van Cauwenberge, P., & Bauwhede, H. V. (2012). Trade credit and company performance during the 2008 financial crisis. *Accounting and Finance, 52*(4), 1125–1151. https://doi.org/10.1111/j.1467-629X.2011.00452.x
Khan, M., & Watts, R. L. (2009). Estimation and empirical properties of a firm-year measure of accounting conservatism. *Journal of Accounting and Economics, 48*(2–3), 132–150. https://doi.org/10.1016/j.jacceco.2009.08.002
Krishnaswami, S., Spindt, P. A., & Subramaniam, V. (1999). Information asymmetry, monitoring, and the placement structure of corporate debt. *Journal of Financial Economics, 51*(3), 407–434. https://doi.org/10.1016/S0304-405X(98)00059-2
Lang, M. H., Lins, K. V., & Miller, D. P. (2004). Concentrated control, analyst following, and valuation: Do analysts matter most when investors are protected least? *Journal of Accounting Research, 42*(3), 589–623. https://doi.org/10.1111/j.1475-679X.2004.t01-1-00142.x
Li, X., Lin, C., & Zhan, X. (2018). Does change in the information environment affect financing choices? *Management Science, 65*(12), 5676–5696. https://doi.org/10.1287/mnsc.2018.3096
Liberti, J. M., & Sturgess, J. (2018). The anatomy of a credit supply shock: Evidence from an internal credit market. *Journal of Financial and Quantitative Analysis, 53*(2), 547–579. https://doi.org/10.1017/S0022109017000837
Lin, C., Ma, Y., Malatesta, P., & Xuan, Y. (2013). Corporate ownership structure and the choice between bank debt and public debt. *Journal of Financial Economics, 109*(2), 517–534. https://doi.org/10.1016/j.jfineco.2013.03.006
Lin, L. (2016). Collateral and the choice between bank debt and public debt. *Management Science, 62*(1), 111–127. https://doi.org/10.1287/mnsc.2014.2094
Ma, Z., Stice, D., & Williams, C. (2019). The effect of bank monitoring on public bond terms. *Journal of Financial Economics, 133*(2), 379–396. https://doi.org/10.1016/j.jfineco.2019.02.003
Meneghetti, C. (2012). Managerial incentives and the choice between public and bank debt. *Journal of Corporate Finance, 18*(1), 65–91. https://doi.org/10.1016/j.jcorpfin.2011.10.003
Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance, 29*(2), 449. https://doi.org/10.2307/2978814
Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research, 18*(1), 109–131. https://doi.org/10.2307/2490395
Pessarossi, P., & Weill, L. (2013). Choice of corporate debt in China: The role of state ownership. *China Economic Review, 26*, 1–16. https://doi.org/10.1016/j.chieco.2013.03.005
Petersen, M. A., & Rajan, R. G. (1994). The benefits of lending relationships: Evidence from small business data. *Journal of Finance, 49*(1), 3–37. https://doi.org/10.1111/j.1540-6261.1994.tb04418.x
Qian, J., Strahan, P. E., & Yang, Z. (2015). The impact of incentives and communication costs on information production and use: Evidence from bank lending. *Journal of Finance, 70*(4), 1457–1493. https://doi.org/10.1111/jofi.12251
Rajan, R. G. (1992). Insiders and outsiders: The choice between informed and arm's-length debt. *Journal of Finance, 47*(4), 1367–1400. https://doi.org/10.2307/2328944
Reisel, N. (2014). On the value of restrictive covenants: Empirical investigation of public bond issues. *Journal of Corporate Finance, 27*, 251–268. https://doi.org/10.1016/j.jcorpfin.2014.05.011
Sakai, K., Uesugi, I., & Watanabe, T. (2010). Firm age and the evolution of borrowing costs: Evidence from Japanese small firms. *Journal of Banking and Finance, 34*(8), 1970–1981. https://doi.org/10.1016/j.jbankfin.2010.01.001

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