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Bing Xu, Adrian van Rixtel and Honglin Wang

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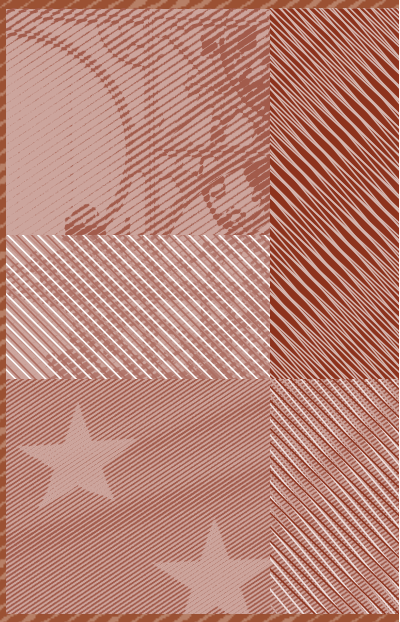

BANCO DE **ESPAÑA**
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DO BANKS EXTRACT INFORMATIONAL RENTS THROUGH COLLATERAL? (*)

Bing Xu

UNIVERSITY CARLOS III OF MADRID

Adrian van Rixtel (**)

BANCO DE ESPAÑA

Honglin Wang

HONG KONG MONETARY AUTHORITY

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(**) Adrian van Rixtel was at the time of writing in the Financial Markets Group, Monetary and Economic Department, BIS.

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Abstract

The use of collateral is one of the defining characteristics of loan contracts. This paper investigates if relationship lending and market concentration allow for informational rent extraction through collateral. We use equity IPO data as informational shocks that erode rent-seeking opportunities. Using a new loan-level database for China, we find that collateral incidence increases with relationship intensity and banking market concentration for loans obtained pre- IPO, while this effect is more moderate post-IPO. We also show that the degree of rent extraction declines for lower-risk firms post-IPO, while it increases for higher-risk firms. These results are not driven by differences or changes in firm-specific financial risks. To our knowledge, our paper is the first to investigate the determinants of collateral for China using loan-level data.

Keywords: Informational rents, collateral, relationship lending, market structure, IPOs, China.

JEL Classification: G21, L11.

Resumen

El uso de colateral es una de las características definitorias de los contratos de préstamos. En este trabajo se investiga si la intensidad de la relación entre bancos y prestatarios y la concentración del mercado de los préstamos permiten la extracción de rentas de información a través de colateral. Utilizamos datos de OPV como shocks informativos que erosionan las oportunidades de búsqueda de rentas. Utilizando una nueva base de datos de préstamos individuales de China, demostramos que la incidencia del colateral aumenta con la intensidad de la relación entre bancos y prestatarios y la concentración del mercado bancario en los préstamos obtenidos antes de la salida a bolsa, mientras que este efecto es moderado después de la salida a bolsa. También demostramos que el grado de extracción de rentas para las empresas de menor riesgo disminuye después de la salida a bolsa, mientras que aumenta para las empresas de mayor riesgo. Estos resultados no son debidos a diferencias o cambios en los riesgos financieros específicos de las empresas. Hasta donde sabemos, nuestro trabajo es el primero en investigar los determinantes del colateral en China usando datos de préstamos individuales.

Palabras clave: rentas de información, colateral, crédito basado en relaciones, estructura del mercado, OPV, China.

Códigos JEL: G21, L11.

1 Introduction

Collateral is one of the defining characteristics of loan contracts and is widely imposed in bank lending markets across the globe (Jiménez et al., 2006; Menkhoff et al., 2006; Steijvers and Voordeckers, 2009). The results of the Survey of Terms of Business Lending published by the Federal Reserve in April 2016 showed that 67.8% of all commercial and industrial loans (weighted by loan amounts) made by commercial banks in the US was collateralized, significantly higher than the 39.6% recorded 10 years earlier.[1] Collateral requirements are even more widespread in developing economies: the World Bank's Enterprise Survey covering 43 developing countries indicated that on average 73% of loans from financial institutions required collateral (Nguyen and Qian, 2012).

Given the prominent role of collateral in debt contracts and credit markets, it is not surprising that collateral has become the central focus of a rapidly expanding body of research.[2] The literature on collateral suggests that credit market-related informational asymmetries may explain why collateral is used in debt contracts. According to this so-called commitment view, collateral mitigates financial frictions arising from moral hazard and adverse selection (Liberti and Sturgess, 2014). Banks accumulate proprietary information about borrowers through lending relationships, which creates informational asymmetries between "inside" banks that are already lending to a firm and "outside" banks that currently are not (Santos and Winton, 2008). Besides relationship lending, recent theoretical studies have highlighted that concentrated bank market structures also facilitate the existence of information asymmetries among lenders (e.g. Dell'Ariccia et al., 1999; Dell'Ariccia, 2001). In the context of these asymmetries, lenders often demand collateral because it mitigates ex-post borrower moral hazard problems: collateral disciplines the borrower and aligns its interests with those of the bank (e.g. Chan and Thakor, 1987; Boot et al., 1991; Chakraborty and Hu, 2006; Brick and Palia, 2007; Berger et al., 2011; Cerqueiro et al., 2015). Collateral also is a signaling device regarding the credit quality of the borrower that mitigates adverse selection problems (Bester, 1985; Besanko and Thakor, 1987; Berger et al., 2011). In other words, when borrowers' credit quality is unknown, high-quality borrowers are more likely to pledge collateral than low-quality borrowers, as by signaling their quality through collateral, the former may secure a lower interest rate on their loans (Jiménez et al., 2006). In addition to these explanations related to information asymmetries, collateral may be required in debt contracts as it minimizes expected loan losses given a borrower's default (Berger and Udell, 1990). Hence, this so-called hedging view proposes that, independent of borrower type and agency risk, pledging collateral provides a hedge against expected default risk (Liberti and Sturgess, 2014). These features imply that collateral is valuable to banks not only should debtors default, but in all stages of the lending process.[3]

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1. See http://www.federalreserve.gov/releases/e2/current/.

2. The literature on collateral covers many different interpretations and theories. Macro-finance investigations highlight the existence of several collateral channels that operate through the effects of fluctuations in collateral values on firms' own debt capacity, other firms' debt financing costs, investment and employment (Gan, 2007; Benmelech and Bergman, 2011; Chaney et al., 2012; Adelino et al., 2015). Fostel and Geanakoplos (2008) present a theory of asset pricing with a collateral channel, in which leverage cycles can cause flights to collateral. Changes in collateral values may affect aggregate output and drive business cycles, through their impact on credit conditions and borrowing (or collateral) constraints (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Caballero and Krishnamurthy, 2001; Iacoviello, 2005; Andrés et al., 2013; Miao et al., 2015). Liberti and Mian (2010) link collateral to the macro financial structure and show that collateral requirements are less severe in more financially developed economies.

3. The value of collateral depends on various factors. Research has been focusing increasingly on the legal and institutional frameworks that protect the enforcement of collateral and creditors' rights; hence, changes in laws governing the seizure

Given the value of collateral for lenders, a natural question is whether loan collateralization may be explained, at least partly, by informational rent extraction. This depends crucially on the existence of informational asymmetries between inside and outside lenders (Schenone, 2010). Informational advantages linked to relationship lending may be used to "hold up" borrowers (Sharpe, 1990; Rajan, 1992; Kysucky and Norden, 2015).[4] Firms will face a cost of borrowing from inside banks that is higher than that from outside banks, due to adverse selection. Empirical validations of this informational rent extraction in the relationship lending literature mainly focus on lending rates (see e.g. Hale and Santos, 2009; Schenone, 2010), while rent extraction operating through non-price terms, such as collateral requirements, has been left largely unexplored.

Besides relationship lending, also the structure of bank lending markets may affect the asymmetric distribution of firm-specific information among inside and outside lenders and hence may facilitate rent extraction as well. We discuss briefly a sequence of theoretical advances that relate market structure to the distribution of information among lenders, which in turn interacts with banks' strategic behavior in determining lending policies and conditions (e.g. Dell'Ariccia, 2001; Marquez, 2002; Dell'Ariccia and Marquez, 2006; Hauswald and Marquez, 2006).[5] First, information extraction is likely to be less effective in markets composed of many small banks compared to those with only a few large banks (Marquez, 2002). Concentrated markets also allow for better protection of proprietary information from spilling-over to competitors, as banks with larger market shares have higher incentives and capacity to maintain this informational advantage. Therefore, concentrated lending markets not only consolidate market shares, but also proprietary information about borrowers. Second, different market structures, which are associated with different implied levels of competition, may also affect the incentive of banks to accumulate information. Increased competition reduces the rents banks can extract, hence decreases the incentives to generate information through credit evaluation (Hauswald and Marquez, 2006). More outside borrowing options for firms in less concentrated markets also inhibit the (re)usability of information and diminishes its value, as firms can switch banks easily; therefore, banks are incentivized to invest less in information production (Boot and Thakor, 2010; Chan et al., 1986; Berlin and Mester, 1999).[6] Third, because of limited outside options, firms are likely to borrow more often from the same lender in concentrated markets, which allows these banks to accumulate more private information. Lastly, consolidation of proprietary information in concentrated markets further deters the entry of new banks, as new entrant banks face larger adverse selection problems. Thus, information consolidation further increases the degree of market concentration and reinforces the information monopoly of incumbent banks (Dell'Ariccia et al., 1999; Dell'Ariccia, 2001). To sum up, these arguments suggest that concentrated markets

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and liquidation of collateral may affect importantly the design of loan contracts, asset liquidation values and bank lending behavior (Haselmann et al., 2010; Vig, 2013; Berkowitz et al., 2015; Cerqueiro et al., 2015; Calomiris et al., 2016).

4. In contrast, inside banks may use their informational monopoly to better evaluate firms in ex-ante screening and ex-post monitoring (Boot and Thakor, 1994). This "information accumulation" view of relationship lending suggests that, as a result, borrowers may obtain better conditions, such as a lower lending rate or less stringent collateral requirements. Hence, relationship intensity is negatively correlated with collateral incidence, as they are substitutes for dealing with information opaqueness. Many empirical studies support this hypothesis (e.g. Petersen and Rajan, 1995; Berger and Udell, 1995; Jimenez et al., 2006; Chakraborty and Hu, 2006; Brick and Palia, 2007; Bharath et al., 2011).

5. We restrict ourselves to theories that relate bank market structure mainly to information asymmetries among inside and outside lenders. Other theories link market structure to collateral incidence through other channels. Manove et al. (2001) propose a "lazy bank" model in which banks choose between screening the borrower or ask for collateral. These authors argue that intensified competition favors bank laziness by reducing screening and requesting more collateral. Hainz et al. (2013) suggest that bank competition makes screening more effective. Hence, collateral, or an alternative to screening, is less required in more competitive markets. Inderst and Muller (2007) develop an inside lenders' based model of collateral which does not assume the existence of information asymmetries on the borrower's side. These authors predict that the incidence of collateral is higher in more competitive markets.

6. If increased competition makes differentiation from outside banks more important, inside banks should acquire information more intensely (Boot and Thakor, 2000 and 2010).

allow for a more efficient extraction of private information and provide stronger incentives to obtain it; offer better protection of this information from spilling over to competitors (outside banks); and deter the entry of competitors which self-reinforces information monopolies. A straightforward implication is that concentrated markets may also facilitate informational rent extraction. The role of concentrated market structures in extracting informational rents, however, receives very little attention in the empirical literature.

In this paper, we intend to fill the gap by examining if inside information, obtained through both relationship lending and concentrated market structures, allows banks to extract informational rents through collateral. That is, more intense lending relationships and more concentrated markets are associated with a higher probability of collateral incidence. We use a unique data set of loan-specific information including data on collateral for a large group of Chinese banks.

One of the main difficulties here is to isolate informational rent extraction from alternative theories that predict the same outcome. In terms of relationship lending, at least three theories other than informational rent extraction also predict a positive association of relationship lending with collateral incidence. Longhofer and Santos (2000) suggest that pledging collateral improves the seniority of the bank's debt claims, which incentivizes the bank to engage in ongoing, long-term lending relationships. Borrowers benefit from this, because bank seniority induces relationship lenders to provide support to distressed borrowers, as the senior debtors gain the most from a turn-around of the firm.[7] Dewatripont and Maskin (1995) highlight another potential cost of relationship lending which hinges on the observation that relationship lenders have the incentive to extend further credit when borrowers are in financial distress in the hope of recovering loans granted previously. Anticipating the ex-post realization of this "soft budget constraint", the borrower is not sufficiently incentivized to make an effort ex-ante to prevent such an adverse outcome ex-post. Collateral is therefore more likely to be requested when bank-firm relationships intensify in order to solve this constraint (Boot, 2000). Both theories suggest that when borrower risk increases, relationship lenders are more likely to request collateral either because the likelihood of a future rescue increases or the soft budget constraint intensifies. Lastly, Menkhoff et al. (2006) suggest banks may extend relationship length (intensity) to minimize the per unit fixed costs associated with the evaluation and monitoring of collateral ("cost minimization incentive"), which *de facto* produces a positive correlation between collateral and relationship duration (intensity). In terms of market structure, the positive association of market concentration with collateral may also be explained by bank market power, i.e. banks can exploit their sheer market power in concentrated markets by imposing more stringent collateral requirements (Hainz, 2003; Berlin and Butler, 2002).

Informational rent extraction depends crucially on information asymmetries existing among inside and outside lenders, while this precondition is not conducive to the core argument in the alternative theories. This observation leads to an intuitive identification strategy: if inside banks extract informational rents through collateral, their ability to do so should be moderated after some exogenous shock that reduces information asymmetries existing between inside and outside banks. If this moderated effect is not validated empirically, one can reject the informational rent hypothesis and attribute the higher incidence of collateral of loans granted by inside banks to competing interpretations. To this end, we follow Schenone (2010) and introduce

7. See Elsas and Krahen (2000) for further discussion and empirical testing of this argument. Their results indicate that "house" banks require more collateral as compensation for their active involvement in the restructuring of distressed borrowers.

the equity IPO of borrowing firms as such an information-releasing shock.[8] In the course of the public offering and after being listed, previously privately-held information about the firm will be released through compulsory listing requirements and subsequent regular financial reporting, public auditing, financial analysts' research and movements in its stock price. As this new information is made public to all banks, the informational monopoly position of inside banks is eroded and the adverse selection problem facing outside banks is alleviated, leading to a lesser likelihood of rent extraction for loans granted after the IPO than for loans granted before the IPO. One crucial part of the methodology is to control for shifts in firm risk around the time of the IPO or for differences in risk between listed and non-listed firms, so that changes in collateral incidence before and after the IPO can be attributed to changes in information asymmetries and are not caused by differences in firm risk before and after the IPO. We control for this by incorporating firm risk characteristics from both before and after the IPO, and conduct additional robustness tests. To the best of our knowledge, our paper is the first to apply equity IPOs as the identification strategy to test if banks charge informational rents through collateral.

Unlike most studies on informational rent extraction which focus on advanced economies, we concentrate on China, which is an ideal testing ground for our purpose, for several reasons. First, collateral is particularly important in markets where banks lack sufficient tools or expertise to price credit risk, or are inhibited to do so due to price regulations. This has been the case in Chinese bank lending markets for many years. An additional incentive to request collateral in these markets is to reduce the personal risks faced by loan officers, as the "loan officer responsibility system" introduced in 2002 holds individual loan officers accountable for bad loans (Qian et al., 2015). Second, Chinese banking has been characterized by strict interest rate controls, which only very recently have been lifted completely. This suggests that banks have had less discretion in setting prices compared to their counterparts in advanced economies, making rent extraction through collateral an attractive alternative. Third, the protection of creditor rights in China was strengthened after the approval of the Property Law of the People's Republic of China in 2006 (Berkowitz et al., 2015), which increased the value of collateral. As our sample starts in 2007, informational rent extraction though collateral may have become more valuable since then, given the enhanced credit rights protection embedded in the new law. Fourth, bank lending markets in China are relatively segmented and offer significant variation across regions and time. This feature allows us to test if collateral requirements vary with the information configurations embedded in regional bank market structures. Finally, the particular features of equity IPO regulations and procedures in China make IPOs a valid choice as an exogenous informational shock for Chinese credit markets. Firms might expect to go public at some point, but the exact timing of an IPO depends on the approval by the China Securities Regulatory Commission (hereafter the CSRC), which is unpredictable and exogenous to both banks and firms, suggesting that adjustments of loan contract terms prior to an IPO are hardly economically viable. We manually collect information on loans obtained by firms listed at the Shenzhen Stock Exchange, both before and after their listing. These firms are generally large and information about them is more symmetrically distributed among lenders. Focusing on this sample will bias *against* finding informational rent extraction, as one would expect that the "hold up" problem is particularly pronounced for smaller firms. Hence, our sample composition should be a safeguard against obtaining results biased by firm size.[9] To test our hypotheses, we use a unique hand-

8. A similar approach has been followed by Santos and Winton (2008) and Hale and Santos (2009) using corporate bond IPOs as informational equalization shocks. These papers together with Schenone (2010) investigate informational rent extraction through lending rates.

9. Berger et al. (2011) point out that testing informational rents related to relationship lending by using a sample of small firms could bias the results towards a positive coefficient for the relationship lending variable, because small and opaque firms are precisely the ones required to pledge collateral (according to "observed-risk" hypothesis), and banks tend to use relationship lending to deal with these informational opaque firms.

collected loan level dataset containing data on around 9,000 loans granted by a differentiated group of Chinese banks to 649 listed non-financial firms.

Our main results can be summarized as follows. First, all else equal, both high relationship intensity and concentrated market structures are associated with higher incidence of collateral, and these effects are less pronounced for transparent firms. We further find that there exists a boundary transparency level beyond which informational rent extraction becomes infeasible.

Second, when applying equity IPOs as an informational shock, we find for pre-IPO originated loans that the likelihood of collateralization is increasing with relationship intensity, while this effect is greatly moderated for post-IPO loans. In some specifications, relationship intensity is no longer significant in predicting collateral incidence for loans originated after the IPO. In contrast to Schenone (2010), which shows for a US sample that the lending spread is decreasing with relationship intensity once the borrower is listed, we do not find a similar pattern for collateral. The relatively low degree of competitiveness of the Chinese banking sector relative to that in the United States might explain this result.[10]

Third, the likelihood of collateral incidence increases with the degree of market concentration both before and after the equity IPO, but the effect is moderated for post-IPO loans. This finding supports the hypothesis that concentrated markets facilitate information asymmetries among lenders and hence are associated with a higher likelihood of rent extraction through collateral. Unlike relationship intensity, the impact of market structure on collateral remains significantly positive and economically large for post-IPO loans. This lends some support to the idea that pure market power stemming from concentrated market structures may allow banks to charge rents, regardless of the level of information asymmetries existing among banks (Hainz, 2003; Berlin and Butler, 2002).

Fourth, using a novel measure of firm risk – whether a firm's first IPO application was rejected by the CSRC or not – we find that once information about firm risk is made public after the IPO, rent extraction through collateral is moderated for safe firms but intensified for risky firms. This result is in line with the theoretical prediction of Rajan (1992) that informed banks are more able to extract rents from risky firms than from safer ones. Our finding further complements Hale and Santos (2009) who report similar results for lending rates.

Finally, we find that more risky firms are more likely to pledge collateral, a result consistent with the "observed-risk" hypothesis (e.g. Boot et al., 1991; Boot and Thakor, 1994). Furthermore, our evidence shows that private firms are much more likely to pledge collateral when compared to state-owned firms, adding to previous findings that private firms in China are charged with higher lending rates in a state-dominant banking system (Cull and Xu, 2003; Allen et al., 2005). To the best of our knowledge, we are the first to investigate collateral incidence in Chinese bank lending markets with loan-level data.[11]

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10. If the relationship lender is facing limited competition (for instance due to restrictions on business scope, geographical restrictions on branch expansion and funding limitations for potential competitors), this bank will not share rents (surpluses) with borrowers or soften its lending standards relative to transaction based lenders simply because its informational advantage is diminished after its IPO.

11. Very few studies have investigated the determinants of collateral in China. Notable exceptions include Firth et al. (2012) and Chen et al. (2013). However, none of these studies investigates the determinants of collateral at the loan-level and pays attention to the importance of relationship lending and market structure for the incidence of collateral, as well as how changes in information asymmetries among lenders may affect these linkages.

Overall, our findings are largely consistent with the informational rent extraction hypothesis, but with two important caveats. First, our results may be explained by alternative theories. Second, the potential endogeneity of key variables could bias our results.

Regarding the first caveat, we contrast the informational rent hypothesis with three alternative explanations. First, both the "bank seniority" and "soft-budget constraint" theories suggest that relationship lenders require less collateral for financially healthier firms. If listed firms are financially sounder than non-listed firms and our analysis has not fully controlled for this difference, the moderated effect of relationship lending on collateral incidence for post-IPO loans could also be explained by these theories. We apply three tests to address this concern. As a first step, we investigate if listed firms are financially healthier than non-listed ones by comparing observed risk proxies. We do not find supporting evidence both in our sample and from previous studies investigating this issue. Then, to address potential selection bias caused by observables, we employ propensity score matching to generate a matched sample of loans that are "identical" in every aspect, expect for the borrower's listing status. We re-estimate the baseline model for this matched sample and find that the results do not change materially. Finally, we address unobserved risk differences by using a recursive bivariate Probit model with instrumental variables, which we discuss below.

The second alternative explanation is related to selection effects based on differences in firms' credit quality. Suppose "relationship dependent" listed firms that obtained loans were on average safer than "relationship dependent" non-listed firms, while "relationship non-dependent" listed firms which received loans were on average riskier than "relationship non-dependent" non-listed firms. This selection effect could explain the moderated effect of relationship lending on collateral incidence that we find for post-IPO loans. To investigate the relevance of this effect, we perform difference-in-difference tests for observed risk proxies broken down by whether a firm is relationship dependent and whether the loan is borrowed after the equity IPO. We do not find any evidence to support this explanation. As a further robustness test, we use propensity score matching to identify matching firms that differ only in their relationship dependencies within both pre- and post-IPO loan samples, and compare the average treatment effects of relationship dependencies on collateral between these two samples. In this way, we can discard of the alternative explanation that some unobserved shifts in firm-risk or heterogeneous dynamics of risk shifting due to the equity IPO drive our results, because we compare matching firms within both pre- and post-IPO samples. We find for the pre-IPO sample that relationship dependent firms are on average 10-12% more likely to pledge collateral than non-dependent firms, while no such difference exists for the post-IPO sample (Internet Appendix A).

The third alternative explanation that we explore is that banks exchange better loan conditions (i.e. a lower likelihood of required collateral) for corporate bond underwriting business.[12] This behavior potentially also may explain the moderated effect of relationship lending on collateral incidence that we find for post-IPO loans, given that most firms have their bond IPO after their equity IPO and that relationship lenders generally are involved extensively in the bond

12. If firms issued for the first time in public corporate bond markets (e.g. bond IPO) prior to their equity IPO, the latter may not serve as the sole significant event of information equalization, as corporate bond IPOs also require extensive information disclosure. This issue is not a major concern in our sample, because only three firms issued corporate bonds before their equity IPO, which does not affect our choice of equity IPOs as the main information disclosure event. Another issue is that commercial banks may promise favorable loan contract terms in exchange for underwriting a firm's equity IPO, which can lead to alternative explanations of our results (see discussion in Schenone, 2010). This concern is alleviated for China, because equity IPOs are strictly underwritten by security firms instead of commercial banks.

IPOs of their borrowers. To isolate this alternative explanation, we re-estimate the baseline model on samples of loans that were originated before the bond IPOs. Also here, our results hold.

Our previous framework relies on the important assumption that the equity IPO and relationship lending variables are exogenous. In reality, both could be endogenous due to omitted variables, therefore generating biased estimations. For instance, there could be uncontrolled variables that improve a firm's likelihood to obtain a listing and at the same time reduce the likelihood of its loans being secured by collateral. Therefore, the moderated effect of relationship lending on collateral incidence for post-IPO loans could be the result of unobserved higher credit quality of listed firms instead of reduced information asymmetries. A similar endogeneity problem applies to relationship lending. Firms of lower credit quality, which is unobserved to the econometrician but known to all banks, may be more likely to borrow from relationship lenders while at the same time being subjected to more stringent collateral requirements. Hence, the higher likelihood of collateral required for relationship loans might simply reflect a firm's unobserved poor credit quality instead of an informational "hold up" problem. To address these concerns, we employ recursive bivariate Probit models to test if the listing status and relationship dependency are endogenous and if our results change after controlling for the endogeneity of the respective variables. In both cases, we find appropriate instrumental variables, so that the identification does not rely solely on the non-linearity of the functional form. In doing so, we derive novel instrumental variables for the IPOs from exogenous policy shocks such as the CSRC IPO suspensions. Our main results also hold after controlling for the endogeneity of both IPOs and relationship lending.

In addition, we perform several tests to investigate if our results are robust to the inclusion of firm fixed effects; the possible endogeneity of other loan contract terms (by both removing these variables and estimating IV Probit models); and to alternative samples. In a set of unreported robustness tests, we further investigate if our results hold when using alternative relationship lending measures and controlling for regional legal and institutional differences that potentially may determine the likelihood of collateral incidence. These tests do not change our results.

The remainder of the paper is organized as follows. Section 2 details our methodology and data. Section 3 presents the main empirical results. Section 4 compares our conclusions with alternative theories. Section 5 controls for endogeneity problems related to IPOs and relationship lending. Section 6 reports the results of further robustness tests. Finally, Section 7 concludes. Additional results are reported in an Internet Appendix to this paper.

2 Methodology and data

2.1 *Methodology*

The methodology of the main analysis contains four parts. First, we investigate if the likelihood of collateral incidence increases with relationship lending and market concentration, after controlling for a broad range of other determinants. The second part attempts to find evidence that the increasing likelihood of collateral incidence is at least partially due to information asymmetries between inside and outside banks. To this end, we test if the effects of relationship lending and market concentration on collateral are less pronounced for transparent firms, using various information transparency proxies. The third part investigates if informational rent extraction is moderated for post-IPO loans relative to pre-IPO loans. Finally, we investigate if this moderated effect for post-IPO loans varies with firm risk. We discuss the methodologies related to alternative explanations, testing of endogeneity of key variables, and further robustness tests in Sections 4, 5 and 6, respectively.

2.1.1 RELATIONSHIP LENDING AND MARKET STRUCTURE AS DETERMINANTS OF COLLATERAL INCIDENCE

We start by testing whether relationship lending and market structure are positively correlated with collateral in a cross-sectional setting. As discussed in the introduction, a positive correlation between relationship intensity and collateral does not automatically imply "informational rent extraction", because at least three competing theories predict the same result (e.g. "bank seniority", "soft budget constraint" and "cost minimization incentive"). In contrast, a negative correlation would support the "information accumulation" view, which considers relationship lending and collateral as substitutes (e.g. Petersen and Rajan, 1995; Berger and Udell, 1995; Bharath et al., 2011). With respect to market structure, a positive association with collateral would not unequivocally suggest informational rent extraction, but could also imply the use of sheer market power in concentrated markets (e.g. Hainz, 2003; Berlin and Butler, 2002). Hence, we postulate the following hypotheses:

H.1: If relationship lending is negatively related to collateral incidence, the information accumulation view holds. In contrast, a positive correlation would reject this.

H.2: Concentrated markets allow for a higher probability of collateral incidence, either because of the existence of informational monopolies, more market power or both.

To test these hypotheses, we estimate the following Probit model:

$$\mathrm{P(Collateral_{il})} = \mathrm{F}\big(\beta_0 + \beta_1 \mathrm{Sizeconcen_{il}} + \beta_2 \mathrm{ACR4_{il}} + \textstyle\sum_{j=1} \sigma_j \mathrm{Relcontrols_{il}} + \rho \mathrm{IPO_{il}} + \sum_{j=1} \varphi_j \mathrm{FC_{il}} + \sum_{j=1} \theta_j \mathrm{LC_{il}} + \sum_{j=1} \gamma_j \mathrm{MC_{il}} + \sum_{j=1} \delta_j \mathrm{RC_{il}} + \sum_{j=1} \alpha_j \mathrm{FE_{il}}\big) \quad [1]$$

where *i* indexes for firm, *l* for loan number, and *F(.)* is the cumulative distribution function of the standard normal distribution. The dependent variable $Collateral_{il}$ is a binary variable that equals one if loan *l* extended to firm *i* is collateralized and zero otherwise. IPO_{il} is a dummy that equals one if a loan is issued after the borrower's IPO and zero otherwise.

The strength of bank-firm relationships is traditionally measured by relationship duration, defined as the time difference between the first loan obtained and the current one (see e.g. Petersen and Rajan, 1995; Berger and Udell, 1995). As suggested in Schenone (2010), duration may not fully capture how dependent a firm is on its current lender or how "locked in" the firm is in the lending relationship. Hence, following Schenone (2010), we measure bank-firm relationships by the intensity with which the borrower turns to the same lender. This measure, which we call *Sizeconcen* $_{il}$, is defined as the amount of loans that firm *i* borrowed from its current lender as a proportion of the total amount of loans which the firm obtained prior to the current loan.[13] By definition, *Sizeconcen* $_{il}$ takes values between zero and one. Borrower *i* is more dependent on the lender if *Sizeconcen* $_{il}$ is closer to one. This measuring of relationship lending essentially takes into account what the relative importance of a lender is to the borrower, compared to other lenders. The next set of controls *Relcontrols* $_{il}$ accounts for additional features of relationship lending that can affect collateral incidence, including: The number of different lenders firm *i* has borrowed from prior to the current loan, *Numlender* $_{il}$; whether the current loan is the first loan borrowed from the lender, *First* $_{il}$; and whether the current lender is different from the previous lender, *Switch* $_{il}$. *Numlender* $_{il}$ controls for the fact that the same value of *Sizeconcen* $_{il}$ does not preclude that a firm has borrowed from a different number of banks. For instance, a loan associated with a value for *Sizeconcen* $_{il}$ of 0.5 can be the result of borrowing from two banks, with each accounting for half of the total loans, or borrowing from five banks, with the largest loan accounting for half of the total loans. Moreover, the first loan from a specific lender (*First* $_{il}$) might be subject to different collateral requirements. Finally, we include *Switch* $_{il}$ to control for the possibility that banks may condition their collateral requirements depending on whether they can also provide subsequent loans to the same borrower, for instance to minimize costs of collateral evaluations. For all these variables, loans originated by either the parent bank or a subsidiary are treated as loans from the same lender, since it is likely that the information available about the borrowing firm is shared within all subsidiaries.

Market structure is measured by the concentration ratio *ACR4* $_{il}$, which is defined as the share of total assets of the four largest banks as a percentage of the total assets of all banks in each province at the time of one semi-accounting year prior to the current loan.[14] We treat each province as a separate banking market.

The set of variables FC_{il} accounts for firm characteristics that are likely to affect collateral. These include the age of the firm in (log) months, *Age* $_{il}$; (log) total assets, *Size* $_{il}$; current assets over total assets, *Liquidity* $_{il}$; return on total assets, *ROA* $_{il}$; tangible assets over total assets, *Tangibility* $_{il}$; and a firm's ownership dummy, *FT* $_{il}$, which equals one if the Chinese State is the majority owner and zero if majority ownership lies in the private sector. Following Berger and Udell (1990), we also control for loan concentration measured by the ratio of the size of loan *l* relative to the total amount of debt outstanding prior to the origination of loan *l* (*Loanconcen* $_{il}$); a higher value of this variable indicates that loan *l* represents a relatively large portion of firm's *i* debt and hence potentially may be more likely to be collateralized. These variables are obtained from the semi-annual financial reports that were published the closest to the moment before the

13. We employ another relationship measure, Numconcenil, defined as the number of loans that firm i borrowed from its current lender as a proportion of the total number of loans which the firm obtained prior to the current loan, as a further robustness check. Our main results are not sensitive to this alternative measure. Results are available upon request. The implicit assumption of Numconcenil is that the inside lender is more informed than outside lenders if the firm borrows more times from its current lender, while the amounts borrowed are irrelevant for the accumulation of information. As it is expected that banks devote more efforts in assessing firms that borrow larger amounts and subsequently accumulate more firm-specific information if the loan is relatively large, *Sizeconcen* $_{il}$ is probably a more precise measure of firm-bank relationships.

14. For our purpose, market structure should be measured at the regional level. The concentration ratio is the only measure available of regional market structures. Market structure is closely related to competition. For a discussion of bank competition in China and the results for various competition measures see Xu et al. (2016).

loan was originated. This procedure ensures that in our estimations, banks use the most recent publicly available accounting information at the time of issuing the loan. All variables in monetary term are deflated to 2006 RMB.

The set of controls LC_{il} covers loan characteristics, such as the maturity of loan *l* in (log) months, *Maturity*$_{il}$; its (log) size in real terms (deflated to 2006 RMB), *Loansize*$_{il}$; and the difference between its lending rate and the benchmark deposit rate of a corresponding maturity, *Spread*$_{il}$. We also control for monetary policy and regional macro-economic factors (MC_{il} and RC_{il}, respectively) that potentially can influence the pledging of collateral (e.g. Boot et al., 1991; Kiyotaki and Moore, 1997; Jimenez et al., 2006). Monetary policy controls include the reserve requirements ratio, *RRR*$_{il}$ and the 7-day repo rate, *Repo*$_{il}$. These variables are matched to the month when the loan was originated. Regional macro-economic controls are the provincial real GDP growth rate (deflated with national CPI), *Realgdpindex*$_{il}$; the provincial non-performing loan ratio, *NPLratio*$_{il}$; and the provincial consumer price index, *CPI*$_{il}$. These variables are matched to one semi-accounting year before the loan was originated. All these data come from the CEIC database.

The last set of controls are fixed effects (FE_{il}) for time (*Time*), bank-type (*Banktype*), province (*Prov*) and industry-type (*Indu*). Time fixed effects capture differences in collateral requirements related to the business or credit cycle at the national level. Bank-type fixed effects control for systematic differences in bank propensities to require collateral. Provincial fixed effects capture systematic differences in collateralization policies across provinces. Industry dummies control for differences in technology, production and market conditions across different industries, which may account for systematic differences in borrowers' risks. Some strategic or government supported industries might enjoy subsidies or favorable loan contract terms, which should also be accounted for by industry dummies. In total seven time dummies, 31 provincial dummies, seven bank type dummies and 51 industries dummies are introduced.

2.1.2 INFORMATIONAL RENTS AND BORROWER TRANSPARENCY

As a next step, we investigate if the likelihood of rent extraction through collateral, related to relationship lending and market concentration, is at least partially due to the informational "hold up" problem. To this end, we test if the effects of relationship lending and market concentration on collateral incidence are less pronounced for transparent firms, because information about these firms is more widely distributed among all lenders. Specifically, we test the following specification:

$$\mathrm{P(Collateral_{il})} = \mathrm{F}\big(\beta_0 + \beta_1 \mathrm{Sizeconcen_{il}} + \beta_2 \mathrm{ACR4_{il}} + \beta_3 \mathrm{Sizeconcen_{il}} * \mathrm{Infor_{il}} + \beta_4 \mathrm{ACR4_{il}} * \mathrm{Infor_{il}} + \omega \mathrm{Infor_{il}} + \sum_{j=1} \sigma_j \mathrm{Relcontrols_{il}} + \rho \mathrm{IPO_{il}} + \sum_{j=1} \varphi_j \mathrm{FC_{il}} + \sum_{j=1} \theta_j \mathrm{LC_{il}} + \sum_{j=1} \gamma_j \mathrm{MC_{il}} + \sum_{j=1} \delta_j \mathrm{RC_{il}} + \sum_{j=1} \alpha_j \mathrm{FE_{il}}\big) \quad [2]$$

where an informational transparency measure *Infor*$_{il}$ (higher value representing higher firm transparency) is interacted with the relationship lending and market structure variables (*Sizeconcen*$_{il}$ and *ACR4*$_{il}$, respectively). If $\beta_1 > 0$ and $\beta_3 < 0$, or respectively $\beta_2 > 0$ and $\beta_4 < 0$, it would lend some support to the idea that relationship lending respectively concentrated markets facilitate informational rent extraction, and that rent extraction is relatively more difficult if borrowers are transparent.

We apply two sets of transparency measures ($Infor_{il}$): transparency based on firm characteristics, and transparency linked to information generated by the stock market. The first set of transparency measures includes: listing board ($Listmain_{il}$); firm ownership (FT_{il}); and firm size ($Medianta_{il}$). $Listmain_{il}$ is a dummy variable that equals one if the firm is listed at the main board of the Shenzhen Stock Exchange, and zero if the firm is listed either at the small and medium-sized firms' board (SME board) or the China Next board (ChiNext board).[15] Firms listed at the latter two boards are typically smaller or high-tech firms, which should be more informational opaque. With respect to FT_{il}, since nearly all banks in China are fully or partly owned by the state, banks should be better informed about state-owned firms than about private firms. Finally, firm size is a standard measure of informational transparency, with smaller firms considered to be more informational opaque. We define a dummy $Medianta_{il}$ that equals one if the firm's total assets are above the provincial median, and zero otherwise.

The second set of transparency measures is related to stock market information production. Specifically, we postulate that firm transparency increases with the number of financial analysts following the firm ($Numalst_{il}$), and the percentage of shares held by non-bank institutional investors ($Instishare_{il}$). Furthermore, we investigate if the information spill-over from the stock market generates a boundary transparency level beyond which inside and outside banks are equally informed, and inside banks can no longer extract informational rents. As these information production variables are available only after the listing of the firm, we restrict in this case the sample exclusively to post-IPO loans.

However, since these informational transparency proxies are also correlated with the probability of firms' financial distress or bargaining power, this identification strategy cannot fully differentiate the "hold-up" problem from competing theories. For instance, under the assumption that larger firms are less likely to face financial distress when compared with smaller firms, these firms have less incentives to pledge collateral to relationship lenders in exchange of a possible future rescue, leading to a smaller impact of relationship intensity on collateral incidence of the former relative to the latter firms. Moreover, the implicit guarantee enjoyed by state owned firms may render collateral irrelevant in exchange for possible future support from their relationship lenders, which can lead to a lower impact of relationship intensity on collateral incidence for these firms. Similarly, as larger firms or state owned firms may have greater bargaining power, market structure could affect their collateral pledging less than in the case of smaller or private firms. The stock market information production measures could also be positively related to firm size or financial health. Namely, larger firms are generally followed by a greater number of analysts, and non-bank institutional investors are more likely to invest in financially stronger firms. These arguments suggest that the coefficients of the interaction terms should be negative, a result that may be independent from the informational rent extraction hypothesis. To better test this hypothesis, we use equity IPOs as informational equalization shocks that reveal information to all banks and therefore reduce the capacity of inside banks to extract informational rents.

2.1.3 EQUITY IPOS AS STRATEGY TO IDENTIFY INFORMATIONAL RENT EXTRACTION

This subsection formulates the methodology applying equity IPOs to identify informational rent extraction. This strategy hinges on the following observations. Before an IPO, inside banks enjoy superior information obtained from lending relationships, which allows for rent extraction through

15. The listing boards are unknown for loans obtained before the listing. However, both firms and banks should have some idea about which listing board will be the most likely outcome when the firm applies for an IPO, given the characteristics of the firm. The lengthy approval process of the CSRC also suggests that firms need to decide at which board they will list long before the actual listing. As a robustness check, we reproduce the *Listmain* regression using loans issued only after listing. Our results hold for this alternative sample as well. Results are available upon request.

collateral. After an IPO, the constant release of information and market monitoring avoid that any inside bank obtains or maintains an informational monopoly position, therefore alleviating the adverse selection problems facing outside banks. Furthermore, a secondary effect might be at work which can reinforce the direct effect of an IPO in reducing information asymmetries among inside and outside banks. Because an IPO will reveal information to all banks, inside banks are less incentivized to acquire additional but costly information to maintain their informational monopoly. This may be caused by a decreasing return on investment in information or an increasing cost of accumulating additional information in markets where all banks are well informed. Banks may also free-ride when costly information can be produced and disseminated by the stock market. With less investment in information production after an IPO, information asymmetries among banks are reduced further. These arguments suggest that the informational monopolies of inside banks are greatly reduced after IPOs, making rent extraction through collateral less likely.

Similar arguments apply to market structure. As discussed in Section 1, when borrowers lack a credible channel for disseminating information, such as before an equity IPO, concentrated markets permit more efficient information extraction (Marquez, 2002), better re-usability of information (Boot and Thakor, 2010; Chan et al., 1986; Berlin and Mester, 1999), better protection of information from spilling over to outside banks and deterring entry of competitors which self-reinforces information monopolies (Dell'Ariccia et al., 1999; Dell'Ariccia, 2001). After an IPO, information is made public to outside banks through regularly published financial statements, public auditing, financial analysts' research and movements in stock prices. Hence, the contribution of market concentration in facilitating the existence of information asymmetries among lenders becomes less important, which erodes the possibility of informational rent extraction.

We formulate the following hypotheses:

H.3: If relationship lenders extract informational rents through collateral, this will be more likely for loans originated before the equity IPO and less likely for those originated after the IPO. If this moderated effect for post-IPO loans is not supported by the empirical results, alternative theories should explain the positive correlation between relationship lending and collateral incidence.

H.4: The positive correlation of market concentration with collateral should be mitigated by the informational shock of an equity IPO. If this result is not established, the positive impact of market concentration on collateral incidence is attributed to market power.

To test these hypotheses, we introduce the interaction terms of the relationship intensity and market structure variables, respectively, with the dummy variable *IPO* in *Equation (1)*, which yields *Equation (3)*:

$$\mathrm{P(Collateral_{il})} = \mathrm{F}\big(\beta_0 + \beta_1 \mathrm{Sizeconcen_{il}} + \beta_2 \mathrm{ACR4_{il}} + \beta_3 \mathrm{Sizeconcen_{il}} * \mathrm{IPO_{il}} + \beta_4 \mathrm{ACR4_{il}} * \mathrm{IPO_{il}} + \sum_{j=1} \sigma_j \mathrm{Relcontrols_{il}} + \sum_{j=1} \mu_j \mathrm{Relcontrols_{il}} * \mathrm{IPO_{il}} + \rho \mathrm{IPO_{il}} + \sum_{j=1} \varphi_j \mathrm{FC_{il}} + \sum_{j=1} \theta_j \mathrm{LC_{il}} + \sum_{j=1} \gamma_j \mathrm{MC_{il}} + \sum_{j=1} \delta_j \mathrm{RC_{il}} + \sum_{j=1} \alpha_j \mathrm{FE_{il}}\big) \quad [3]$$

where IPO_{il} equals one if loan *l* is issued after the IPO and zero otherwise. Informational rent extraction by relationship lenders is identified if $\beta_1 > 0$ and $\beta_3 < 0$. Similarly, market concentration facilitates informational rent extraction if $\beta_2 > 0$ and $\beta_4 < 0$. If $\beta_3 < 0$ or $\beta_4 < 0$ is rejected, the positive coefficients of β_1 and β_2 should be explained by other theories. We include the interaction term $Relcontrols_{il} * IPO_{il}$ to control for the possible heterogeneous impact of other relationship characteristics on collateral incidence before and after the IPO.

Two important caveats must be kept in mind. First, as discussed in Section 1, the moderated effect of relationship lending on collateral could be explained by theories other than informational rent extraction. We discuss and test these alternative explanations in Section 4. A second caveat is related to the endogeneity assumptions related to the equity IPOs and relationship lending. In practice, both variables could be endogenous due to omitted variables. We address this issue using recursive bivariate Probit models in Section 5. We discuss some further robustness tests in Section 6.

2.1.4 INFORMATIONAL RENT EXTRACTION AND FIRM RISK

Rajan (1992) suggested that inside banks can charge informational rents more easily from riskier borrowers than from safer ones, because outside banks will be less inclined to lend once the borrower is revealed as risky. This view suggests that when information asymmetries between inside and outside banks are reduced, rent extraction will decline for safer firms but not for risky ones. We test if this prediction applies to collateral as well (see Hale and Santos, 2009, for similar tests using bond IPOs on lending rates).

We propose a novel measure of firm risk: whether the first IPO application of a firm was rejected by the CSRC or not, $Multiapp_{il}$. A firm's listing request can be rejected by the CSRC on many grounds, such as cash-flow problems, uncertain or weak profitability perspectives, vague corporate governance structures or suspicious earnings, all of which suggest the potential existence of risk factors that do not meet the CSRC's listing requirements. In a way, this measure is similar to a credit rating (see Hale and Santos, 2009), but now the firm is rated by a government body instead of private sector rating companies. To test this hypothesis, we expand the baseline *Equation (3)* with three-way interaction terms between informational rent variables ($Sizeconcen_{il}$ and $ACR4_{il}$), IPO_{il}, and the firm risk proxy $Multiapp_{il}$.

2.2 *Data*

We manually collect *loan-level* data from the financial reports of listed firms, published by Wind Finance Co., Ltd. Hence, our analysis departs importantly from most studies on Chinese loan markets, which either use yearly aggregate *firm-level* data from the China Securities Markets and Accounting Research Database (CSMAR) (e.g. Firth et al., 2012; Chen et al., 2013) or rely on loan-level datasets provided by a *few* state-owned banks (Chang et al., 2014; Qian et al., 2015).

Our dataset consists of 10,654 loans made to 676 firms listed at the Shenzhen Stock Exchange (SZSE) between 2007 and 2013.[16][17] The size of the sample is reduced by some recording errors, incomplete loan contract information and questionable financial data. In

16. We concentrate on firms listed at the Shenzhen Stock Exchange because they are more diverse in terms of size and industry when compared with those listed at the Shanghai Stock Exchange. Our sample starts in 2007 because listed firms were required to comprehensively report their loan records from 2007 onwards.

17. Unfortunately, listed firms do not report if their loans are syndicated loans or not. This shortcoming is unlikely to affect our analysis as syndicated loans are rare in China. Pessarossi et al. (2012) investigate syndicated loans obtained by Chinese listed firms for the period 1999-2009. Only a very small sample of 92 syndicated loans was registered for this period. The syndicated loan market in China amounted to less than 30 billion dollars in 2009 (Dealscan), a very small number compared to the total amount of loans outstanding.

particular, loans issued at rates below the lending rate floor (i.e. below 90% of the baseline lending rate) are removed, because these loans are likely to have been issued at non-commercial terms. We further remove loans to financial institutions and loans made in foreign currencies. This all reduces our database to 9,288 loans provided to 649 listed non-financial firms. Our database provides information on multiple borrowings by each firm (on average, each firm has 20 loans in our sample) and from multiple banks (on average four banks per firm), including almost all types of Chinese banks.

Summary statistics of all variables are provided in Table I. 66% of the loans in our database are collateralized, which is comparable to figures recorded for other emerging market economies, such as 53% for Mexico (La Porta et al., 2003) and 72% for Thailand (Menkhoff et al., 2006). Our main relationship variable $Sizeconcen_{il}$ has an average value of 0.33, suggesting that on average around one third of the amount of loans is obtained from the current lender. The concentration ratio $ACR4_{il}$, which is our proxy for market structure, has an average of 0.55, indicating that the four largest banks in each province on average hold 55% of the total provincial banking assets.

The summary statistics for IPO_{il} show that 83% of the loans in our sample were issued after an IPO. Among the 649 firms in our sample, 111 firms reported at least one loan before their IPO and at least one after; in total these firms had 2,181 loans, representing 23% of all loans. The rest of the firms only had loans either before their IPO (142 firms with 660 loans) or after (396 firms with 6,447 loans). Furthermore, our sample consists of relatively old (on average 13 years) and large firms (average total assets of RMB 2,139.5 million). Regarding firm ownership (FT_{il}), firms with state majority ownership represent 33% of all firms in our sample and take up 40% of all loans.

Regarding the controls for loan characteristics, the average maturity of the loans in our sample ($Maturity_{il}$) is around two years (25.9 months), while average size ($Loansize_{il}$) in real terms is RMB 62.6 million. The average spread between loan lending rates and corresponding deposit rates ($Spread_{il}$) is 2.85%.

Of the other controls, we provide further detail only for the variable that we used to investigate rent extraction and firm risk, i.e. $Multiapp_i$ that measures if the firm is rejected in its first IPO application. 40 firms, or around 7% of all firms, were rejected for IPO evaluation when they applied for the first time (but were eventually listed, after multiple applications). Definitions and summary statistics of instrumental variables and additional variables are discussed in their respective sections, but are all reported in Table I, panels F and G.

Table I: Summary statistics and variable definition

Variable	Definition	N	Mean	S.D	Min	Max
Panel A: Market structure						
ACR4	The market share (in terms of assets) of the top four banks in the province. Measured at one semi-accounting year prior to current loan.	9288	0.55	0.06	0.35	0.97
Panel B: Firm characteristics						
Size	Natural logarithm of total assets in millions of RMB deflated to year 2006 value. Measured at one semi-accounting year prior to current loan.	8779	7.67	1.16	4.01	12.72
Leverage	Outstanding debt/total assets, measured at one semi-accounting year prior to current loan.	8779	0.56	0.19	0.02	2.37
ROA		8779			-0.44	1.71

	Return on assets, measured at one semi-accounting year prior to current loan.		0.06	0.07		
Age	Natural log of firm age. Firm age is the difference in months between the firm's establishment date and the loan initiation date.	9288	5.03	0.40	2.77	6.62
Tangibility	(Net property, plants and equipment)/total assets, measured at one semi-accounting year prior to current loan.	8779	0.27	0.19	0.00	0.92
FT	= 1 if majority stake is owned by the State, and 0 otherwise.	9288	0.40	0.49	0	1
Liquidity	Current assets/total assets, measured at one semi-accounting year prior to current loan.	8779	0.55	0.23	0.01	1
Loanconcen	Loan concentration ratio. Defined as Loansize / (Loansize and debt outstanding).	8779	0.04	0.07	0.00	0.93
IPO	= 1 if loan is issued after the IPO, and 0 otherwise.	9288	0.83	0.37	0	1
Panel C: Loan characteristics						
Collateral	= 1 if loan is secured by collateral, and 0 otherwise.	9288	0.66	0.47	0	1
Maturity	Natural log of loan maturity. Measured in months.	9288	3.25	0.79	0.00	5.70
Spread	Difference between lending rate and benchmark deposit rate of corresponding maturity. Measured in percentage.	9288	2.85	1.21	0.71	13.60
Loansize	Natural log of loan size. Measured in millions of RMB deflated to year 2006 value.	9288	3.13	1.41	-3.70	8.97
Panel D: Relationship variables						
Numlender	Number of different lenders the firm has borrowed from prior to origination of current loan.	9288	3.93	3.45	0	28
Sizeconcen	The amount of loans that a firm has borrowed from its current lender as a proportion of the total amount of loans it obtained prior to the current loan.	9288	0.33	0.35	0	1
Numconcen	The number of loans that a firm has borrowed from its current lender as a proportion of the total number of loans it borrowed prior to the current loan.	9288	0.34	0.34	0	1
First	= 1 if the current loan is the first loan borrowed from this lender, and 0 otherwise.	9288	0.24	0.43	0	1
Switch	= 1 if the current loan is borrowed from the same lender as the previous loan, and 0 otherwise.	9288	0.40	0.49	0	1
Panel E: Monetary and regional macroeconomic variables						
RRR	Reserve Requirement Ratio for the month when the loan is issued.	9288	0.17	0.03	0.10	0.21
Repo	7-day repo rate for the month when the loan is issued, in percentage.	9288	2.55	1.21	0.94	6.92
CPI	Provincial consumer price index, measured at one semi-account year prior to current loan.	9288	1.03	0.03	0.98	1.10
NPLratio	Provincial non-Performing loan ratio, measured at one semi-account year prior to current loan.	9288	0.03	0.03	0.00	0.21
Realgdpindex	Provincial real GDP growth rate, measured at one semi-account year prior to current loan	9288	0.09	0.03	0.01	0.18
Panel F: Instrumental variables						
Amaturity	((current assets/total assets)*(current assets/cost of goods sold)+(fixed assets/total assets)*(fixed assets/depreciation))/1000	9288	10.68	6.64	0.18	55.33

dd_lag2	The number of CSRC IPO suspension days during the 2-year window prior to listing date.	9288	188.6	168.8	0	523
Affected_Firms	Dummy variable equals 1 if firm experienced at least one CSRC IPO suspension during the 2-year window prior to listing date.	9288	0.68	0.47	0	1
Termspread	Yield difference between 5-year Treasury bond and 1-year Treasury bond, for the month when the loan is issued, in percentage.	9288	0.86	0.44	-0.19	1.54
Localavrate	People's Bank of China reports on a yearly basis the percentage of loans that are issued below/at/above the corresponding benchmark rate. The actual lending rate to benchmark rate ratio is classified in seven groups: [0.9,1], [1], [1.0-1.1], [1.1-1.3],[1.3-1.5],[1.5-2.0] and [above 2.0]. We take the middle value of each group and calculate the weighted average ratio using the percentage of loans within each group as weight. This weighted average is then multiplied with the one-year reference rate to calculate the regional average lending rates. Measured at one semi-account year prior to the current loan. In percentage.	9288	6.79	0.94	5.14	9.88
Benchsprd	Benchmark lending rate minus benchmark deposit rate of corresponding maturity, for the month the loan is issued. In percentage.	9288	2.42	0.55	1.4	3.78
Panel G: Additional variables						
Numalst	Number of analysts following the firms measured at one semi-accounting year before loan origination.	7719	11.01	10.90	0	66
Instishare	Percentage of shares held by institutional investors measured at one semi-accounting year before loan origination, in percentage.	7367	29.07	22.03	0	96.33
Multiapp	Dummy variable that equals 1 if firm applied for its IPO multiple times before eventually listed, and 0 if succeeded in the first IPO application.	9288	0.05	0.22	0	1
Affected_Loans	Dummy variable equals 1 if the loan is borrowed by firms that experienced CSRC IPO suspension during the suspension periods.	9288	0.15	0.36	0	1

3 Main results

3.1 *Univariate tests*

This subsection compares if the mean values of the key variables differ across relationship intensity, market structure and for pre- and post-IPO loans. Results are reported in Table II.

Relationship loans, defined as the ones with *Sizeconcen* $_{il}$ above the sample median, on average enjoy better loan terms such as longer maturity and lower lending spreads. At the same time, these loans are smaller; however, collateral requirements do not differ significantly between relationship and non-relationship loans.

Collateral requirements are significantly more severe in concentrated markets, where concentrated markets are defined as the ones with *ACR4* $_{il}$ above the sample median. Loan maturity does not differ across markets, while loan size and the average lending spread are significantly larger in lowly concentrated markets. Lastly, loan contract terms such as collateral (-), maturity (+) and loan size (+) change significantly after listing (in brackets change after IPO compared to before), while the average lending spread does not differ for loans issued before and after IPOs.

Firm characteristics do not depict a clear pattern between groups. For instance, firms that borrow from relationship lenders are on average more liquid, less leveraged and have higher tangibility ratios. However, they are also younger and smaller than firms borrowing from non-relationship banks. Firms that borrow in concentrated markets are on average less liquid, smaller, younger and more leveraged, and have higher tangibility ratios. Lastly, firms that borrowed after the IPO are less liquid and less profitable, but the leverage ratio of borrowing firms does not differ before and after the IPO.

Table II: Univariate tests

	Panel A: Sizeconcen			Panel B: ACR4			Panel C: IPO		
	<Median	>=Median	Mean diff	<Median	>=Median	Mean diff	Pre-IPO	Post-IPO	Mean diff
Relationship variables									
Sizeconcen	--	--	--	0.32	0.35	-0.02***	0.40	0.32	0.08***
Numconcen	0.22	0.73	-0.51***	0.33	0.35	-0.02***	0.41	0.33	0.08***
Numlender	4.65	3.21	1.44***	4.41	3.46	0.96***	2.17	4.29	-2.11***
Market structure									
ACR4	0.55	0.55	-0.00*	-	-	-	0.56	0.55	0.01***
Loan characteristics									
Collateral	0.66	0.66	-0.00	0.62	0.70	-0.08***	0.86	0.62	0.24***
Maturity	3.19	3.32	-0.13***	3.26	3.25	0.00	3.12	3.28	-0.16***
Spread	2.99	2.70	0.30***	2.87	2.82	0.04*	2.85	2.85	0.01
Loansize	3.19	3.07	0.12***	3.17	3.10	0.08**	2.32	3.30	-0.97***
Firm characteristics									
FT	0.42	0.39	-0.03**	0.42	0.39	0.03***	0.11	0.46	-

									0.35***
Liquidity	0.55	0.54	0.01*	0.60	0.50	0.10***	0.58	0.54	0.04***
Total Assets	7.76	7.58	0.18***	7.81	7.53	0.28***	6.32	7.85	-
									1.53***
Leverage	0.57	0.55	0.02***	0.55	0.57	-	0.55	0.56	-0.00
						0.02***			
ROA	0.07	0.06	0.00	0.06	0.07	-0.00	0.15	0.05	0.09***
Age	5.04	5.02	0.02***	5.06	5.00	0.06***	4.70	5.10	-
									0.40***
Tangibility	0.27	0.27	-0.01*	0.24	0.31	-	0.27	0.27	-0.01
						0.07***			

*** p<0.01, ** p<0.05, * p<0.1.

3.2 *Multivariate tests*

3.2.1 DO RELATIONSHIP LENDING AND MARKET STRUCTURE DETERMINE COLLATERAL INCIDENCE?

In this section, we first test the impact of relationship lending and market structure on collateral incidence in a cross-sectional setting by estimating *Equation (1)* in Section 2.1.1. The results are reported in Panel A of Table III. Marginal effects (M.E.) are calculated based on the results in Column (1). To account for the possibility that some loan contract terms such as *Maturity* and *Spread* might be endogenous, we follow Berger and Udell (1995) and estimate the model with and without these terms (Columns (1) and (2), respectively). We shall conduct additional robustness tests for endogeneity issues of loan contract terms in Section 6.2.

Our results show that relationship intensity is positively related to the incidence of collateral and highly significant. The marginal effects show that one standard deviation increase in *Sizeconcen* from its sample mean increases the probability of collateralization by 1.4%. This result does not support the "information accumulation" view that relationship lending and collateral are substitutes in mitigating borrower risks (e.g. Berger and Udell, 1995). In contrast, our finding is in line with the other hypotheses discussed in Section 1 (e.g. "hold-up" problem (Sharp, 1990; Rajan, 1992), "soft budget constraint" (Dewatripont and Maskin, 1995; Boot, 2000), "bank seniority" (Longhofer and Santos, 2000) and "cost minimization incentive" (Menkhoff et al., 2006)). Results similar to ours have been reported in e.g. Elsas and Krahnen (2000) and Ono and Uesugi (2009).

Market structure, measured as the concentration ratio *ACR4*, is positive and highly significant at 1% across all specifications. A one standard deviation increase in this ratio increases the likelihood of collateral incidence by 4.45%. This result confirms Hypothesis *H.2* (Section 2.1.1) that concentrated markets are associated with a higher likelihood of collateralization. Our finding is in line with Hainz et al. (2013), but contrasts Jimenez et al. (2006). As discussed before, both the "informational rent extraction" and "market power" hypotheses can explain this positive coefficient.

The coefficient of *Numlender* is significant and positive as well. A one standard deviation increase in the number of lenders of the firm from its mean increases the incidence of collateral by 2.13%.[18] Other relationship control variables such as *First* and *Switch* are not statistically significant; we shall discuss these results in more detail later on.

18. This result is in line with Chakraborty and Hu (2006) and Jimenez et al. (2006), but in contrast to Menkhoff et al. (2006).

Loans obtained after the IPO are significantly less likely to be collateralized (marginal effect is -10.39%). This result lends some support to the notion that IPOs are beneficial to firms with respect to the non-price terms of lending. This adds to the empirical findings in Santos and Winton (2008), Hale and Santos (2009) and Schenone (2010) that loan terms improve after bond or equity IPOs, with these studies presenting evidence of a decline in the lending rate.

Before moving forward, we discuss briefly other determinants of collateral, which has merit in itself, as the existing literature on Chinese lending markets has investigated this issue only using firm-year data (e.g. Firth et al., 2012; Chen et al., 2013). As expected, the coefficients of *Age* and *Size* are negative and significant, indicating that older and larger firms are less likely to pledge collateral, possibly because these firms are less prone to moral hazard problems. Firms that are more profitable, more liquid, have a higher tangible assets ratio and are less leveraged are less likely to pledge collateral. Similar to Berger and Udell (1990), we find that *Loanconcen* is significantly positive at the 1% level across all specifications.[19] Among all factors, the most important determinant of collateral is firm ownership. Private firms in China have on average a 16.7% higher probability of pledging collateral than state-owned firms, presumably because the latter enjoy the implicit guarantee from the State. This results adds to the previous empirical studies that private firms in China have been financially discriminated in a state-dominant banking system (Cull and Xu, 2003; Allen et al., 2005).

Other loan contract terms affect the incidence of collateral as well. Loans with a longer maturity are more likely to be collateralized. A one standard deviation increase in loan maturity from its sample mean increases the incidence of collateral by 3.39%. This result is in line with the theoretical prediction that banks use shorter loan maturities to solve adverse selection or moral hazard problems (e.g. Berlin and Mester, 1992; Flannery, 1986; Barclay et al., 1995; Degryse and Van Cayseele, 2000). Larger loans (*Loansize*) are less likely to be collateralized. A one standard deviation increase of loan size reduces the incidence of collateral by 3.37%.[20] Finally, loans with a higher interest rate spread (*Spread*) are more likely to be collateralized (marginal effect of 1%), giving some support to the notion that collateral is associated with risky loans. Nevertheless, the results for contract terms on collateral should be treated with caution, as these variables are potentially endogenous. Excluding potentially endogenous loan contract terms such as *Maturity* and *Spread* does not alter our results for other determinants, as shown in Column (2).

In contrast, the monetary policy stance has limited impact on the incidence of collateral, with only the *7-day Repo* rate being positively related to collateral at the 10% significance level.[21] Regional macroeconomic variables (*CPI*, *NPLratio* and *Realgdpindex*) generally do not affect collateral decisions. It is likely that the impact of business cycle developments is captured by the time fixed effects, which show that collateral incidence is significantly lower during the 2010-2013 period relative to 2007 (base year). Lastly, loans from foreign banks are significantly more likely to be collateralized, while loans from trust and finance companies and other financial institutions (mainly credit companies) are significantly less collateralized, compared to the benchmark state-owned banks. As a further robustness check, we include regional legal and

19. See for instance Boot et al. (1991), Dennis et al. (2000) and Bharath et al. (2011) for similar results.

20. This result is consistent with Leeth and Scott (1989), Jimenez and Saurina (2004) and Menkhoff et al. (2006), but in contrast to the findings of Boot et al. (1991).

21. Jimenez et al. (2006) find that collateral incidence is lower during episodes of monetary tightening. They resort to credit rationing to explain their results, since during tightening periods banks prefer high-quality borrowers (hence less collateral). Bernanke and Gertler (1995) suggest that higher interest rates raise a firm's default probability, resulting in a higher likelihood of collateral incidence during monetary policy tightening cycles. Our insignificant result could be due to the combined effect of competing theories, which we shall leave to future research.

institutional variables.[22] Our results do not materially change when these additional controls are added.

3.2.2 DOES RENT EXTRACTION VARY WITH FIRM INFORMATION TRANSPARENCY?

We test in this section if informational rent extraction is less pronounced for transparent firms. To this extent, we estimate *Equation (2)* in Section 2.1.2 using various informational transparency proxies. Results are reported in Table III, Panels B and C, where Panel B uses firm characteristics as transparency measure, while Panel C employs stock market information production variables.

Firms that are not listed at the main board, privately owned or smaller, are more likely to pledge collateral when relationship intensity increases, as suggested by the significantly positive coefficients of $Sizeconcen_{il}$ in all specifications of Panel B. For transparent firms, the impact of $Sizeconcen_{il}$ on collateral vanishes, as the null-hypothesis H_0: $Sizeconcen_{il} + Infor_{il} * Sizeconcen_{il} = 0$ is not rejected for all three informational transparency measures. As for the impact of market structure on collateral, a similar pattern prevails. The concentration ratio $ACR4_{il}$ is statistically positive in all specifications, and its interaction term with information transparency measures is significantly negative for all three cases. Unlike for relationship lending, the null hypothesis that market structure has no impact on collateral for transparent firm (e.g. firms listed at the main board or state-owned firms), i.e. $ACR4_{il} + Infor_{il} * ACR4_{il} = 0$, is rejected. Both results suggest the inside banks' ability to charge rent decreases with firms' information transparency.

Next we employ stock market information production variables ($Numalst_{il}$ and $Instishare_{il}$) as proxies of firm transparency. Results are reported in Panel C, Columns (6) and (7). All interaction terms are significantly negative, indicating a moderated effect on rent extraction when more information is generated by the stock market, a result similar to Panel B. Moreover, the magnitude of the coefficients further suggests a boundary effect of information production on rent extraction. In other words, rent extraction becomes infeasible when sufficient information is produced by the stock market. Specifically, in Column (6), when a borrower is followed by more than 11 analysts (65th percentile), the positive impact of *Sizeconcen* vanishes. Similarly, a higher market concentration does not increase collateral incidence for borrowers followed by more than 22 analysts (88th percentile). Column (7) reports similar results where *Instishare* serves as a measure of information production[23]. The thresholds for relationship lending and market concentration to charge rents are 20% (55th percentile) and 70% (96th percentile) of shares held by non-bank institutional investors, respectively. For firms with institutional shareholdings above these values, rent extraction becomes infeasible. The results in this subsection are in line with the informational rent hypothesis. However, as discussed in the Section 1 and Section 2.1.2, alternative theories can also support these findings as information transparency measures are

22. Empirical studies have identified that banks are better able to control for credit risk if legal frameworks allow lenders to seize collateralized assets in times of default (Qian and Strahan, 2007). We employ the indices of legal infrastructure developed by Fan and Wang (2011). These indices have been widely applied for China (e.g. Firth et al., 2009; Li et al., 2009), with Li et al. (2009) providing a detailed description. As data for these indices end in 2009 (while our sample ends in 2013), we interpolate the missing values by assuming that the indices grow at the average growth rate of 2006-2009. Our results show that collateral is more likely to be pledged in provinces with better legal infrastructure, a result that is similar to Qian and Strahan (2007). These authors suggest that a better protection of credit rights increases the incidence of collateral for firms with more tangible assets. The results that we present in the rest of the paper are not sensitive to the inclusion of these legal and institutional variables. Results are available upon request.

23. Arguably, institutional investors not only bring on board more information disclosure, but also active monitoring and better alignment of management incentives, such as reducing tunneling behavior (e.g. Lin et al., 2011). We control for these effects by incorporating corporate governance variables that directly affect firms' tunneling incentives: the "control and cash flow rights wedge" and cash-flow rights. Our results remain intact and are available upon request.

often correlated with firm quality or likelihood of financial distress. We proceed in the next subsection using equity IPOs as the identification strategy.

Table III: Collateral determinants and borrower information transparency

Panel A shows the results for the estimation of *Equation (1)*. M.E are the marginal effects calculated on the basis of the results in Column (1). Panel B estimates *Equation (2)*. It reports the impact of $Sizeconcen_{il}$ and $ACR4_{il}$ on collateral incidence differentiated by the informational transparency of borrowers ($Infor_{il}$), which is defined by three proxies: *Borrower ownership* (*FT*=1 if state owned and 0 otherwise); *Listed Board* (*Listmain*=1 if listed in the main board and 0 otherwise); and *Firm Size* (*Medianta* = 1if *log (total assets)* is above the provincial median and 0 otherwise). Panel C estimates *Equation (2)* using stock market information production (*Numalst* and *Instishare*) as measures of informational transparency of borrowers. The sample is restricted to post-IPO loans for Column (6) and (7). In all panels, the control variables include firm characteristics, loan contract terms, monetary policy variables, regional macroeconomic variables and a set of fixed effects, including *Industry, Province, Banktype* and *Loan-year* dummies. In column (2), *Maturity* and *Spread* are excluded for endogeneity concerns. Removing these terms in Panel B and C do not affect our results, which are available upon request. Results for fixed effects dummies are not reported to save space. The equations are estimated with the Probit model. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Panel A: Main Effects			Panel B: Borrower Information Transparency			Panel C: Stock Market Infor Production	
	With contract	Without contract	M.E	Board of listing	Ownership	Firm size	Numalst	Instishare
VARIABLES	(1)	(2)		(3)	(4)	(5)	(6)	(7)
Sizeconcen	0.153**	0.170**	1.40	0.231***	0.256***	0.287***	0.209**	0.277***
	(0.068)	(0.068)		(0.085)	(0.082)	(0.076)	(0.088)	(0.097)
ACR4	2.685***	2.623***	4.45	3.826***	3.463***	3.482***	4.912***	4.897***
	(0.805)	(0.802)		(0.895)	(0.858)	(0.832)	(0.901)	(0.924)
Listmain*Sizeconcen				-0.129				
				(0.098)				
FT*Sizeconcen					-0.203**			
					(0.098)			
Medianta*Sizeconcen						-		
						(0.102)		
Numalst*Sizeconcen							-0.010**	
							(0.005)	
Instishare*Sizeconcen								-
								(0.240)
Listmain*ACR4				-				
				(0.616)				
FT*ACR4					-1.603***			
					(0.619)			
Medianta*ACR4						-		
						(0.571)		
Numalst*ACR4							-	
							(0.032)	
Instishare*ACR4								-
								(1.318)
Listmain				0.705**				
				(0.346)				
Medianta						1.334***		
						(0.316)		

Numalst							0.074***	
							(0.017)	
Instishare								2.574***
								(0.722)
FT	-	-	-16.7	-	0.335	-	-	-
	(0.047)	(0.046)		(0.048)	(0.340)	(0.047)	(0.050)	(0.050)
First	0.036	0.049	0.94	0.048	0.044	0.019	-0.030	-0.042
	(0.056)	(0.055)		(0.056)	(0.056)	(0.056)	(0.059)	(0.059)
Switch	-0.028	-0.064	-0.75	-0.033	-0.028	-0.023	-0.020	-0.023
	(0.039)	(0.039)		(0.040)	(0.039)	(0.039)	(0.042)	(0.042)
IPO	-	-	-	-	-0.391***	-		
	(0.071)	(0.071)		(0.073)	(0.071)	(0.071)		
Numlender	0.024***	0.018**	2.13	0.021***	0.024***	0.020***	0.027***	0.024***
	(0.007)	(0.007)		(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Liquidity	-	-	-2.76	-	-0.447***	-0.375**	-	-
	(0.155)	(0.153)		(0.156)	(0.155)	(0.155)	(0.168)	(0.167)
Size	-	-	-7.29	-	-0.222***	-	-	-
	(0.027)	(0.027)		(0.028)	(0.027)	(0.030)	(0.033)	(0.030)
Leverage	0.941***	1.049***	4.53	1.040***	0.926***	0.951***	0.891***	0.963***
	(0.127)	(0.126)		(0.129)	(0.127)	(0.127)	(0.138)	(0.137)
ROA	-	-	-2.22	-	-1.102***	-	-0.583*	-0.704**
	(0.277)	(0.282)		(0.279)	(0.278)	(0.276)	(0.330)	(0.325)
Age	-	-	-4.50	-	-0.419***	-	-	-
	(0.058)	(0.057)		(0.060)	(0.058)	(0.058)	(0.064)	(0.064)
Tangibility	-	-	-4.43	-	-0.855***	-	-	-
	(0.179)	(0.178)		(0.180)	(0.179)	(0.179)	(0.189)	(0.188)
Maturity	0.169***		3.39	0.169***	0.169***	0.171***	0.187***	0.200***
	(0.028)			(0.028)	(0.028)	(0.028)	(0.030)	(0.030)
Spread	0.031*		1.00	0.036**	0.031*	0.035**	0.021	0.023
	(0.017)			(0.017)	(0.017)	(0.017)	(0.018)	(0.018)
Loansize	-	-	-3.37	-	-0.090***	-	-	-
	(0.020)	(0.020)		(0.020)	(0.020)	(0.020)	(0.021)	(0.021)
Loanconcen	1.830***	1.921***	3.37	1.956***	1.804***	1.866***	1.779***	1.672***
	(0.413)	(0.408)		(0.410)	(0.414)	(0.415)	(0.440)	(0.434)
RRR	-0.071	-0.021	-0.05	0.050	-0.202	-0.188	0.645	0.422
	(2.902)	(2.884)		(2.909)	(2.904)	(2.907)	(3.068)	(3.068)
Repo	0.048*	0.045*	1.51	0.044	0.048*	0.050*	0.054*	0.047*
	(0.027)	(0.027)		(0.027)	(0.027)	(0.027)	(0.029)	(0.029)
CPI	1.475	2.003	1.04	1.241	1.320	1.518	2.608	2.614
	(1.510)	(1.501)		(1.514)	(1.513)	(1.513)	(1.601)	(1.597)
NPLratio	-0.535	-0.647	-0.42	-0.305	-0.526	-0.685	-0.414	-0.121
	(1.135)	(1.132)		(1.137)	(1.135)	(1.140)	(1.183)	(1.179)
Realgdpindex	1.097	1.548	1.00	0.763	0.787	0.975	1.606	1.198
	(1.435)	(1.429)		(1.441)	(1.442)	(1.439)	(1.500)	(1.496)
Constant	-0.566	-0.644		-1.577	-0.850	-1.123	-7.478	-6.924
	(1.874)	(1.869)		(1.888)	(1.879)	(1.884)	(106.776)	(106.273)
Observations	8,741	8,753		8,741	8,741	8,741	7,620	7,620
Pseudo R2	0.287	0.283		0.289	0.288	0.290	0.291	0.291
H_0:Sizeconcen+Infor*Sizeconcen=0				0.102	0.052	-0.103		
H_0: ACR4+Infor*ACR4=0				2.162***	1.860**	1.431		

3.2.3 DO EQUITY IPOS REDUCE INFORMATIONAL RENTS?

In this subsection, we provide a direct test of informational rent extraction, i.e. we compare the impact of $Sizeconcen_{il}$ and $ACR4_{il}$ on collateral incidence for pre-IPO and post-IPO loans where information asymmetries among lenders are significantly lower for the latter group than for the former. Estimations are based on *Equation (3)*.

Results are reported in Table IV. Column (1) includes only the interaction term $Sizeconcen_{il} * IPO_{il}$; Column (2) includes only the interaction term $ACR4_{il} * IPO_{il}$; Column (3) includes both, while Column (4) re-estimates Column (3) excluding possible endogenous loan contract terms (*Maturity* and *Spread*). The results show that $Sizeconcen_{il}$ is significantly positive across all models. The coefficient of the interaction term $Sizeconcen_{il} * IPO_{il}$ is negative and significant for the broader specification (Column (3)), while it is marginally insignificant (p-value 0.102) in Column (1). The coefficient of $ACR4_{il}$ is significantly positive while the interaction term with IPO_{il} is significantly negative across all specifications. As the results of these three specifications are quantitatively similar, we explain in more detail only the results presented in Column (3), our baseline model.

The likelihood of pledging collateral is increasing with relationship intensity for pre-IPO loans (coefficient 0.596***), while for post-IPO loans this positive impact is greatly moderated (coefficient 0.124*, and H_0: $Sizeconcen_{il} + Sizeconcen_{il} * IPO_{il} = 0$ is rejected at the 10% level). In terms of marginal effects, a one standard deviation increase in $Sizeconcen_{il}$ increases the probability of pledging collateral by 4.78% for pre-IPO loans, compared to 1.17% for post-IPO loans. This pattern is consistent with Hypothesis *H.3* (Section 2.1.3) that a reduction in informational asymmetries among banks makes it harder to establish informational "hold-ups" through relationship lending, therefore lowering the likelihood of rent extraction through collateral.
.

A similar pattern is observed for market structure. The pre-IPO coefficient of the concentration ratio $ACR4_{il}$ is 5.94***, indicating that pre-IPO loans obtained in concentrated markets are significantly more likely to be collateralized. The post-IPO impact of $ACR4_{il}$ is moderated, but remains statistically positive (coefficient 2.43***, H_0: $ACR4_{il} + ACR4_{il} * IPO_{il} = 0$ rejected at 1%). Alternatively, looking at the marginal effects, a one standard deviation increase in the concentration ratio increases the probability of collateral incidence by 8.51% for pre-IPO loans, while for post-IPO loans this effect is reduced to 4.15%. Hence, the contribution of concentrated markets in facilitating the extraction of information rents, or preventing informational spill-over to competitors, is greatly eroded, since more information about borrowing firms has been disseminated due to the equity IPO. This more equal distribution of information further reduces *de novo* banks' adverse selection problems and lowers barriers to entry, which is another reason why informational rent extraction is more difficult for post-IPO loans. This result confirms Hypothesis *H.4* (Section 2.1.3).

We find that the positive impact of market concentration on collateral is both statistically and economically significant even for post-IPO loans. The presence of a certain degree of informational asymmetry existing among lenders even post-IPO could explain this result. At the same time, it also could lend some support to the view that information asymmetries are not the only channel that may lead to higher collateral incidence in concentrated markets. The "market power channel", which we discussed in Section 1, suggests that monopolistic or oligopolistic banks can extract rents by using their market power, increasing collateral requirements even in environments where all lenders are equally informed. This channel could be particularly important for banking markets characterized by geographic restrictions in branch expansion or restrictions

in business scope. Furthermore, given that our sample is composed of large listed firms whose funding needs might not be served by smaller banks, large banks can enjoy their market power further, even when borrower information is equally distributed among inside and outside lenders.

It is likely that firms gain bargaining power vis-à-vis lenders after their IPO, for example because the listing will improve their access to capital markets or increase their attractiveness as client for other lenders. This would reduce the positive impact of relationship lending or bank market structure on collateral incidence. Nevertheless, at least part of the bargaining power gain is due to the higher visibility of post-IPO information dissemination, which makes it extremely hard to differentiate informational effects from power/bargaining effects.[24] We control for possible shifts in borrowing firms' bargaining power by introducing the interaction term $Numlender_{il} * IPO_{il}$. It is expected that firms that can borrow from more different lenders may benefit from higher competition between inside and outside banks, therefore having more bargaining power vis-à-vis their current lender(s) (Yasuda, 2007). In our univariate tests, we found that an average firm borrows from two banks before the IPO, while this number increases to four after the IPO, suggesting increasing bargaining power. However, the coefficients on $Numlender_{il}$ and $Numlender_{il} * IPO_{il}$ are both insignificant.

Next, we briefly discuss the results for the other control variables. $First_{il}$ is significantly positive for pre-IPO loans, indicating that borrowing for the first time from a certain lender before the IPO is associated with a higher likelihood of collateral pledging. For post-IPO loans, collateral incidence is not affected by whether the loan is the first one from a certain lender or not (H_0: $First_{il} + First_{il} * IPO_{il} = 0$ cannot be rejected). This pattern is fairly persistent throughout all our regressions, which further supports the role of equity IPOs in disseminating information. Before an IPO, the first loan is associated with a higher collateral incidence due to limited knowledge of the borrower. However, this significant relationship disappears after the IPO, given that the IPO process and post-IPO information disclosure increase the transparency of the borrowing firm to all potential lenders. Switching lenders ($Switch_{il}$), however, does not affect collateral incidence before or after the IPO. The coefficients of other control variables are similar to those reported in Table III, and are available upon request.

To conclude, using equity IPOs as an informational shock, the results in this section provide evidence of informational rent extraction, whether the informational advantage is driven by relationship lending or concentrated markets. As discussed in Section 1, the results of this section are subject to caveats related to alternative explanations and endogeneity issues of key variables, which we examine in Section 4 and 5.

Table IV: Identify informational rents through IPOs

This table reports estimates based on various versions of *Equation (3)*. Column (1) to Column (3) add the interaction terms $Sizeconcen_{il}*IPO_{il}$ and $ACR4_{il}*IPO_{il}$ progressively. Column (4) excludes the potentially endogenous contract terms *Spread* and *Maturity* and re-estimates Column (3). M.E. are marginal effects based on Column (3). For variables interacting with IPO_{il}, we report marginal effects of said variable from before and after the IPO. Results for control variables and fixed effects dummies are not reported to save space. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

24. Pagano et al., (1998) suggest it is impossible to distinguish information and bargaining power effects related to IPOs. Saunders and Steffen (2011) investigate the bargaining power effect of IPOs through information effects.

VARIABLES	(1)	(2)	(3)	(4)	M.E.
Sizeconcen	0.493**	0.169**	0.596***	0.604***	4.78
	(0.215)	(0.069)	(0.218)	(0.218)	
ACR4	2.806***	5.617***	5.935***	5.931***	8.51
	(0.807)	(1.201)	(1.216)	(1.211)	
Sizeconcen*IPO	-0.369		-0.471**	-0.463**	1.17
	(0.226)		(0.229)	(0.228)	
ACR4*IPO		-3.218***	-3.503***	-3.574***	4.15
		(1.000)	(1.016)	(1.012)	
First	0.423**	0.203	0.478**	0.462**	10.78
	(0.194)	(0.143)	(0.195)	(0.195)	
First*IPO	-0.430**	-0.190	-0.485**	-0.454**	-0.19
	(0.201)	(0.144)	(0.203)	(0.203)	
Switch	0.177	0.153	0.175	0.133	4.14
	(0.126)	(0.126)	(0.126)	(0.126)	
Switch*IPO	-0.218*	-0.189	-0.215	-0.207	-1.06
	(0.132)	(0.132)	(0.132)	(0.132)	
Numlender	-0.000	-0.023	0.009	-0.002	0.78
	(0.033)	(0.028)	(0.033)	(0.033)	
Numlender*IPO	0.025	0.051*	0.016	0.021	2.34
	(0.034)	(0.029)	(0.034)	(0.034)	
IPO	-0.132	1.396**	1.914***	1.951***	-7.13
	(0.206)	(0.572)	(0.627)	(0.626)	
Constant	-1.063	-2.417	-2.936	-3.025	
	(1.886)	(1.946)	(1.964)	(1.959)	
Fixed effects dummies	Industry, Province, Bank				
Other loan contract terms	Yes	Yes	Yes	No	
Controls variables	firm characteristics, monetary				
Observations	8,741	8,741	8,741	8,753	
Pseudo R2	0.288	0.289	0.289	0.285	
H_0:Sizeconcen+Sizeconcen*IPO=0	0.124*		0.124*	0.141**	
H_0: ACR4+ACR4*IPO=0		2.399***	2.431***	2.357***	
H_0:First+First*IPO=0	-0.007	0.013	-0.007	0.008	
H_0:Switch+Switch*IPO=0	-0.041	-0.036	-0.039	-0.074*	

3.2.4 DO INFORMATIONAL RENTS VARY WITH FIRM RISK?

Finally, we test whether after the IPO informational rents are reduced for safe firms, but not, or to a lesser extent, for risky firms. We introduce the three-way interaction terms between our informational rent variables (*Sizeconcen* $_{il}$ or *ACR4* $_{il}$), *IPO* $_{il}$ and the firm risk proxy *Multiapp* $_{il}$. Results are reported in Table V.

In the first column, we examine the main effect of *Multiapp* $_{il}$. A firm with multiple applications is 7% more likely to pledge collateral than first-time approved firms, which is consistent with our belief that being rejected for a stock exchange listing is associated with higher firm risk. Three-way interaction terms are introduced in Column (2). Our results show that the marginal effects of the informational rent variables (*Sizeconcen* $_{il}$ and *ACR4* $_{il}$) on collateral are all *positive* both before and after IPOs. However, whether these marginal effects are moderated after the IPO depends on the riskiness of the firms. To see this, we calculate the *changes* in the

marginal effects of the informational rent variables before and after IPOs, for both safe ($Multiapp_{il} = 0$) and risky firms ($Multiapp_{il} = 1$). For safe firms, the marginal effect of $Sizeconcen_{il}$ on collateral drops by 4% after the IPO, while for risky firms it increases by 3.2%. Similar results are found for market structure. The marginal effect of $ACR4_{il}$ declines by 6% for safe firms after the IPO, but for risky firms it increases by 5.5%.

These results show that the ability of inside banks to charge informational rents after the IPO declines for safer firms, but increases for risky ones. This is because once the borrower is identified as safe, outside banks bid aggressively for lending business, reducing the inside bank's monopoly power. In contrast, outside banks will be less interested in lending to risky firms when the latter poorer creditworthiness is revealed, strengthening the ability of inside banks to extract rents. We test the robustness of these results by removing loan contract terms (Column (3)) and monetary policy and regional macroeconomic variables (Column (4)). Our results remain the same.

Table V: Informational rents and firm risk

This table investigates how informational rents vary with firm risk. Firm risk is proxied by a dummy variable *Multiapp* that equals one if the firm applied multiple times before eventually being listed, and zero if being listed in its first IPO application. Column (1) tests the main effect of *Multiapp*. Column (2) introduces three-way interaction terms among informational rent variables (*Sizeconcen* and *ACR4*), listing status (*IPO*) and *Multiapp*. For these two columns, other control variables are the same as in Table III (Column (1)). Column (3) and (4) removes progressively loan contract terms and monetary and regional macroeconomic variables. Results of control variables and fixed effects dummies are not reported to save space. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	(1)	(2)	(3)	(4)
Sizeconcen	0.600***	0.634***	0.648***	0.646***
	(0.219)	(0.225)	(0.225)	(0.225)
ACR4	5.979***	6.073***	6.081***	5.741***
	(1.217)	(1.254)	(1.249)	(1.226)
Sizeconcen*IPO	-0.476**	-0.532**	-0.526**	-0.526**
	(0.229)	(0.236)	(0.235)	(0.235)
ACR4*IPO	-3.558***	-4.368***	-4.441***	-4.419***
	(1.016)	(1.060)	(1.055)	(1.054)
Multiapp	0.286***	0.730	0.925	0.820
	(0.094)	(2.131)	(2.093)	(2.098)
Sizeconcen*Multiapp		-0.462	-0.497	-0.510
		(0.471)	(0.465)	(0.465)
ACR4*Multiapp		-1.493	-1.856	-1.647
		(3.676)	(3.608)	(3.617)
Multiapp*IPO		-4.872**	-4.873**	-4.791**
		(2.364)	(2.327)	(2.331)
Sizeconcen*Multiapp*IPO		0.944*	0.959*	0.974*
		(0.552)	(0.546)	(0.546)
ACR4*Multapp*IPO		9.315**	9.305**	9.143**
		(4.085)	(4.019)	(4.026)
IPO	1.962***	2.347***	2.384***	2.379***
	(0.627)	(0.650)	(0.647)	(0.647)
Constant	-2.854	-2.794	-2.904	-0.632
	(1.963)	(1.972)	(1.967)	(0.925)
Fixed effects dummies	Industry, Province, Bank Type, Time			
Firm characteristics	Yes	Yes	Yes	Yes

Other loan contract terms	Yes	Yes	No	No
Monetary policy variables	Yes	Yes	Yes	No
Regional macro variables	Yes	Yes	Yes	No
Observations	8,741	8,741	8,753	8,753
Pseudo R2	0.290	0.293	0.289	0.289

4 Alternative explanations

As noted earlier, the moderated effect of relationship lending on collateral incidence for post-IPO loans could be explained by alternative theories, which we investigate in this section.[25] One possible alternative explanation is that credit quality is significantly higher for listed firms compared to non-listed ones. In other words, it is higher credit quality instead of lower information asymmetries that explains this moderated effect. The second possible explanation of this effect is related to the specific selection by banks of their prospective customers. The final alternative explanation that we explore is that relationship banks reduce their collateral requirements in exchange for corporate bond underwriting business. We do not find supporting evidence for the first two alternative explanations, while the last alternative explanation cannot dismiss the informational rent extraction hypothesis.

4.1 *Higher credit quality of listed firms*

Both Boot (2000) and Longhofer and Santos (2000) (see Section 1) predict a weaker positive correlation between relationship lending and collateral incidence for financially sound firms relative to distressed firms. If listed firms are financially healthier than non-listed ones, it would reduce the need to post collateral from the relationship lender's perspective, as the risk of financial distress and the likelihood of engaging in future rescue is lowered. However, various studies have shown that the operating performance of listed Chinese firms deteriorates markedly after their IPO. For example, Allen et al. (2014) compare the operating performance of listed and non-listed firms in China for the years around the IPO and find that the average return on assets of the former drops significantly from 0.12 to 0.07 within a [-3, 3] years window. This sudden drop is not observed for the non-listed firms over the same time horizon. These authors attribute the deterioration of performance to the extremely strict listing requirements of the CSRC,[26] which induce firms to improve earnings in the years prior to the IPO in order to meet these requirements, adjusting operations to generate short-term profits at the cost of sacrificing long-term growth. Similar evidence is also found in our sample where the average return on assets before the IPO is around 10% higher than after (e.g. from 15% prior to the IPO to 5% after, see Table II).

To further address selection bias due to the listing status caused by observables, we employ propensity score matching. The propensity score of loans obtained by listed firms is estimated based on a set of variables determining the IPO. Using nearest neighbor matching, loans granted to listed firms are then matched to the ones granted to non-listed firms. We drop loans that are outside of the common support to minimize the potential bias they may introduce. This process generates a matched sample of loans that are "identical" in every aspect, expect for the borrower's listing status. We re-estimate the baseline model in Table IV, Column (3), on this matched sample. Our results do not materially change (available upon request). We conclude that the higher observed credit quality of listed firms is unlikely to drive our results.

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25. We can discard rather straightforward one alternative explanation of the positive correlation between collateral incidence and relationship lending intensity that we find. This is the "cost minimization incentive" view (Menkhoff et al., 2006), which we discussed in Section 1. This interpretation is not able to explain our results, as this incentive is unlikely to change depending on whether the borrower is listed or unlisted. Hence, the observed significant and negative coefficient of the interaction term $Sizeconcen_{il} * IPO_i$ is not supported by this theory.

26. To be approved for listing, firms need to report positive earnings in the three consecutive years prior to the IPO or have accumulated at least RMB 30 million in net income. In addition, firms are required to have accumulated net cash flows of more than RMB 50 billion or revenues in excess of RMB 300 million in the three years prior to the IPO.

Obviously, the credit quality of listed and non-listed firms may also differ in an immeasurable way. We conduct further analysis in Section 5 to account for these unobserved risk factors.

4.2 *Selection effect*

Suppose the "relationship dependent" listed firms that obtained loans are on average safer than "relationship dependent" non-listed firms, while the "relationship non-dependent" listed firms that obtained loans are on average riskier than "relationship non-dependent" non-listed firms. This selection effect could explain the moderated effect of relationship lending on collateral incidence that we find for post-IPO loans. To address this concern, we perform difference-in-difference tests for observed risk proxies broken down by whether a firm is relationship dependent and whether the loan is borrowed after the IPO. In a fashion similar to Presbitero and Zazzaro (2010), a relationship dependency dummy is defined to equal one if *Sizeconcen* is above or equal to the sample median (0.20). We construct difference-in-difference tests for the key financial risk proxies (*ROA*, *Leverage*, *Tangibility*, *Liquidity*, *Size*, *Maturity*, *Spread* and *Loansize*). For each of these variables, we compute the mean values broken down by relationship dependency and listing status. We then calculate for each firm type ("relationship dependent or not") the mean difference between the listed and non-listed samples, and investigate whether the difference between these two means is significant. This procedure is equivalent to estimating a linear regression for each of the firm risk proxies on IPO_{il}, the relationship dependency dummy and the interaction terms of these two variables. The coefficient of the interaction term and its statistical significance indicate whether relationship dependent and non-dependent firms differ significantly depending on their listing status. Results are reported in Table IA.I. In all these difference-in-difference tests, the interaction terms are statistically insignificant except for *Liquidity*. Hence, the selection effect is unlikely to be the key driver of our results.

Finally, we conduct matched sample analysis within pre- and post-IPO samples and compare the impact of relationship lending on collateral pledging across samples. This way we remove the possibility that firm-risk dynamics around the IPO could be driving our results. If relationship banks extract informational rents and if IPOs reduce information asymmetries among lenders, the average treatment effect of relationship lending should be positive for pre-IPO loans and be moderated or insignificant for post-IPO loans. We find that relationship dependent firms are on average 10% to 12% more likely to pledge collateral relative to matched non-dependent firms for pre-IPO loans, while the difference between these two groups vanishes for post-IPO loans. Technical details, estimation results and sensitivity tests (including balancing property of covariates and sensitivity to unobservables) are reported in the Internet Appendix, Section A and Tables IA.II-III.

4.3 *Corporate bond underwriting and concurrent lending*

Banks may exchange better loan conditions for corporate bond underwriting business.[27] As most firms have their bond IPO after the equity IPO, and many firms choose their relationship banks as underwriters, the moderated effect of relationship lending for post-IPO loans could be the result of exchanging better loan conditions for bond underwriting fees, instead of an informational equalization effect. Our sample includes 1,287 loans that were originated after the firms' bond IPOs, which is a sizeable sample that could drive our results. To address this issue, we construct various samples that only incorporate loans granted before the firms' bond IPOs. If our results are driven by concurrent lending and corporate bond underwriting, once we exclude loans borrowed after the bond IPO, the significant results for the interaction term $Sizeconcen_{il} * IPO_{il}$ should vanish. We find that this is not the case. Results are reported in the Internet Appendix, Table IA.IV.

27. For instance, Yasuda (2007) documents that firms in Japan obtain a fee discount when employing relationship banks as corporate bond underwriters.

5 Endogeneity of IPO and relationship lending

In the previous sections, we have treated the IPO and relationship lending as exogenous variables. As discussed in Section 1, they could be endogenous due to unobserved risk factors. We apply recursive bivariate Probit models to address the endogeneity issue of IPOs in Section 5.1 and of relationship lending in Section 5.2. Our results are robust after controlling for these endogeneity issues.

5.1 *Endogeneity of IPOs*

The fact that all firms in our sample eventually conducted an IPO alleviates the endogeneity concern of IPOs to some extent. However, selection bias could still be present due to unobserved factors. As discussed in Section 1, the exact timing of an IPO is to a large extent unpredictable for firms, but it is possible that there exists an uncontrolled factor which may affect both the timing of the IPO and the pledging of collateral. For instance, firms' political connections (unobserved to the econometrician) can speed up the listing process and at the same time lower collateral requirements, as banks may consider politically connected firms less risky. This omitted variable problem makes the *IPO* variable and subsequently its interaction terms with other covariates in *Equation (3)* correlated with the error terms, leading to biased estimates. To address this issue, we follow Wooldridge (2010) and implement a recursive bivariate Probit model with instrumental variables.[28] The model is estimated with Maximum Likelihood Estimation (MLE). Besides consistency and efficiency of MLE, a crucial benefit of this approach is that we can easily estimate the interactions of binary endogenous variables with exogenous variables in the structural equation (Wooldridge, 2010).[29] One simply needs to specify that the only source of endogeneity results from the binary treatment variable, treating the interaction terms in the structural equation as if they were exogenous. Specifically, we estimate the following model:

$$Collateral = 1[Z_1\alpha_1 + IPOX_1\beta_1 + \varepsilon_1] > 0$$

$$IPO = 1[Z_2\gamma + \varepsilon_2] > 0 \qquad [4]$$

where Z_1 is a vector of collateral determinants and X_1 contains unity and variables that are allowed to be interacted with IPO. This *Collateral Equation* is the same as *Equation (3)*. In the *IPO Equation*, Z_2 contains all variables in Z_1 and at least one additional instrumental variable, i.e. it contains some exogenous variable that affects the listing status, but does not explain collateral incidence except through a firm's listing status.[30] The error terms are assumed to be bivariate normal distributed with correlation ρ, i.e. $\varepsilon_1, \varepsilon_2 \sim \emptyset(0, 0, 1, 1, \rho)$.

We derive our instrumental variables from IPO suspensions announced by the CSRC. By the end of 2013, the CSRC had suspended the IPO reviewing and approval process

28. Since IPO is a binary variable, traditional two-stage least squares models will produce inconsistent estimators (Green, 2008).

29. The existence of endogenous interaction terms in the structural equation causes no problem for MLE estimations of the bivariate Probit model, because the density function of the outcome variable is conditional on all exogenous variables and the endogenous binary variable (or is a function of the endogenous binary variable); therefore, the conditional density function is the same whether or not the endogenous binary variable (or function of the endogenous binary variable) enters the structural equation.

30. Wilde (2000) shows that the exclusion restriction is not generally needed in multi-equation Probit systems and that identification is achieved if varying exogenous regressors appear in both equations of the bivarate Probit model. Wooldridge (2010), however, recommends not to rely on nonlinearities solely to identify the parameters in these models.

unexpectedly eight times.[31] These suspensions were unforeseeable for both banks and borrowers, and therefore can serve as exogenous shocks. During these suspension periods, no new IPOs were approved, while IPO applications that already had started were put on hold. These suspensions affected the listing status for at least two reasons: first, listings were delayed as the amount of reviewing work for the CSRC to complete simply piled up; and second, some applicants needed to renew their application documents, as the ones used initially had expired because of the IPO suspension. This process involved significant costs and at times was even not feasible for firms that exhausted their resources to (artificially) improve their accounting performance.

Naturally, it is unrealistic to assume that IPO applications were affected by all past CSRC suspensions: only the suspensions that occurred during a firm's preparation period should have affected its IPO. The actual dates when firms started their preparation process is unknown, but the preparation and completion of an IPO usually takes at least one to three years. We take the middle value of two years prior to the actual listing date as our cut-off point.[32] Our first instrument is a dummy variable, *Affected_Firms*, which equals one if firms experienced at least one IPO suspension during the two-year window prior to their actual listing. 442 firms (or 68% of all firms) satisfied this condition; in total, these firms obtained 6,351 loans (or 68% of all loans) throughout our sample period. We further calculate the number of IPO suspension days within this 2-year window as our second instrument, denoted it as *dd_lag2*. The average number of suspension days for *Affected_Firms* are 258 days. For unaffected firms, the number of suspension days is zero. To address skewness, we use *log(1+dd_lag2)* in the estimation.

The results of the recursive bivariate Probit model are reported in Table VI. For comparison purposes, Column (1) reproduces the baseline model of Table IV, Column (3). Columns (2) and (3) show the estimates of the recursive bivariate Probit model using *Affected_Firms* and *log (1 + dd_lag2)* as instruments, respectively. For the purpose of brevity we report the key results only. Regarding the instrumental variables in the *IPO Equation*, we find that the coefficients of *Affected_Firms* and *log (1 + dd_lag2)* are negative and statistically significant at 1%, consistent with our expectation that IPO suspensions affected the listing status. More importantly, after controlling for the endogeneity of IPOs, the coefficients of the key variables in the structural equation (*Collateral Equation*) are very similar to the single Probit estimation results in Column (1). This result should not come as a surprise, since the MLE estimates of the correlation coefficient ρ are statistically insignificant in both Column (2) and (3), indicating that the exogeneity assumption of IPOs cannot be rejected, which further validates our estimations in the previous sections using a single equation Probit model.

Obviously, the validity of instruments hinges on the assumption that the CSRC IPO suspensions did not influence collateral incidence directly. Unfortunately, this assumption is not testable. An informal test of the exclusion restriction can be derived by including instrumental variables in the structural equation and test if their coefficients are statistically significant. The coefficients of *log (1 + dd_lag2)* and *Affected_Firms* are -0.009 (p-value 0.22) and -0.03 (p-value 0.53), both of which are statistically insignificant. Another caveat is that banks may consider the IPO suspensions as negative shocks to the firms involved. Consequently, banks may raise collateral requirements for loans obtained during the suspension periods. This could relate IPO suspensions directly to the incidence of collateral, and therefore violate the exclusion restriction.

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31. By the end of 2013, the CSRC IPO suspension periods were: 1) 1994/7/21-1994/12/7; 2) 1995/1/19-1995/6/9; 3) 1995/7/5-1996/1/3; 4) 2001/7/31-2001/11/2; 5) 2004/8/26-2005/1/23; 6) 2005/5/25-2006/6/2; 7) 2008/9/16-2009/7/10; 8) 2012/11/16-2013/12/31.

32. Defining a 3-year window does not materially change our results. Results are available upon request.

To test this, we define a dummy variable *Affected_Loans* which equals one if loans are obtained by *Affected_Firms* during the suspension periods and zero otherwise. We find that 1,410 loans (or 15% of our sample) satisfy this condition. We re-estimate the baseline model (Table IV, Column (3)) including the *Affected_Loans* dummy. If banks consider the IPO suspensions as negative shocks to firms, *Affected_Loans* should be significantly positive. The coefficient of *Affected_Loans* is indeed positive (0.04, with p-value 0.48), but statistically insignificant.[33]

To conclude, the test results are consistent with our view that collateral incidence is independent from the IPO suspensions ordered by the CSRC, and *log(1+dd_lag2)* and *Affected_Firms* are valid instruments. Furthermore, our main results hold after controlling for the endogeneity of IPOs.

5.2 *Endogeneity of relationship lending*

Relationship lending may also be endogenous due to omitted variables affecting both relationship formation and collateral incidence.[34] For instance, firms with a bad credit reputation (unobserved to the econometrician but known to all competing banks) could only borrow repeatedly from their incumbent banks due to limited outside options. Therefore, the positive correlation between relationship intensity and collateral incidence may result from unobserved poor credit quality instead of informational rent extraction. We employ the recursive bivariate Probit model with instrumental variables to address this concern. To implement this approach, first we need to transfer the continuous measure of relationship lending into a binary variable. In a fashion similar to Presbitero and Zazzaro (2010), a relationship dependency dummy (Rel) is defined to equal one if the firm obtained at least 20% (sample median of *Sizeconcen*) of its loans from the lender prior to the current loan and zero otherwise. Second, at least one exclusion restriction must be provided: at least one exogenous variable should exist that determines Rel, but which does not affect collateral incidence except through relationship intensity. We create a lagged regional average lending rate (*Localavrate*) as such an instrument (definition and summary statistics are reported in Table I). A similar approach has been applied in Bharath et al. (2011).[35] *Localavrate* is expected to affect relationship lending positively, as firms might prefer to borrow from their relationship lenders if conditions in regional (local) credit markets had been tight before. It is unlikely that past regional average lending rates would affect the collateral pledged for current individual loans.[36]

Similar to *Equation (4)*, the recursive bivariate Probit model is defined by a two-equation system: a *Collateral Equation* and a *Relationship Equation*, where the relationship dependency dummy Rel and its interaction term with *IPO* ($Rel * IPO$) enter the *Collateral Equation*. Other covariates in the *Collateral Equation* correspond to the ones used in Table IV, Column (3). The model is identified once the exclusion restriction *Localavrate* is added to the *Relationship*

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33. These tests of the exclusion restriction are not tabulated to save space. Full results are available upon request.

34. The self-selection issue of borrowing in concentrated or non-concentrated banking markets is not modeled. This self-selection issue is unlikely to be relevant, because cross-regional loans are rare, due to the segmentation of Chinese banking markets. Regional banks such as city commercial banks and rural commercial (co-operative) banks mainly serve clients located in their own region. It is only recently that some city commercial banks have been allowed to establish branches outside their home province to better serve local customers. Banks that operate at the national level, such as state-owned commercial banks (SOCBs) and joint-stock commercial banks (JSCBs), have extensive branch networks, which allow their local branches to provide loans to local firms. It is unlikely that firms will self-select themselves to borrow from banks (branches) outside their home province or in regional markets characterized by specific market structures in order to avoid collateral requirements.

35. Bharath et al. (2011) conducts joint estimations of loan contract terms, employing lagged average lending spreads over the last six months as instruments for collateral. These authors suggest that lagged average lending spreads do not necessary affect non-price terms such as collateral, based on concrete information obtained from bankers.

36. Unreported results show that *Localavrate* is statistically insignificant as a determinant of collateral incidence. Results are available upon request.

Equation, together with other determinants of relationship lending.[37] Results are reported in Table VI, Column (4). The estimated correlation between the error terms of the two equations, i.e. ρ, is significantly negative (-0.508***, p-value 0.002), rejecting the exogeneity assumption of relationship lending and supporting the recursive bivariate Probit estimation approach. The coefficient of the instrumental variable (*Localavrate*) in the *Relationship Equation* is 0.115 and significant at 1%, indicating that firms in provinces with higher past average lending rates were also more likely to borrow from relationship lenders. Turning to the *Collateral Equation*, the estimates controlling for the endogeneity of relationship lending are consistent with the baseline results in Column (1).

Table VI: Bivariate Probit Models

This table reports the results of recursive Bivariate Probit models with instrumental variables. Column (1) replicates the Probit model results of Table IV, column (3) for comparison purposes. Column (2) and (3) treat *IPO* as endogenous variable. Column (4) treats relationship lending dummy *Rel* as endogenous variable, where *Rel* is a dummy variable equals 1 if the firm obtains at least 20% (i.e. the sample median of the *Sizeconcen*) of bank loans from the lender prior to the current loan, and 0 otherwise. In all specifications, the variables in the *Collateral Equation* correspond to the ones used in Table IV, column (3), except that in Column (4) where *Sizeconcen* and *Sizeconcen*IPO* are replaced by *Rel* and *Rel*IPO*, respectively. Variables in the *IPO Equation* include one instrument (*Affected_Firms* or *Log (1 + dd_lag2)*) and all variables in the *Collateral Equation*, except *IPO* and its interaction terms with other covariates. Variables in the *Relationship Equation* include one instrument (*Localavrate*) and all variables in the *Collateral Equation*, except *Rel*, *Rel * IPO*, relationship control variables (*Relcontrols* defined in section 2.1.1), and their interactions with *IPO*. The instrumental variables are defined as following: *Affected_Firms* is a dummy variable equals 1 if the firm has experienced at least one CSRC IPO suspension within the 2-year window prior to the firm's actual listing; *Log (1 + dd_lag2)* is the logarithm of 1 plus the number of CSRC IPO suspension days within the 2-year window prior to the firm's actual listing; *Localavrate* is the regional average lending rate one semi-accounting year before the current loan. Full results of Bivariate Probit models are available upon request. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Probit	Bivariate probit *IPO* as endogenous		Bivariate Probit *Rel* as endogenous
VARIABLES		IV: Affected_Firms	IV: Log(1+dd_lag2)	IV: Localavrate
	(1)	(2)	(3)	(4)
Collateral Equation				
Sizeconcen (Rel)	0.596***	0.589***	0.589***	1.314***
	(0.218)	(0.217)	(0.217)	(0.247)
ACR4	5.935***	5.873***	5.848***	4.999***
	(1.216)	(1.214)	(1.214)	(1.178)
Sizeconcen*IPO (Rel*IPO)	-0.471**	-0.460**	-0.460**	-0.521***
	(0.229)	(0.228)	(0.228)	(0.148)
ACR4*IPO	-3.503***	-3.487***	-3.469***	-3.198***
	(1.016)	(1.013)	(1.012)	(0.935)
IPO Equation				

37. Covariates in the *Relationship Equation* include firm and loan characteristics, monetary policy and regional macroeconomic variables, and fixed effects dummies. Excluding potentially endogenous loan characteristics does not change our results. Estimation of the R*elationship Equation* shows that firms are more likely to borrow from relationship lenders if they are located in concentrated markets, are liquid, smaller, more leveraged, less profitable, have better loan contract terms such as longer loan maturities and lower spreads, and if the loan represents a relatively large portion of the firm's existing debt (*Loanconcen*). Full results for the recursive bivariate Probit model are available upon request.

Affected_Firms		-0.681***		
		(0.094)		
Log(1+dd_lag2)			-0.080***	
			(0.016)	
Relationship Equation				
Localavrate				0.115***
				(0.040)
ρ		-0.129 (p=0.12)	-0.114 (p=0.17)	-0.508***(p=0.002)
Observations	8741	8,765	8,765	8765

6 Further robustness tests

This section presents further robustness tests accounting for unobserved firm specific time-invariant risks with the fixed effects Logit model (6.1); the endogeneity of other loan contract terms using the instrumental (IV) Probit model (6.2); and the sensitivity of the results to alternative samples (6.3). Our main results are robust to all these tests.

6.1 *Firm fixed effects*

Including firm fixed effects alleviates the concern that unobserved time-invariant risk factors can drive our results. As the Probit model is not suitable for fixed effects regressions, we resort to the fixed effects Logit model. Table VII reports the full sample results for specifications without potentially endogenous loan contract terms (Column (1)) and with those terms (Column (2)). Column (3) and (4) replicate these regressions for a sample excluding loans originated after a firm's bond IPO. After controlling for firm fixed effects, the impact of relationship intensity on collateral incidence is significantly positive for pre-IPO loans, but statistically insignificant across all specifications for post-IPO loans (H_0: $Sizeconcen_{il} + Sizeconcen_{il} * IPO_{il} = 0$ cannot be rejected). This result is even stronger than that of our baseline model (Column (3) of Table IV), supporting the hypothesis that IPOs as informational shocks eliminate rent extraction opportunities. The results for market concentration are similar to our previous findings, i.e. more concentrated markets increase the likelihood of collateral incidence and this effect is stronger for pre-IPO loans.

Table VII: Firm fixed effects

This table reports the results for the fixed effects Logit model for alternative samples, and for specifications with and without loan contract terms. Results for firm characteristics and fixed effects dummies are not reported to save space. Monetary policy variables and regional macro variables are not included in this estimation. Including them does not change our results. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Fixed effects Logit model			
	All loans		*Loans originated before corporate bond IPOs*	
	Without loan contract terms	With loan contract terms	Without loan contract terms	With loan contract terms
VARIABLES	(1)	(2)	(3)	(4)
Sizeconcen	1.645***	1.634***	1.750***	1.713***
	(0.543)	(0.544)	(0.542)	(0.543)
ACR4	23.247***	24.007***	23.356***	24.055***
	(5.305)	(5.284)	(5.337)	(5.309)
Sizeconcen*IPO	-1.472***	-1.453**	-1.774***	-1.722***
	(0.564)	(0.565)	(0.567)	(0.568)
ACR4*IPO	-17.824***	-18.051***	-19.251***	-19.548***
	(5.210)	(5.177)	(5.209)	(5.169)
First	1.074***	1.080***	1.292***	1.287***
	(0.389)	(0.388)	(0.397)	(0.395)
First*IPO	-1.209***	-1.199***	-1.547***	-1.527***
	(0.400)	(0.399)	(0.410)	(0.408)
Switch	0.407	0.448	0.325	0.374
	(0.300)	(0.299)	(0.303)	(0.302)
Switch*IPO	-0.472	-0.476	-0.365	-0.368
	(0.311)	(0.310)	(0.316)	(0.315)

Numlender	0.023	0.033	0.063**	0.075**
	(0.028)	(0.029)	(0.030)	(0.030)
IPO	10.171***	10.272***	10.954***	11.097***
	(2.978)	(2.959)	(2.978)	(2.954)
Observations	5,856	5,851	4,816	4,811
Number of firms	291	291	255	255
Pseudo R2	0.137	0.142	0.138	0.144
H_0:Sizeconcen+Sizeconcen*IPO=0	0.173	0.181	-0.024	-0.009
H_0: ACR4+ACR4*IPO=0	5.423***	5.967***	4.105*	4.506*

6.2 *Endogeneity of loan contract terms*

In this subsection, we apply instrumental variable (IV) Probit regressions to address the endogeneity issue of loan contract terms. We examine two possibilities: exclude *Spread* from the determinants of collateral and treat *Maturity* as the sole endogenous variable; and treat both *Spread* and *Maturity* as endogenous variables.[38] The instruments chosen for *Maturity* are asset maturity (*Amaturity*, see Barclay et al., 1995) and term spread (*Termspread*, see Dennis et al., 2000; Brick and Ravid, 1985). Regarding the lending spread (*Spread*), we use as instruments the benchmark loan spread (*Benchsprd*, defined as the benchmark lending rate minus the benchmark deposit rate) and the lagged regional average lending rate (*Localavrate*). *Benchsprd* and *Localavrate* should be correlated with the actual lending spread, but they are not likely to be related to whether or not a particular loan is collateralized.[39] Summary statistics and definitions of these instrumental variables are in Panel F of Table I. Technical details, results and relevance and validity of instrumental variables are reported in the Internet Appendix, Section B and Table IA.V. We find that loan contract terms are indeed endogenous as the null hypotheses that *Maturity* alone or *Maturity* and *Spread* together are exogenous are strongly rejected (Wald-test p-value=0.0192 and 0.0000, respectively). Nevertheless, the IV Probit results are largely consistent with our previous findings, except that $Sizeconcen_{il}$ loses its explanatory power for post-IPO loans (H_0: $Sizeconcen_{il} + Sizeconcen_{il} * IPO_{il} = 0$ cannot be rejected, p-value = 0.99 or 0.86 depending on specifications), which is an even stronger result than the one obtained in our baseline model. Results for market structure are also similar to our previous findings.

6.3 *Alternative samples*

Lastly, we investigate in this section if the results for our baseline model are sensitive to alternative samples. First, we focus on a sample of firms that borrowed at least once before the equity IPO and at least once after, which allows us to compare more precisely changes in collateral incidence around the actual moment of the IPO. Second, we restrict the sample to loans that were originated right before and after the IPO (e.g. one loan before and one loan after); four loans closest to the IPO date (e.g. two before and two after); and six loans closest to the IPO date (e.g. three before and three after). These short event windows minimize the possibility that significant events other than IPOs may affect our results. Results for these samples are reported in the Internet Appendix, Table IA.VI. Finally, we investigate if our results are driven by loans that were

38. The existing literature differs in treating which of the loan contract terms should be endogenous in determining collateral. Dennis et al. (2000) and Bharath et al. (2011) consider *Maturity* as the only endogenous contract term that affects collateral incidence. The underlining assumption is that the lending spread is determined after the decision on collateral pledging. On the other hand, Brick and Paila (2007) and Ono and Uesugi (2009) model the spread as an endogenous determinant of collateral. As empirical validations are provided for both assumptions and theoretical advantages of either assumption are unknown a priori, we examine both.

39. *Benchsprd* and *Localavrate* may reflect changes in the monetary policy stance or business cycle, which in turn might affect the incidence of collateral (see Jimenez et al., 2006). If this were true, these variables cannot serve as valid instruments. However, our estimations show that monetary conditions measured by the reserve requirement ratio or 7-day repo rate, or the business cycle measured by regional GDP growth rates, do not affect collateral incidence significantly, as reported in most of our tables.

granted on non-commercial terms, for example because of political connections. We re-estimate *Equation (3)* by removing progressively loans from policy banks, state-owned banks, trust and investment companies and other financial institutions, under the assumption that loans from these institutions could be based on policy preferences, political pressure or other non-standard credit criteria. Results are reported in the Internet Appendix, Table IA.VII. Our main findings remain solid in almost all of these samples.

7 Conclusions

In this paper, we investigate if proprietary information obtained from both lending relationships and concentrated markets allows for informational rent extraction through collateral. We find that collateral incidence increases with both relationship lending and market concentration, and that these effects are less pronounced for transparent firms. Using equity IPOs as informational shocks, we find that collateral incidence increases with both relationship intensity and market concentration for pre-IPO loans, while these effects are greatly moderated for post-IPO loans. Furthermore, we demonstrate that after the IPO, rent extraction through collateral is moderated for safe firms but intensified for risky ones, a result in line with the prediction of Rajan (1992). Further robustness tests suggest that our results are not caused by differences in credit risk, endogeneity of IPOs and relationship lending, concurrent lending and underwriting business or loans granted at non-commercial terms. Our results complement the findings that banks extract informational rents by charging higher lending rates (Hale and Santos, 2009; Schenone, 2009), and in part validate the theoretical predictions that concentrated market structures facilitate the accumulation of inside information (Dell'Ariccia et al., 1999; Dell'Ariccia, 2001). Finally, we provide the first loan-level analysis of collateral incidence for China, which has received little attention so far.

Our study opens up a few avenues for future research. A cross-country investigation on rent extraction through collateral could be fruitful. Rent extraction through collateral could be more likely to occur in less developed markets where banks lack sufficient tools to price credit risks in comparison to more advanced markets. Another interesting question is whether banks choose different methods to charge rents (either through lending rates or collateral) depending on the degree of price regulation or the stance of monetary policy. A third avenue is to investigate how rent extraction through collateral could vary with the legal and institutional environment, as these aspects crucially determine how valuable collateral is to banks. We leave these for future research.

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Appendix

This appendix provides technical details and results of the propensity score matching analysis (Section 4.2) and the instrumental variable Probit model (Section 6.2). Results of propensity score matching analysis are reported in Table IA.II and Table IA.III. Results controlling for endogeneity of loan contract terms are reported in Table IA.V. Moreover, details and results are reported of several additional tests discussed in Section 4.2 ("difference-in-difference" tests, Table IA.I.) and Section 4.3 (corporate bond underwriting and concurrent lending, Table IA.IV), and for alternative samples such as conducted in Section 6.3 (Table IA.VI-VII).

A. *Propensity score matching*

This section presents the technical details of propensity score matching (e.g. Heckman et al., 1998). We divide our sample into two subsamples: pre-IPO loans and post-IPO loans, with the former presumably subjected to a higher degree of information asymmetries for non-relationship banks. Within each subsample, we estimate the propensity score of loans borrowed from relationship lenders using a Logit model. Specifically, for each sample, we regress the relationship dummy on the following covariates: *ACR4*, *FT*, *Liquidity*, *Size*, *Leverage*, *ROA*, *Age* and *Tangibility.*[40] For the sake of robustness, we further expand the covariates list by introducing their square terms.[41] Relationship dummies equal one if *Sizeconcen* is greater or equal to the sample median of the respective samples (0.25 for the pre-IPO sample and 0.19 for the post-IPO sample, respectively). Then we match each relationship loan (treatment group) with a (set) of non-relationship loans (control group) that have the closest propensity scores to that specific relationship loan. The average treatment effects of relationship intensity on collateral incidence are expected to be significantly positive for the pre-IPO loans, and moderated or insignificant for the post-IPO loans.

To compute the average treatment effects, two alternative matching methods are used, i.e. "nearest neighbor" matching and "kernel" matching. We drop all loans that are outside of the common support to minimize the potential bias introduced by these loans. Bootstrap standard errors based on 50 replications are reported.

Next, we test the balancing property of covariates. The estimated average treatment effects are biased if the covariates determining participation in the treatment group are not sufficiently balanced. The standardized bias of Rosenbaum and Rubin (1985) is a common statistic to test the balance of the distribution of the covariates in both the control and treatment groups. For brevity, we only report the mean bias of the matched sample.[42] Several other overall balancing tests including the pseudo-R^2, Rubin's B and Rubin's R are also reported. All of these diagnoses confirm that the covariates of the matched sample are balanced. In more detail: the mean bias for the matched sample is below the 5% threshold; the pseudo-R^2 for the matched sample is fairly low; Rubin's B is below 25 thresholds for most of the cases, and Rubin's R is within [0.5, 2].[43] Results are reported in the Internet Appendix Table IA.II.

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40. Estimates on propensity scores are available upon request.

41. The main purpose of propensity score estimation is not to predict selection into treatment as good as possible, but to balance all covariates (Augurzky and Schmidt, 2000).

42. The standardized biases of individual covariates are available upon request.

43. Sianesi (2004) suggests that a low pseudo-R^2 for the post matching sample is an indicator of balanced matching. Rubin's B is the absolute standardized difference of the means of the linear index of the propensity score in the treated and matched

Finally, we test the sensitivity of our results to unobserved variables that affect both relationship lending and collateral incidence. Rosenbaum (2002) developed a bounding approach to address whether or not inference about treatment effects may be affected by unobserved factors. We focus on pre-IPO loans, because as noted by Hujer et al. (2004), sensitivity analysis for insignificant treatment effects is not meaningful. Results are reported in Internet Appendix Table IA.III. Taking into account that the estimated treatment effect is positive for pre-IPO loans, the lower bounds (*Q_mh-*) – under the assumption that the true treatment effect has been underestimated – are less interesting (Becker and Caliendo, 2007). Therefore, we focus on the upper bounds (*Q_mh+*). We report the Rosenbaum bounds for propensity score model II with the nearest neighbor matching (*NN(20)*). The results for the bounds are similar for propensity score model I and other matching methods. The critical level e^{γ}, at which one would question the positive effect of relationship lending on collateral incidence, is 1.85, a fairly large value by normal standards (see e.g. Bharath et al., 2011, for further discussion). Note that a critical value of 1.85 does not mean that relationship lending has no effect on collateral incidence and that unobserved heterogeneity exists. It only states that the confidence interval for the treatment effect would include zero if unobserved variables caused the odds ratio of relationship lending to differ between relationship borrowers and non-relationship borrowers by a factor 1.85. We conclude that it is unlikely that our causal inference of the positive effect of relationship lending on collateral incidence for pre-IPO loans could be challenged by powerful unobserved variables.

sample. Rubin's R is the ratio of treated to matched variances of the propensity score index. Rubin (2001) recommends that Rubin's B is less than 25 and Rubin's R lies between 0.5 and 2 for the samples to be sufficiently balanced.

B. *Endogeneity of loan contract terms: IV Probit model*

This section addresses the endogeneity issue of loan contract terms using IV Probit estimations. Our choices of instruments are guided by the existing literature and the specific characteristics of Chinese banking regulation. For *Maturity*, we follow Barclay et al. (1995) and employ asset maturity (*Amaturity*) as instrument, as firms may match their debt maturity with that of their assets to mitigate agency costs.[44] In addition, as proposed in Dennis et al. (2000) and Brick and Ravid (1985), loan maturity is expected to be positively related to the slope of the yield curve, proxied by the term spread (*Termspread*). This spread is defined as the yield difference between the 5- and 1-year government bonds for the month when the loan was originated. Regarding the lending spread, we use as instrument the benchmark loan spread (*Benchsprd*) for maturities that correspond with that of loan *l* in the month of the loan origination (*Benchsprd* = benchmark lending rate minus the benchmark deposit rate). Another instrument we introduce is the lagged regional average lending rate (*Localavrate*), measured at one semi-accounting year before the current loan. *Benchsprd* and *Localavrate* should be correlated with the actual lending spread, but they are not likely to be related to whether a particular loan is collateralized or not. Summary statistics and definitions of these instrumental variables are in Panel F of Table I.

Results of the IV Probit model are reported in Internet Appendix, Table IA.V. Column (1) excludes *Spread* from the determinants of collateral and treats *Maturity* as the sole endogenous variable, whereas Column (2) treats both *Spread* and *Maturity* as endogenous variables.[45] Newey's efficient two-step estimator is employed to obtain coefficient estimates for both specifications. The relevance and validity of our instruments in the IV Probit model are reported at the bottom rows.[46] In both Column (1) and (2), the null hypotheses that *Maturity* alone or *Maturity* and *Spread* together are exogenous are strongly rejected (Wald-test p-value=0.0192 and 0.0000, respectively), validating the IV Probit approach. The results of the conditional likelihood-ratio (*CLR*) test, *K* test and Anderson-Rubin Chi square test (*AR*) all reject the null hypothesis that the coefficients of the endogenous regressors in the structural equation are (jointly) zero. We also conduct the *J* statistics test, which assesses the validity of the instruments, i.e. the null hypothesis is that the instruments are uncorrelated with the error term. In both Column (1) and (2), the *J* statistics are statistically insignificant, confirming the validity of our instruments for the endogenous loan contract term *Maturity*, or for both *Maturity* and *Spread*.

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44. Bharath et al. (2011) and Barclay et al. (2003) provide in-depth discussions of the validity of using asset maturity as an instrument for debt maturity. We follow Li et al. (2009) in defining asset maturity. See Table I, Panel F for definitions. Missing data for asset maturity is replaced by the industry median.

45. The existing literature differs in treating which loan contract terms should be endogenous in determining collateral. Dennis et al. (2000) and Bharath et al. (2011) consider *Maturity* as the only endogenous contract term that affects collateral. The underlining assumption is that the lending spread is determined after the decision on collateral pledging. On the other hand, Brick and Paila (2007) and Ono and Uesugi (2009) model the spread as an endogenous determinant of collateral. As empirical validations are provided for both assumptions and theoretical advantages of either assumption are unknown a priori, we examine both possibilities.

46. See Finlay and Magnusson (2009) for details on weak instrument robustness tests for limited dependent variable models.

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Table IA.I Difference-in-Difference

This table reports the difference-in-difference tests in key risk factors for post- and pre-IPO samples (*post-IPO-pre-IPO*) and for both relationship dependent and non-dependent firms. Relationship dependent firms are the ones with *Sizeconcen* greater or equal to the sample median, while the rest are non-dependent firms. *** p<0.01, ** p<0.05, * p<0.1.

	Mean differences (*post-IPO-pre-IPO*)							
	ROA	Leverage	Tangibility	Liquidity	Size	Maturity	Spread	Loansize
Relationship dependent Firms	- 0.03***	0.21***	0.08***	0.23***	4.04***	0.14**	0.25**	1.06***
Relationship non-dependent firms	- 0.05***	0.20***	0.11***	0.15***	3.94***	0.19***	-0.06	0.83***
Difference-in-Differences	-0.01	-0.00	0.03	-0.08***	-0.11	0.04	0.19	-0.23

Table IA.II: Selection of observables – Propensity score matching on relationship lending.

This table reports average treatment effects of relationship lending on collateral incidence for pre-IPO and post-IPO loans. Propensity Score Model I in Panel A employs the following variables: *ACR4*, *FT*, *Liquidity*, *Size*, *Leverage*, *ROA*, *Age* and *Tangibility*. The Propensity Score Model II in Panel B includes all variables used in Panel A and the square terms of these variables (except the square term of *FT*). Logit regression is adopted in both panels. Bootstrap standard errors based on 50 replications are reported. NN(20) and NN(50) are the nearest neighbor matching estimators with 20 and 50 nearest neighbors. Epanechnikov kernel with bandwidth 0.06 is applied for the kernel matching estimator. Observations of common support are discarded. All balancing tests are based on matched samples. *** p<0.01, ** p<0.05, * p<0.1.

Panel A: Propensity Score Model I						
	Pre-IPO loans			Post-IPO loans		
	NN(20)	NN(50)	Kernel	NN(20)	NN(50)	Kernel
ATE	0.126***	0.116***	0.115***	-0.005	-0.005	-0.008
Std.Err.	(0.033)	(0.032)	(0.029)	(0.012)	(0.014)	(0.012)
Pseudo R2	0.006	0.004	0.006	0.002	0.002	0.001
Mean Bias	4.7	3.2	4.3	3.1	2.5	2.0
Rubin's B	17.6	15.0	18.3	10.7	9.5	8.0
Rubin's R	0.99	1.16	1.01	1.28	1.46	1.36
Panel B: Propensity Score Model II						
ATE	0.103***	0.102***	0.108***	0.007	-0.002	0.002
Std.Err.	(0.033)	(0.036)	(0.037)	(0.015)	(0.014)	(0.011)
Pseudo R2	0.013	0.013	0.007	0.002	0.002	0.002
Mean Bias	3.3	4.4	3.3	1.8	1.4	1.9
Rubin's B	27.0*	27.4*	20.2	11.0	11.2	9.8
Rubin's R	1.16	1.23	1.04	1.42	1.41	1.44

Table IA.III: Sensitivity test-Rosenbaum bounds.

This table reports results for the Rosenbaum bounds test for Propensity Score Model II with nearest neighbor matching (NN(20)). e^{γ} is the odds of differential assignment due to unobserved factors. *Q_mh+* and *Q_mh-* are the upper and lower bounds of the Mantel-Haenszel statistic. With increasing e^{γ}, the bounds move apart, reflecting uncertainty about the test-statistics in the presence of hidden bias. *p_mh+* and *p_mh-* are significance levels for upper and lower bounds.

e^{γ}	Q_mh+	Q_mh-	p_mh+	p_mh-
1	4.51	4.51	0.00	0.00
1.05	4.24	4.78	0.00	0.00
1.1	3.98	5.04	0.00	0.00
1.15	3.74	5.29	0.00	0.00
1.2	3.51	5.53	0.00	0.00
1.25	3.29	5.77	0.00	0.00
1.3	3.07	6.00	0.00	0.00
1.35	2.87	6.22	0.00	0.00
1.4	2.68	6.43	0.00	0.00
1.45	2.49	6.64	0.01	0.00
1.5	2.31	6.84	0.01	0.00
1.55	2.13	7.04	0.02	0.00
1.6	1.97	7.23	0.02	0.00
1.65	1.80	7.42	0.04	0.00
1.7	1.64	7.60	0.05	0.00
1.75	1.49	7.78	0.07	0.00
1.8	1.34	7.95	0.09	0.00
1.85	1.20	8.13	0.12	0.00

Table IA.IV: Corporate bond underwriting and concurrent lending

This table reports the results for samples of loans issued before corporate bond IPOs using the Probit model. Column (1) reports results for the full sample. Column (2) report results for a sample of firms that borrowed both before and after their equity IPOs. In both columns, loans borrowed after corporate bond IPOs are excluded. Results for firm characteristics and fixed effects dummies are not reported to save space. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Loans before corporate bond IPOs	
	All firms	Firms that borrowed both before and after equity IPO
VARIABLES	(1)	(2)
Sizeconcen	0.642***	1.531***
	(0.190)	(0.326)
ACR4	4.651***	12.911***
	(1.228)	(2.637)
Sizeconcen*IPO	-0.511**	-0.813**
	(0.201)	(0.398)
ACR4*IPO	-3.777***	-4.129*
	(1.022)	(2.460)
First	0.542***	1.083***
	(0.154)	(0.252)
First*IPO	-0.562***	-1.079***
	(0.160)	(0.288)
Switch	0.106	0.500***
	(0.121)	(0.188)
Switch*IPO	-0.182	-0.592***
	(0.128)	(0.222)
Numlender	0.027***	0.111***
	(0.008)	(0.028)
IPO	2.086***	3.371**
	(0.601)	(1.425)
FT	-0.631***	-0.731***
	(0.052)	(0.255)
Constant	-0.341	-7.682
	(0.920)	(182.973)
Fixed effects dummies	Industry, Province, Bank Type, Time	
Firm characteristics	Yes	Yes
Monetary policy variables	No	No
Regional macro variables	No	No
Other contract terms	No	No
Observations	7,453	1,606
Pseudo R2	0.270	0.401
H_0:Sizeconcen+Sizeconcen*IPO=0	0.131*	0.719***
H_0: ACR4+ACR4*IPO=0	0.875	8.781***

Table IA.V: Endogeneity of loan contract terms.

This table reports IV Probit regression results, treating other loan contract terms as endogenous variables. Column (1) treats Maturity as the sole endogenous variable, assuming that Spread does not affect collateral incidence. Column (2) treats both Spread and Maturity as endogenous variables. The instruments for Maturity are asset maturity (Amaturity) and term spread (Termsprd). Instruments for Spread are the lagged local average lending rate (Localavrate) and benchmark loan spread (Benchsprd). Definitions and summary statistics for these instrumental variables are reported in Table I, Panel F. Results for fixed effects dummies and first stage estimations of IV Probit regression are not reported to save space. They are available upon request. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	IV Probit	
VARIABLES	(1)	(2)
$\widehat{\text{Maturity}}$		0.597**
		(0.273)
$\widehat{\text{Spread}}$	0.996**	0.746***
	(0.426)	(0.271)
Sizeconcen	0.503**	0.591**
	(0.250)	(0.242)
ACR4	4.972***	5.279***
	(1.314)	(1.320)
Sizeconcen*IPO	-0.501**	-0.608**
	(0.251)	(0.253)
ACR4*IPO	-3.013***	-3.364***
	(1.099)	(1.098)
First	0.394*	0.345
	(0.217)	(0.223)
First*IPO	-0.446**	-0.480**
	(0.225)	(0.228)
Switch	0.530***	0.358**
	(0.191)	(0.146)
Switch*IPO	-0.392***	-0.368**
	(0.149)	(0.148)
Numlender	0.076	-0.016
	(0.049)	(0.039)
Numlender*IPO	-0.018	0.021
	(0.040)	(0.037)
IPO	1.648**	1.920***
	(0.684)	(0.683)
FT	-0.671***	-0.534***
	(0.067)	(0.056)
Liquidity	0.090	-0.242
	(0.329)	(0.201)
Size	-0.260***	-0.172***
	(0.038)	(0.036)
Leverage	0.372	0.667***
	(0.262)	(0.155)
ROA	-1.460***	-1.077***
	(0.335)	(0.351)
Age	-0.452***	-0.521***
	(0.071)	(0.064)
Tangibility	-0.587**	-0.788***
	(0.284)	(0.222)
Loansize	-0.200***	-0.107***
	(0.060)	(0.024)
Loanconcen	1.471***	1.665***
	(0.523)	(0.475)

RRR	-3.191	-0.083
	(3.273)	(3.755)
Repo	0.045	0.068**
	(0.030)	(0.031)
CPI	-1.791	-1.389
	(1.949)	(1.839)
NPLratio	0.891	-0.905
	(1.309)	(1.382)
Realgdpindex	-1.625	-0.290
	(1.858)	(1.647)
Constant	0.385	-2.186
	(2.193)	(2.468)
Observations	8,159	8,159
Fixed effects dummies	Industry, Province, Bank Type, Time	
H_0:Sizeconcen+Sizeconcen*IPO=0	0.002 (p=0.99)	-0.017 (p=0.86)
H_0: ACR4+ACR4*IPO=0	1.959**(p=0.03)	1.914** (p=0.03)
H_0:First+First*IPO=0	-0.052 (p=0.46)	-0.136 (p=0.14)
H_0:Switch+Switch*IPO=0	0.138 (p=0.21)	-0.009 (p=0.86)
Wald test (p-value)	Chi2(1)=5.48 (0.0192)	Chi2(2)=20.36 (0.0000)
CLR (p-value)	6.12 (0.0146)	23.94 (0.0000)
K (p-value)	Chi2(1)=6.12 (0.0134)	Chi2(2)=23.23 (0.0000)
J (p-value)	Chi2(1)=0.00 (0.9488)	Chi2(2)=1.81 (0.4041)
AR (p-value)	Chi2(2)=6.12 (0.0469)	Chi2(4)=25.04 (0.0000)

Table IA.VI: Alternative samples – Firms which borrowed both before and after IPO.

This table reports the results for a sample of firms that borrowed both before and after their equity IPOs. Panel A reports results for all loans. Panel B further restricts this sample to loans around IPO dates. Results for firm characteristics and fixed effects dummies are not reported to save space. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Firms borrowed both before and after IPO			
	Panel A: All loans	Panel B: Loans around IPOs dates		
		One loan before and one after equity IPO	Two loans before and two after equity IPO	Three loans before and three after equity IPO
VARIABLES	(1)	(2)	(3)	(4)
Sizeconcen	1.532***	2.293**	1.099**	1.173***
	(0.324)	(0.921)	(0.534)	(0.441)
ACR4	12.211***	14.652	11.515**	7.357*
	(2.543)	(9.731)	(5.416)	(4.284)
Sizeconcen*IPO	-0.713*	-1.108	-1.165*	-1.076*
	(0.394)	(1.208)	(0.683)	(0.552)
ACR4*IPO	-4.224*	-0.766	-8.850*	-8.722**
	(2.405)	(8.008)	(4.901)	(4.031)
First	1.121***	2.497***	1.439***	0.854**
	(0.251)	(0.842)	(0.499)	(0.378)
First*IPO	-1.069***	-1.086	-1.351**	-0.860*
	(0.286)	(0.873)	(0.564)	(0.447)
Switch	0.491***	-0.815	-0.049	0.277
	(0.188)	(0.623)	(0.381)	(0.283)
Switch*IPO	-0.588***	-0.138	-0.423	-0.465
	(0.220)	(0.831)	(0.494)	(0.376)
Numlender	0.114***	0.367**	0.176**	0.131**
	(0.027)	(0.158)	(0.084)	(0.058)
IPO	3.353**	1.439	6.374**	6.165***
	(1.394)	(4.649)	(2.837)	(2.332)
FT	-0.683***	-5.019***	-2.392***	-1.880***
	(0.244)	(1.291)	(0.555)	(0.410)
Constant	-7.514	-14.636	-12.967	-8.227
	(159.820)	(326.925)	(326.330)	(242.200)
Fixed effects dummies	Industry FE, Province FE, Bank Type FE, Time FE			
Firm characteristics	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	No
Monetary policy variables	No	No	No	No
Regional macro variables	No	No	No	No
Other loan contract terms	No	No	No	No
Observations	1,663	215	421	564
Pseudo R2	0.403	0.553	0.452	0.364
H_0:Sizeconcen+Sizeconcen*IPO=0	0.819***	1.184	-0.066	0.096
H_0: ACR4+ACR4*IPO=0	7.987***	13.886	2.665	-1.365

Table IA.VII: Alternative samples – Excluding non-commercially viable loans.

This table reports results for samples of loans provided by different types of banks. We exclude progressively loans that are less likely to be issued on a commercial basis. The model specification is based on Equation (4) excluding: Maturity, Spread, monetary variables and regional macroeconomic variables. Including these variables does not affect our results. Column (1) excludes loans borrowed from state-owned banks (SOCBS). Column (2) excludes loans from policy banks (PBs). Column (3) excludes loans from both policy banks and state-owned banks. Column (4) further excludes loans borrowed from trust and investment companies (TICs). Column (5) further excludes loans from other financial companies (Other), which leaves loans from joint-stock commercial banks, city commercial banks, rural commercial (cooperative) banks and foreign banks remaining. Results for firm characteristics and fixed effects dummies are not reported to save space. The equation is estimated with the Probit model. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	Excluding SOCBs	Excluding PBs	Excluding SOCBs&PBs	Excluding SOCBs&PBs &TICs	Excluding SOCBs&PBs &TICs&Other
VARIABLES	(1)	(2)	(3)	(4)	(5)
Sizeconcen	1.323***	0.556***	0.792**	0.958**	0.957**
	(0.344)	(0.194)	(0.368)	(0.388)	(0.393)
ACR4	11.231***	5.047***	10.203***	9.115***	9.108***
	(1.972)	(1.212)	(2.076)	(2.173)	(2.195)
IPO*Sizeconcen	-1.229***	-0.409**	-0.680*	-0.722*	-0.706*
	(0.358)	(0.203)	(0.385)	(0.406)	(0.412)
IPO*ACR4	-7.334***	-3.153***	-6.541***	-4.875***	-5.358***
	(1.718)	(1.022)	(1.779)	(1.871)	(1.881)
First	0.703***	0.501***	0.528**	0.682***	0.616**
	(0.227)	(0.157)	(0.246)	(0.257)	(0.262)
IPO*First	-0.673***	-0.474***	-0.446*	-0.605**	-0.550**
	(0.234)	(0.162)	(0.254)	(0.264)	(0.269)
Switch	0.316*	0.030	0.070	0.077	0.110
	(0.190)	(0.123)	(0.207)	(0.217)	(0.221)
IPO*Switch	-0.444**	-0.126	-0.263	-0.277	-0.308
	(0.200)	(0.129)	(0.217)	(0.227)	(0.231)
Numlender	0.024**	0.026***	0.034***	0.027**	0.028**
	(0.009)	(0.007)	(0.010)	(0.011)	(0.012)
IPO	4.511***	1.731***	3.773***	2.811**	3.039***
	(1.017)	(0.604)	(1.065)	(1.120)	(1.127)
FT	-0.520***	-0.565***	-0.440***	-0.477***	-0.476***
	(0.070)	(0.048)	(0.075)	(0.083)	(0.084)
Constant	-9.580	-0.111	-8.429	-8.433	-6.706
	(165.908)	(0.917)	(95.904)	(92.578)	(80.646)
Fixed effects dummies	Industry, Province, Bank Type, Time				
Firm characteristics	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	No	No
Monetary policy variables	No	No	No	No	No
Regional macro variables	No	No	No	No	No
Other loan contract terms	No	No	No	No	No
Observations	4,098	8,273	3,573	3,274	3,132
Pseudo R2	0.313	0.286	0.317	0.322	0.312
H0: ACR4+IPO*ACR4=0	3.897***	1.894**	3.662***	4.239***	3.750***
H0:Sizeconcen+IPO*Sizeconcen=0	0.094	0.147*	0.112	0.238*	0.251*

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Unidad de Servicios Auxiliares
Alcalá, 48 - 28014 Madrid
E-mail: publicaciones@bde.es
www.bde.es