Credit Tightening, Trade Credit, and Misallocation on Supply Chains*

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Abstract

When bank credit supply declines, large customers may turn to their small suppliers for trade credit. This direction of trade credit flow and its real consequences are underexplored. Using a transaction-level dataset of bank-accepted commercial bills (as trade-credit payments to suppliers) in China, we find that the 2011–2015 credit tightening under the loan-to-deposit ratio regulation motivates banks to substitute bill acceptance for loans. Consequently, smaller, younger, and more productive suppliers receive less cash payments and cut investments to finance their larger and less productive customers. The shift from bank credit to trade credit results in a widened capital return gap between paired suppliers and customers. Our results imply a new channel through which the bank credit tightening leads to misallocation on supply chains.

JEL Codes: G21, G23, G32, L60

Key Words: Commercial Bills, Trade Credit, LDR, Investment, Misallocation

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1 Introduction

Shocks to the bank credit supply alter real activities of employment and investment in the corporate sector (Bernanke and Gertler, 1995; Gan, 2007; Chodorow-Reich, 2014). These shocks are then transmitted and consequently affect customer and supplier firms via the inter-firm trade credit network (Kiyotaki and Moore, 1997; Costello, 2020; Adelino, Ferreira, Giannetti, and Pires, 2022). However, when empirically studying the real consequence, the literature treats firms as singletons and remains silent on whether trade credit improves or deteriorates resource allocation among firms. Do suppliers and customers fare differentially from the shock transmission from bank credit to trade credit? Do financially constrained suppliers provide trade credit, and if they do, could they be adversely affected?

These questions are important given the ongoing discussion on trade credit. Conventional literature assumes that large and deep-pocketed supplier firms lend to small and constrained customer firms. However, recent studies find large customers may also borrow from small and non-deep-pocketed suppliers (Nilsen, 2002; Klapper, Laeven, and Rajan, 2012; Murfin and Njoroge, 2015; Barrot, 2016; Giannetti, Serrano-Velarde, and Tarantino, 2021). This possibility raises the efficiency question as constrained suppliers could better deploy short-term working capital and have higher investment efficiency. In addition, the idea that delayed payments could harm small suppliers is at the center of policy debates to urge prompt business-to-business payments in many countries.[1] Yet, except for several studies on specific sectors (Murfin and Njoroge, 2015; Barrot, 2016; Barrot and Nanda, 2020), the quantitative magnitude of such adverse effect remains less understood.

This paper answers the above questions using a unique dataset that links banks, large customers, and small suppliers in China. China serves our research purpose well with a bank-dominated financial system in which large firms are closely linked to the banking sector and are hence exposed to credit supply shocks (Allen, Qian, and Qian, 2005; Song, Storesletten, and Zilibotti, 2011; Song and Xiong, 2018). Our dataset is from one of the leading commercial bill (CB) brokers and comprises 140,000 transactions of bills from 2011 to 2017, a period featuring with bank credit supply that was first tightened and then relaxed. Analogous to their European predecessor (i.e., bills of exchange) (Santarosa, 2015; Gor-

[1] Examples include the QuickPay initiative in the United States, the Late Payment Directive in the European Union, and the Prompt Payment Code in the United Kingdom. Despite these policy resolutions, the late-payment problem persists as an increasing number of public firms are delaying payments to small suppliers. See news articles from the *Wall Street Journal* https://www.wsj.com/articles/delaying-payments-to-suppliers-help-companies-unlock-cash-1530178201 and the *Financial Times* https://www.ft.com/content/f6a6f26f-05e5-43f9-97df-85805905e707.

ton, 2020), CBs are issued by customer firms to their suppliers as trade-credit payments (see Figure I for an example). These bills are then endorsed by the supplier and further transferred to the supplier's suppliers or discounted at local brokers or banks for cash. In terms of volume, CBs accounted for around a quarter of the overall trade credit for listed companies and were comparable to 10% of aggregate bank loans in 2015.[2] More than 90% of bills were accepted by commercial banks, meaning that banks would repay them if the customer defaults.

How does bank credit supply tightening affect the corporate usage of CBs? Different from studies that use early market-wide crises as exogenous bank lending shocks (Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montoriol-Garriga, 2013; Costello, 2020), we use the loan-to-deposit ratio (LDR) regulation in China to identify an exogenous tightening of bank credit supply. Enacted in 1994, the LDR regulation stipulates a cap for the outstanding loan of a bank as 75% of its deposit balance (Chen, Ren, and Zha, 2018; Hachem and Song, 2021; Zhu, 2021). It was loosely implemented before 2010, when China tightened the post-stimulus credit supply by strictly imposing the LDR cap on commercial banks. Before its unexpected abolition in 2015,[3] banks had incentives to substitute bills for loans since bill acceptance lowered the loan balance and boosted the deposit balance.

To this end, we merge our commercial bill data with the National Registry of Industry and Commerce (NRIC) and the Annual Survey of Industrial Firms (ASIF) balance sheet data, as well as the financial data for commercial banks. The merged data includes 2,981 city-level accepting bank branches from 306 banks, 44,233 customers, and 47,357 suppliers from a wide range of manufacturing industries in China. More than 95% of suppliers and customers are small, unlisted, and non-state owned.

Our first observation in the data is that bank loan growth decelerates more in regulation-constrained cities and banks with higher pre-2009 LDR levels during the time period of 2011–2015 (when the LDR regulation was in place). Such pattern disappears after 2015 (when the LDR regulation was abolished). Using policy document archives from the CBRC, we find evidence that the compliance of the regulation did occur at both the city and bank levels. As a result, when bank loan supply is tightened by the regulation, customer firms whose demand for credit cannot be satisfied turn to their suppliers for trade

[2]We calculate the first percentage as notes receivable divided by the sum of notes and accounts receivable for listed firms in the China Stock Market & Accounting Research (CSMAR) data. The second percentage is calculated as the outstanding undiscounted bills divided by outstanding loans, according to the table of Aggregate Financing to the Real Economy (AFRE) from the People's Bank of China (PBoC).

[3]The regulation was abolished in October. However, we find evidence that local China Banking Regulatory Commission (CBRC, now the China Banking and Insurance Regulation Commission) offices (e.g., in Anhui province) still emphasized execution of the regulation in April in their regulatory documents.

credit via issuing CBs. We show such a substitution exists across city-level bank branches and across customer firms.

This negative relationship between loan growth and CB issuance could be contaminated by unobserved demand factors affecting both. To identify causality, we use the bank- and city-level pre-09 (excluding 2009) LDR levels to instrument bank- and city-level loan growth rates. Arguably, a bank branch located in a city or belonging to a bank with a higher pre-09 LDR would lower its loan growth and accept more bills to circumvent the regulation. The pre-09 LDR measure is not directly related to the CB issuance after 2011 and hence satisfies the exclusion condition for a valid instrument. Using the fitted value of bank loan growth rates, we find a significant, negative, and more pronounced association (than the OLS estimate) between loan growth and CB issuance. Such a relationship disappears after 2015 when the regulation was removed, confirming our argument that the binding bank credit supply to customer firms explains the loan-to-CB substitution. These results again hold across city-level bank branches and across customer firms.

We proceed to study whether and how this bank credit tightening and the loan-to-CB substitution affect the capital investment of upstream suppliers, which ultimately affects capital reallocation along supply chains. We exploit the firm location and bank branch information to differentiate customer firms that are most affected by this substitution. Our goal is to investigate whether suppliers paired with the most affected customers decrease investment the most, consequently exacerbating misallocation between the two groups of firms.

The use of CBs would have immaterial real effects on suppliers *if* these suppliers were deep-pocketed (Kiyotaki and Moore, 1997). We find that this is not true in our data. Contrary to the conventional image of large and financially affluent suppliers in the previous literature (e.g., Petersen and Rajan, 1997; Adelino et al., 2022), suppliers in our dataset are more financially constrained than their connected customers. They are two years younger and 63% smaller in registered capital on average. These features suggest that the negative credit shock originated from customers could have real consequences on suppliers.

Suppliers who accept more CBs as payments indeed experience lower cash sales and declined capital investment. For an average supplier, a 1 percentage point increase in bill sales ratio is associated with a 1.12 percentage points decrease in cash sales. As a result, a 1 standard deviation increase in the predicted bill issuance (instrumented by the city-level LDRs) decreases the contemporaneous investment rate by 9 percentage points, about 14% of its mean investment rate in the data. Furthermore, this crowding-out effect is stronger for young, non-state owned, and unlisted suppliers with less access to finance. Put dif-

ferently, more financially constrained suppliers sacrifice more of their own investment to fund customers when bank credit is tightened. We also find a weaker crowding-out effect if the bills are more liquid, that is, issued by state-owned customers or accepted by state-owned banks, consistent with the finding in Gorton (2020) in the context of British bills in the 19th century.

Our last empirical exercise studies the efficiency implication of this loan-to-CB substitution. In the spirit of Hsieh and Klenow (2009), we compute the marginal revenue product of capital (MRPK) for each firm and its pairwise difference between customers and suppliers. We find that customers, on average, have an MRPK 16% lower than their paired suppliers in the year they issue bills. The operating efficiency gap is widened by 6 percentage points (or 7% of its standard deviation) in the subsequent year given a 1 standard deviation increase in the predicted bill issuance. Absent bill issuance, suppliers would invest more and the fraction of customer-supplier pairs in which the customer with a lower subsequent MRPK than the supplier would decrease from 50% in the data to a hypothetical 15%. That said, the regulation-induced CB issuance may result in capital misallocation along the supply chain. Thus, our study provides a novel channel through which credit policies cause unintended consequences in distorting allocations in the real economy.

Our paper contributes to a burgeoning literature on the transmission of credit shocks in the banking sector to the corporate sector (Gan, 2007; Chodorow-Reich, 2014; Amiti and Weinstein, 2018; Jiménez, Mian, Peydró, and Saurina, 2020). According to Ivashina, Laeven, and Moral-Benito (2022), the focus of the most recent research has not been whether such connections exist but what the economic mechanisms are. For instance, Chodorow-Reich and Falato (2022) explore the covenant violation channel for bank-firm transmission in the U.S. and propose the question what is the transmission channel for other countries. Our paper provides the answer using data from China.

Our paper is also closely related to the literature that studies the credit transmission mechanism along supply chains. Examples include Boissay and Gropp (2013) and Jacobson and Von Schedvin (2015) on corporate default shocks and Adelino et al. (2022) and Costello (2020) on supply shocks of trade credit. The latter two are the closest to ours because they study how changes in bank credit supply to suppliers induce changes of trade credit supply in the same direction. We differentiate our study from theirs in three ways. First, we utilize the LDR regulation to purge out the shock to the demand for trade credit from the customer side, rather than the shock on the supply side as current literature explores. Second, our suppliers are smaller in size and more financially constrained than their paired customers, allowing us to uncover different implications from literature that

assumes deep-pocketed suppliers. Third, we study the usage of CBs, which have a secondary market and are supposed to be more liquid than conventional trade credit. However, our findings suggest that this market is insufficiently liquid. Frictions in this market lead to capital misallocation along supply chains.

We next contribute to the literature on trade credit. The conventional rationale for trade credit is that small and more financially constrained firms need to borrow from their deep-pocketed suppliers (Petersen and Rajan, 1997). In contrast, Nilsen (2002) finds the puzzle that large listed firms actually increase account payables when credit tightens. Later research, Klapper et al. (2012), Murfin and Njoroge (2015), and Barrot (2016), also show large customers borrowing from small suppliers in normal times using different samples. We study this issue by providing customer-supplier paired evidence from a big emerging market and analyzing its real consequences.

The mechanisms we explore in the CB market are similar in spirit to studies of shadow banking in China. Although CBs are a traditional banking business, the notion of loan-to-CB substitution is analogous to the switch from bank loans to trust and entrusted loans, as discussed in Hachem and Song (2021), Chen et al. (2018), and Allen, Qian, Tu, and Yu (2019). When less productive customer firms switch to their suppliers for short-term funding, the effectiveness of bank credit tightening could be undermined and the efficiency of capital allocation could be distorted, similar to the implications of Chen et al. (2018), Allen et al. (2019) and Zhu (2021).

The rest of the paper is organized as follows. Section II introduces the institutional background of CBs and the LDR regulation in China. Section III introduces data and sample construction. Section IV studies how bank credit tightening invokes the usage of CBs. Section V investigates the real effects of the usage of CBs. Section VI presents robustness checks and further discussions. Section VII concludes.

2 Institutional Background

This section introduces the institutional background of our study. We introduce the emergence and development of the CB market in China. Then we discuss the LDR regulation in China and its potential impact on the CB market.

2.1 The Commercial Bill Contract and Market

Commercial bills, *piaoju*, in Chinese, are issued by a customer firm to its supplier as a payment method after the latter provides goods and services. It is similar to the promissory notes and bills of exchange used in early industrialization in Europe (Ashton, 1945; Gorton, 2020). Figure 1 shows the front and back sides of an example bill issued by an automaker. On the front side, the bill specifies the issuer (i.e., the customer), the receiver (i.e., the supplier), the face value (i.e., how much the customer owes to the supplier), the issuance date, the due date, the acceptor, and the bank account of the customer. On the back side, a chain of endorsers and endorsees is illustrated.[4]

After issuance, the supplier who receives the bill could keep it until the due date or endorse and use it to pay its upstream supplier. The second supplier can further endorse and use this bill to pay its upstream supplier and so on. Alternatively, any firm that receives the bill could also discount it at local commercial banks or bill brokers at certain discount rates. In the latter case, the broker will further discount the bill at banks to profit from the rate difference. Once the bill is discounted at a commercial bank, it enters the interbank market, in which it could be rediscounted by other commercial banks or by the central bank. Upon the due date, the owner of the bill, that is, a bank or a firm, could present the bill to the issuer for cash payment. If the issuer defaults, the owner could ask the accepting bank or any prior endorser to repay. This joint-liability rule mitigates information problems and is similar to the one used in the bills of exchange market (see Santarosa, 2015).

There are two types of bills depending on whether the acceptor is a bank (a.k.a. bankers' acceptance or *yinpiao* in Chinese) or the customer itself (*shangpiao* in Chinese). Before 2017, more than 90% of the bills issued were bankers' acceptance, suggesting the credit-enhancing role of banks in this interfirm financing market.[5] In this paper, we equate CBs to bank accepted bills.

Starting in 2016, the central bank of China urged commercial banks to transit from paper bills to electronic ones. The e-paper infrastructure was built into the Shanghai Commercial Paper Exchange (SHCPE) that is under the supervision of the PBoC and

[4]This bill was issued by the customer firm and paid to the "Sales Company" (i.e., the receiver whose detailed name information is removed for privacy). Then the "Sales Company" paid the bill to its upstream supplier, Volkswagen Automobile Company. In the endorsement chain, the "Sales Company" acted as the first endorser and Volkswagen was the first endorsee.

[5]Generally, the discount rate of *shangpiao* is higher than that of *yinpiao*. For example, *shangpiao* issued by Evergrande had been discounted at a rate higher than 20% years before it defaulted on corporate bond denominated in U.S. dollars. *Yinpiao* issued during the same time period, in contrast, were discounted at an average rate around 5%.

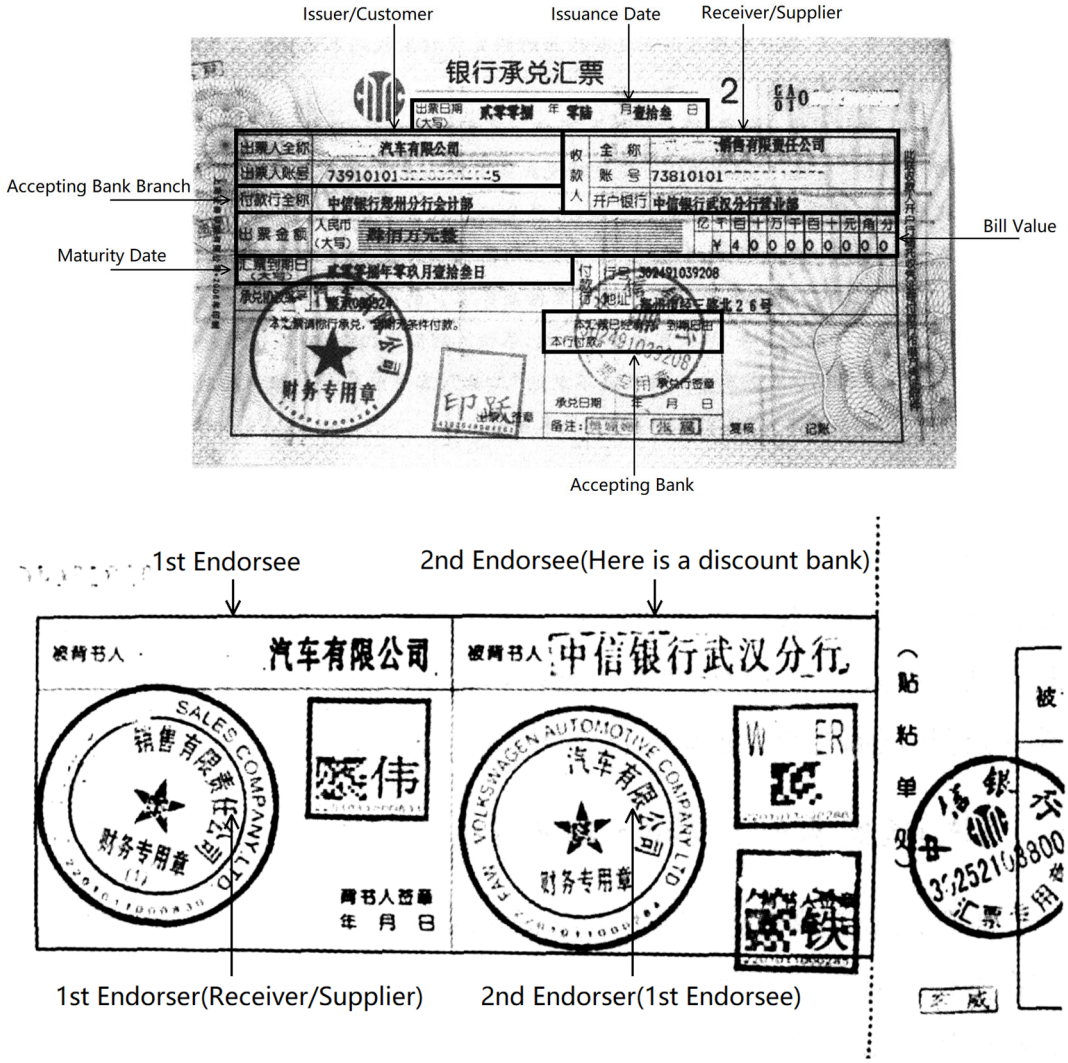


Figure 1: An Example Paper Bill, Front (Above) and Back (Below)

This paper bill was issued by an automaker and accepted by the Wuhan branch of China Citic Bank (joint-equity owned). The upper panel shows the front side of the bill marked with the issuer (i.e., the customer), the receiver (i.e., the supplier), the accepting bank and the branch, the bill value, the issuance date, and the due date. The bottom panel shows its back side with two endorsements. Names of the issuer, the receiver, the endorser, and the endorsee are erased for privacy issues. This example is from the book Payment and Clearing Association of China (2016).

serves two major functions.[6] First, it records all issuances, discounting, rediscounting, and other transfer transactions in the bill market. Since market participants (i.e., firms, banks, and brokers) slowly adapted to this new system during 2016–2018, major statistics

[6]Although the SHCPE translates its Chinese name, *piaoju*, into *commercial paper*, we use *commercial bill* instead to differentiate it from the commercial paper product used in Europe and in the United States. This naming also follows an old convention adopted by the Bank of England (BoE). See https://www.bankofengland.co.uk/quarterly-bulletin/1961/q4/commercial-bills.

other than the undiscounted volume and the discounting volume were unavailable before 2018. Second, it provides a centralized electronic platform for nationwide bill exchange businesses to mitigate geographical market segmentations and promote the bill market liquidity. While the purpose that has been served awaits further examination, the PBoC is less active in this market compared to its predecessors such as the BoE and the Fed.[7] For instance, the rediscount rate kept flat at 2.25% from 2011 to 2020.

2.2 The LDR Regulation

The LDR cap was one major liquidity rule for Chinese banks before 2015. It specifies that the amount of outstanding loans for a bank should not exceed 75% of its deposit balance. Enacted in 1994, the regulation was loosely implemented before the 2008 credit crisis (Hachem and Song, 2021; Chen et al., 2018). But from 2010, the regulatory body started to closely monitor bank- and city-level LDR levels first on an annual basis and then gradually moved to monthly basis and daily basis (Hachem and Song, 2021), in order to avoid an excessive post-08 credit expansion of the banking sector. At the same time, as China started to implement the Basel III accord, the CBRC followed Basel requirements to strengthen the bank capital regulation. Basel III also proposed new liquidity ratios that are more comprehensive in identifying bank risks. In October 2015, the regulatory body announced its abolition of the LDR regulation partially due to its objective to align with the new international banking standard. It also claimed that the LDR measure was no longer compatible with China's banking system because of its increasingly diversified asset and liability portfolios in addition to loans and deposits.

Figure 2 shows the amount of outstanding bank loans and CBs in the past two decades. Although China's CB market has existed for decades, it did not grow much in size until 2010, when the CBRC and the PBoC strengthened the LDR regulation on commercial banks. Why did the CB market grow exponentially when the LDR regulation was tightened? Policy documents and our communications with practitioners suggest that CB acceptance can lower the bank-level LDRs. First, banks do not count bill acceptances as loans on their balance sheets. Second, contractual arrangements of CBs add to their attractiveness to banks, since it is a common practice for the accepting bank to require the customer firm to provide a deposit installment (cash or cash equivalent) as collateral, which is often

[7] Historically, the BoE viewed bills of exchange as an important instrument in its domestic money market. To quote from the article titled "Commercial Bills" in the BoE Quarterly Bulletin (see the link above), one of its aims is "to maintain the standards of quality long associated with the London prime bank bill and hence its reputation as a liquid asset of undoubted security".

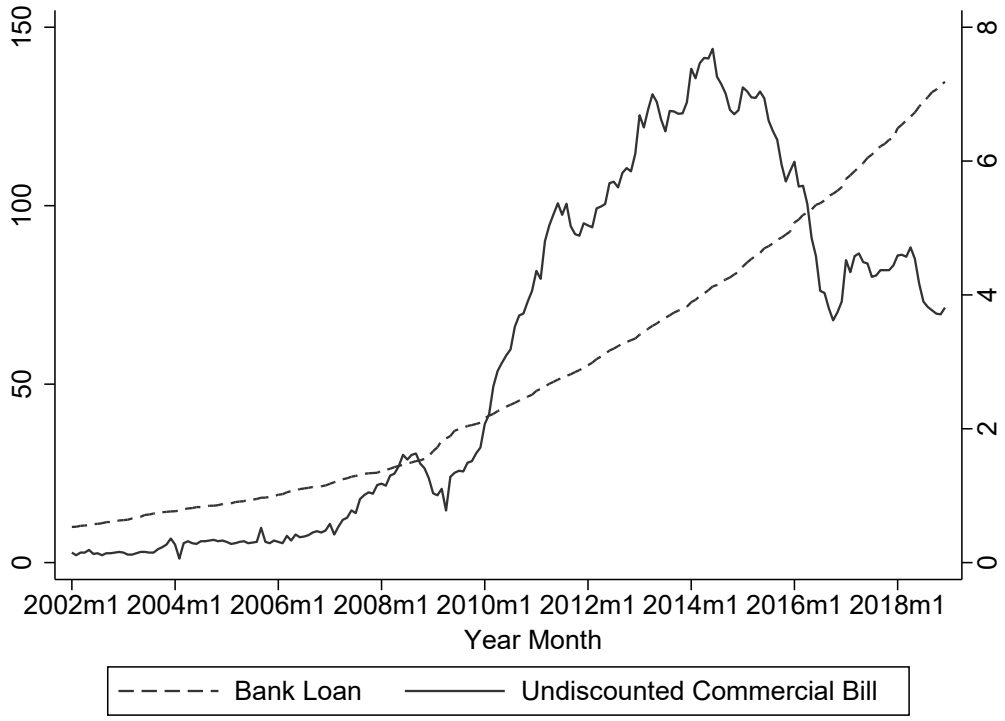


Figure 2: Monthly Amount of Outstanding Bank Loan and Undiscounted CBs, Trillion CNY

This figure plots monthly outstanding amount of bank loan (the left axis) and un-discounted CBs (the right axis) in trillion CNY from January 2002 to December 2019. The end-of-month bill amount equals to the beginning-of-month outstanding value plus the new issuance net the sum of discounted and matured bill amount during the month. Data is from the monthly AFRE table disclosed by the PBoC (http://www.pbc.gov.cn/diaochatongjisi/116219/index.html).

some fraction of the bill value. This practice boosts the accepting bank's deposit balance which further lowers its LDR. Therefore, when the LDR cap becomes binding, a bank has incentives to constrain its loan supply and shift to bill acceptance to meet the regulation requirement.

3 Data and Sample

We use multiple datasets to explore the CB usage and its real effect on firms. We combine transaction-level CB information, firm-level data for bill issuers and receivers, and bank-level financial data for bill-accepting banks for our analysis.

3.1 Data Source and Sample Construction

Commercial Bill Data We obtain a proprietary dataset that includes more than 140,000 CB transactions from January 4, 2011, to November 29, 2017 (excluding the year 2013), from one of the leading bill brokers in China. Our data cover about 10% of the aggregate acceptance volume and 15% of the discounting volumn as reported by listed banks in China during the period of 2011–2017.[8] The difference between the two percentages arises because a fraction of bills stay in the real sector and remain undiscounted until the due date.

We observe detailed information for each transacted bill, including transaction value, issuance date, due date, transaction date, and discount rate. We also observe the identity of the issuing firm (the issuer, or the customer), the receiving firm (the receiver, or the supplier), the discounting firm (the discounter, i.e., the firm that goes to the broker to discount the bill), the accepting bank branch, and the discounting bank branch. We use the identity information to link financial data for the bill issuer, the receiver, and the accepting bank.

Firm Data We obtain firm attribute information from the National Registry of Industry and Commerce (NRIC) data, including industry, size, age, geography, and ownership information. We manually match bill issuer and receiver names in our CB dataset to company names in the NRIC database via API (application programming interface) inquiries. Our matched dataset includes 44,233 unique issuers and 47,357 unique receivers during the entire sample period of 2011–2017. Each year, more than 10,000 unique issuers and receivers are involved in bill transactions. For the subperiod of 2011–2012, we extract additional firm financial and production information from the ASIF database. We manually match issuer and receiver names in the CB dataset with firm names in the ASIF.

We compare firm characteristics in our sample with those of the universe in the ASIF data, and verify that firms in our data are close to those in the ASIF data in terms of industry and size distributions.[9] Figure B.5 shows that the bill data cover a broad set of

[8] See details in Table C.2 in the appendix. A precise way to estimate this fraction is to compare the volume with the aggregate bill acceptance data by both listed and unlisted banks. However, such information is unavailable before 2017. The PBoC discloses monthly flows of undiscounted bills in the AFRE table (http://www.pbc.gov.cn/en/3688247/3688975/3984235/4503866/index.html), which does not apply for our calculation since it nets the monthly amount of maturing and discounted bills. The discounting volume reported is from the table of Sources & Uses of Funds of Financial Institutions from the PBoC.

[9] It would be ideal to examine the representativeness of our sample in the NRIC data. However, NRIC does not release descriptive statistics on firm characteristics such as industry and size distribution.

manufacturing industries for both issuers and receivers and therefore could speak to the aggregate effect of credit tightening. Figure B.6 shows that issuers and receivers are relatively large compared to ASIF firms but much smaller than the listed ones. In terms of total assets, an average firm in our data is about 4 to 5 times that of an average ASIF firm (224 million CNY) and only 1.8% to 2.3% that of an average listed firm (46,200 million CNY). Our data hence covers firms that could have limited financing sources during the credit-tightening period.

Bank Data Our bill data records the accepting and discounting bank branch information. Across observations, employees at the bill broker write down branches at different levels. For example, a branch may refer to the provincial branch, the prefecture-level branch or a banking location with a street name. We manually identify the associated headquarter bank for each accepting and discounting bank branch, the city and the province where the branch is located.[10] We redefine a branch as the city-level office of a commercial bank and may thus include multiple banking locations within the city in our raw bill data. We then merge the financial information of banks from the Wind Financial Terminal, which covers mostly listed banks in equity and corporate bond markets. Our sample involves 306 unique accepting banks and their 2,981 city-level branches. These accepting banks include all of the big 5 state-owned and 12 joint-equity banks, and 117 out of 134 city commercial banks in China.

We confirm that the ownership type distribution of accepting banks in our data is close to that reported by the SHCPE in later years. During the period of 2011–2017, 18%, 47%, and 27% of bills in our data are accepted by state-owned, joint-equity, and city commercial banks, respectively. These numbers are fairly close to the three percentages of 18%, 42%, and 25% reported by the SHCPE 2018 annual report.[11] Therefore, our sample is also representative in the dimension of accepting banks.

As described above, one nice feature of our data is that it allows us to observe both bank-firm pairs and issuer-receiver (i.e., supplier-customer) pairs. This feature makes it an ideal laboratory to study the transmission of credit shocks via the bank-firm and interfirm network.

[10] We assign the province and city variables to be missing when (i) the street name is used in many cities in China, such as "Liberation Street" (*jiefang jie*); (ii) the bank branch only contains the headquarter bank information. We assign the headquarter bank variable to be missing when the branch is written in acronym, which is hard to identify using Google search.

[11] See more details in http://www.shcpe.com.cn/content/shcpe/research/marketE.html?articleType=research-marketE&articleId=WZ20200805129103516949633 4336.

Table 1: Transaction-Level Bill Summary Statistics

This table describes the transaction-level characteristics of CBs in our data. Panel A describes transactional characteristics averaged during the period of 2011–2017. The transaction value is in million CNY, the maturity and the duration are in days, and the (annual) discount rate is in percents. The second to ninth columns report the number of observations, the mean, the standard deviation, the minimum, the maximum, the 25% percentile, the median, and the 75% percentile of bill characteristics, respectively. Each variable is winsorized at the 1% level. Panel B describes means of these variables by year. We also list the unique numbers of bill issuers, receivers, accepting bank branches, and accepting bank headquarters each year and for the entire sample period. See Table C.1 in Appendix for variable definitions.

Panel A. All Years

Variable	Obs.	Mean	Std. Dev.	Min	Max	P25	P50	P75
Transaction Value	142,787	19.00	23.12	0.10	180	5	10	20
Maturity	143,449	192.86	42.63	120	366	182	183	184
Duration	142,824	187.88	43.24	83	366	180	182	183
Discount Rate	142,065	4.94	1.31	1.90	8.70	3.90	5.06	5.54
Number of Bills	143,555	1.91	1.80	1	13	1	1	2

Panel B. By Year

					Number of Unique				
Year	Transaction Value	Maturity	Duration	Discount Rate	Bills	Issuers	Receivers	Accept. Branches	Accept. Banks
2011	13.94	182.85	180.19	6.15	1	11,372	11,596	1,096	46
2012	20.56	182.37	181.56	5.59	2.16	12,913	13,011	1,471	117
2014	20.78	188.65	184.05	5.20	2.20	10,600	10,633	1,905	235
2015	17.47	198.85	189.25	3.99	1.94	12,784	13,401	2,133	280
2016	22.21	207.33	200.31	3.32	2.18	9,805	10,082	1,877	281
2017	22.55	247.34	233.64	4.99	2.38	2,650	2,731	1,131	201
All	19.00	192.86	187.88	4.94	1.91	44,233	47,357	2,981	306

3.2 Summary Statistics

Transaction-Level Panel A of Table 1 summarizes the transaction-level statistics for CBs. On average, each transaction includes 2 bills and has a value of 19 million CNY. The average discount rate is 4.94%, about 30 basis points higher than the 1-day repo rate during this time period. The average maturity is more than half a year, similar to that of bills of exchange (Ashton, 1945) and longer than the 90-day interval in the trade credit literature (e.g., Petersen and Rajan, 1997; Giannetti, Burkart, and Ellingsen, 2011). The average duration, defined as the difference between the due date and the transaction date, is close to the average maturity. This suggests that receivers discount their bills at the broker soon after the issuance date.

Panel B of Table 1 further shows the distribution of the CB sample over time. Due to data availability, observations in 2017 are incomplete. From 2011 to 2017, the average bill value kept increasing except in 2015 (the year of abolishment of the LDR regulation). The number of unique bill issuers, receivers, and accepting bank branches also peaked in 2015 and then started to decline. The distribution by year echoes the pattern in outstanding amount of CBs we have showned in Figure 2.

Bank-Level Panel A in Table 2 presents the bank-year characteristics of accepting banks. Accepting banks on average valued 360.92 billion CNY in total assets, 34% larger than the average asset level (270 billion CNY) of all Chinese listed banks during this time period. Moreover, 47% of transacted bills in our data were accepted by joint-equity banks and 27% by state-owned ones. We highlight accepting banks since they are more relevant than discounting banks for CB issuances.[12]

For other characteristics, the average LDR of accepting banks is 65%, similar to the average of all Chinese listed banks, 67%. Note that this population average was higher during the period of 2006–2010, at a level of 72%. The loan growth rate of accepting banks is 4% on average, about the same as that of all listed banks. Our sample accepting banks were well capitalized, with the Tier 1 ratio, the total capital ratio, and the leverage ratio of 12%, 14%, and 8%, respectively. Furthermore, their noninterest income ratio (21%) is comparable to all listed banks.

[12]Nevertheless, discounting banks are vital because they inject the scarce liquidity into the bill market. There are 103 discounting banks (excluding 9 factoring companies and bill brokers) that account for 93% bill transactions in our data. In contrast to accepting banks, discounting banks are mostly city commercial banks (42% of transactions) or agricultural commercial, credit associations, and township and village banks (48% of transactions).

Table 2: Bank-Year and Firm-Year Summary Statistics

This table describes characteristics of accepting banks, bill issuing firms (i.e., the issuers) and bill receiving firms (i.e., the receivers). We merge our bill data to publicly disclosed bank data in the Wind database and summarize the bank-year characteristics in Panel A. Asset and loan balances are in billion CNY. In Panels B and C, we merge the bill data to registry information from the NRIC for 2011–2017 and to the ASIF data for 2011–2012. State owernship, listing status, firm age and registered capital are from NRIC. Other financial information, total assets, leverage, asset turnover, payables-to-assets, and investment rate are from ASIF. The annual loan growth rates for issuers' and receivers' cities are obtained by matching the firm's location city to the city-level loan data in the Wind database. Registered capital and asset are in million CNY. Variables are winsorized at the 1% level. See Table C.1 in Appendix for variable definitions.

Variable	Obs.	Mean	Std.	Min	Max	P25	P50	P75
Panel A. Bank-Year Characteristics of Accepting Banks								
Asset	1,795	360.92	1,341.35	3.67	15,363.21	21.58	54.56	149.33
Loan Balance	1,755	169.02	671.60	2.06	8098.07	11.03	24.34	63.03
LDR	1,739	0.65	0.11	0.31	0.91	0.58	0.67	0.72
Leverage Ratio	1,314	0.08	0.02	0.04	0.17	0.06	0.07	0.09
Non-interest Income Ratio	1,604	0.21	0.18	0.01	0.84	0.08	0.16	0.30
Tier 1 Ratio	1,236	0.12	0.03	0.07	0.24	0.10	0.11	0.13
Capital Ratio	1,662	0.14	0.03	0.09	0.38	0.12	0.13	0.15
Quarterly Loan Growth Rate	1,628	0.04	0.02	-0.02	0.14	0.03	0.04	0.05
Panel B. Firm-Year Characteristics of Issuers								
SOE	57,711	0.01	0.08	0	1	0	0	0
Listed	57,711	0.03	0.16	0	1	0	0	0
Number of Suppliers	57,711	1.34	0.90	1	37	1	1	1
Age	54,253	9.21	5.62	1.00	30.00	5.00	8.00	13.00
Registered Capital	53,928	134.09	333.99	0.30	3,085.06	10.00	30.00	100.00
Annual City Loan Growth	56,996	0.12	0.06	0.02	0.24	0.09	0.12	0.15
Total Assets	5,460	860.89	1,860.55	10.44	19,451.65	112.71	288.93	738.59
Leverage Ratio	5,222	0.63	0.23	0.03	0.99	0.47	0.66	0.81
Asset Turnover	5,414	1.63	1.75	0.12	13.94	0.61	1.06	1.91
Payable to Asset Ratio	4,728	0.09	0.11	0.00	0.67	0.01	0.05	0.13
Investment Rate	4,062	0.95	2.59	-1.91	25.43	0.01	0.16	0.83
Panel C. Firm-Year Characteristics of Receivers								
SOE	61,458	0.01	0.09	0	1	0	0	0
Listed	61,458	0.02	0.12	0	1	0	0	0
Number of Customers	61,458	1.30	1.12	1	57	1	1	1
Age	57,081	7.72	5.35	1.00	30.00	3.00	7.00	11.00
Registered Capital	56,114	96.55	288.49	0.28	3,080.00	5.00	18.00	50.09
Annual City Loan Growth	58,024	0.12	0.05	0.01	0.25	0.09	0.12	0.15
Total Assets	4,142	1,058.58	2,328.66	10.36	19,451.65	84.32	256.31	819.97
Leverage Ratio	4,009	0.62	0.24	0.03	0.99	0.46	0.65	0.81
Asset Turnover	4,186	2.08	2.12	0.12	13.83	0.76	1.35	2.49
Receivable to Asset Ratio	3,975	0.13	0.13	0.00	0.66	0.03	0.08	0.19
Investment Rate	2,979	0.95	2.67	-1.89	26.09	0.00	0.15	0.76

Firm-Level Panel B and Panel C in Table 2 describe the firm-year NRIC statistics for issuers and receivers, respectively. As shown, the majority of our sample issuers and receivers are non-state owned and unlisted firms. Each year, an average issuer has 1.34 suppliers and an average receiver has a similar number of customers. Comparing issuers with receivers, we find the former larger and older. The average registered capital for issuers is 134.1 million CNY, which is 28% larger than that of receivers (96.6 million CNY). Examining pairs of suppliers and customers, 63% of all pair-year observations have issuers larger than receivers. The average age of issuers is 9 years and about 1.5 years older than the receivers. Results are similar if we compare the 25th, 50th, and 75th percentiles of the size and age distributions between the two groups. This pattern is similar to that documented in the SHCPE's 2019 annual report.

In the lower parts of Panel B and Panel C in Table 2, we report statistics for issuers and receivers with financial data available in the ASIF database. In this sample of firms successfully matched with the ASIF data, issuers' total assets are comparable to those of receivers. For other characteristics, issuers and receivers have similar distributions in ROA and in the leverage ratio. Receivers have better operating performance in terms of higher asset turnover. In terms of trade credit usage, receivers have a higher receivable-to-asset ratio than issuers' payable-to-asset ratio. We will investigate how these firm-level characteristics are associated with bill activities in the following sections.

4 Transmission of Bank Loan Tightening to CBs: Empirical Results

This section studies how banks substitute bill acceptance for loan supply because of the LDR regulation and, as a result, how customer firms increase payment via CBs to their suppliers. Our identification relies on the cross-bank and cross-city variations in the regulation's tightness and the unexpected abolition of the regulation in October 2015.

4.1 Regulation Tightness Measures

The CBRC monitored LDRs of city-level bank branches instead of their national aggregate LDR levels, which disallows banks to reallocate loanable funds across different cities. We exemplify this branch-level monitoring using two cases from the CBIRC website.[13] In the

[13]See http://www.cbirc.gov.cn/cn/view/pages/index/index.html.

first case, in March 2012, the CBRC Shanghai office urged foreign banks in Shanghai to meet the regulation requirement. Foreign banks were required to use the monthly average of daily LDRs as monitoring targets. In the second one, the Xi'An branch of Bank of Beijing in Shaanxi province set the LDR as a core performance criteria for all banking locations in December 2014.[14] In both cases, the city-level bank branches were urged to maintain an LDR level below the 75% cap with incentives aligned.

Therefore, we view a city-level bank branch as the decision-making unit in setting the LDR and examines how the regulation tightness at the branch-level is associated with the bill acceptance volume. To do so, we need a branch-level measure of the regulation tightness, which however is unavailable without branch-level balance sheet information. As an alternative, we construct two joint proxies: average bank- and city-level LDRs before 2009. Because the LDR regulation was loosely implemented before 2009, a bank with a higher pre-09 LDR is likely to be more constrained by the regulation from 2011 to 2015, similarly for a city with a higher pre-09 LDR. Combined, a branch of a constrained bank in a constrained city is likely to be affected by the regulation more than other branches.

Specifically, for the branch of bank b in city c, we calculate the bank-level average LDR before 2009 as

$$LDR_{b,pre09} = \frac{1}{3} \sum_{year=2006}^{2008} LDR_{b,year}. \tag{1}$$

We start from 2006, the first year in which most bank-level balance sheet information became available. Our city-level pre-09 LDR measure is similarly defined[15]

$$LDR_{c,pre09} = \frac{1}{3} \sum_{year=2006}^{2008} LDR_{c,year}, \tag{2}$$

This measure includes loans also issued by non-depositary financial institutions, e.g., entrusted loan companies, which are not subject to the LDR regulation. Thus, we drop observations with $LDR_{c,pre09}$ absurdly high, i.e., greater than 1.17 (the top 1%). These observations are from cities of Taiyuan in Shanxi, Jianyuguan in Gansu, and Tongliao from Inner

[14] We attach screenshots of these example policy statements from the CBRIC website in Figures A.1 and A.2 in the appendix, with their web links provided in QR(quick response) codes.

[15] $LDR_{c,pre09}$ needs to correlate with the branch-level $LDR_{bc,pre09}$ for its validity as a proxy, which would be true if geographically close banks compete in both deposit and lending markets and have similar LDRs. We find supportive evidence along this line using the CEIC database that covers province-level loan and deposit balances for the big four state-owned banks during 1997–2004. Specifically, the within-province standard deviation of LDRs across four banks averages 0.14, only 17% of the within-province average LDR.

Mongolia.[16]

We also notice a change in the policy tone after the removal of the regulation in 2015. After 2015, local offices instead urged city-level branches to lend more and promote the LDR levels, especially in less-developed areas. They did so by encouraging banks to lend to local small and medium-sized enterprises and anti-poverty projects.

4.2 Substitution between Bank Loan and Commercial Bill Issuance: Baseline Results

Using OLS regressions, we first show that city-level commercial bill acceptances are negatively correlated with city-level loan growth rates before 2015. This relationship disappeared after 2015. Our regression specification is

$$\begin{aligned}\ln CBAccepted_{cbt} = \beta_0 + \beta_1 LoanGrowth_{bt} \times Pre15 + \beta_2 LoanGrowth_{ct} \times Pre15 \\ + \beta_3 LoanGrowth_{bt} \times Post15 + \beta_4 LoanGrowth_{ct} \times Post15 + \beta_X X_{cbt} + \epsilon_{cbt}, \end{aligned} \tag{3}$$

where $\ln CBAccepted_{cbt}$ is the natural logarithm of the quarterly maturity-adjusted bill value accepted by bank b in city c at time t. The $Pre15$ indicator equals 1 before 2015Q3 and 0 otherwise. Our key explanatory variable is the bank-level loan growth rate, $LoanGrowth_{bt}$, on a quarterly basis. Our city-level loan growth rate, $LoanGrowth_{ct}$, is on a yearly basis because most cities (224 out of 285) in China do not regularly report quarterly loan balance during the period of 2011–2017.

Other control variables include natural logarithms of the annual GDP of the city, $\ln CityGDP_{ct}$; the average maturity of bills accepted, $\ln AvgMaturity_{cbt}$; the quarterly bank asset, $\ln BankAsset_{bt}$; the quarterly nonperforming loan ratio, $BankNPL_{bt}$; and the ownership dummies of the headquarter banks, $StateOwned_b$ and $JointEquity_b$. The dummy indicator, $StateOwned_b$, equals 1 if the bank is state-owned and 0 otherwise. $JointEquity_b$ is similarly defined for the joint-equity ownership. The default type of a bank is city commercial (when both

[16] An alternative way to define the city-level pre-09 LDR is

$$LDR_{c,pre09} = \frac{1}{3} \sum_{b \in B_c} \sum_{year=2006}^{2008} mshare_{bc,year} LDR_{b,year},$$

where $mshare_{bc,year}$ is the banking location shares of banks b in city c (Acharya, Qian, Su, and Yang, 2020). Using this definition, we obtain similar results with what follows. The caveat of this approach is that we do not have LDR levels for non-publicly disclosed banks and we have to assume a national average LDR level for these banks.

Table 3: Bill Acceptances and Loan Growth: Bank-Level Estimates

This table implements the following OLS regression:

$$\ln CbAccepted_{cbt} = \beta_0 + \beta_1 LoanGrowth_{bt} \times Pre15 + \beta_2 LoanGrowth_{ct} \times Pre15 + \beta_3 LoanGrowth_{bt} \times Post15 + \beta_4 LoanGrowth_{ct} \times Post15 + \beta_X X_{cbt} + \epsilon_{cbt},$$

where c, b, and t represent for the city branch, the headquarter bank, and the year-quarter the bill is issued. The city-branch-quarter sample covers all city branches that accept bills from 2011 to 2017 in our data. The dependent variable $lnCbAccepted_{cbt}$ is the maturity-adjusted sum of bill values bank b in city c accepted during year-quarter t. $lnCityGDP_{ct}$ and $LoanGrowth_{ct}$ are on a annual basis. Other variables are measured quarterly. $Pre15$ equals 1 if the observation is before 2015Q3 and 0 otherwise. Column (1) uses the full sample. Column (2) includes branches that accept bills both before and after 2015. Column (3) includes branches with headquarter banks that accept bills both before and after 2015. Standard errors are in parentheses and clustered within bank branches. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: $\ln CbAccepted_{cbt}$		
	(1) All	(2) Branches Accept Before & After	(3) Banks Accept Before & After
Bank Loan Growth (%) × pre15	-0.001	0.001	-0.001
	(0.006)	(0.006)	(0.006)
City Loan Growth (%) × pre15	-0.009*	-0.010**	-0.009*
	(0.007)	(0.007)	(0.007)
Bank Loan Growth (%) × post15	-0.017	-0.007	-0.018
	(0.016)	(0.012)	(0.016)
City Loan Growth (%) × post15	0.003	0.005	0.003
	(0.006)	(0.006)	(0.006)
ln Maturity	2.223***	2.229***	2.222***
	(0.095)	(0.098)	(0.095)
State Owned	-1.969***	-2.000***	-1.970***
	(0.099)	(0.086)	(0.100)
Joint Equity	-1.080***	-1.084***	-1.080***
	(0.154)	(0.156)	(0.154)
NPL	-0.003	-0.007	-0.001
	(0.054)	(0.055)	(0.054)
ln Asset	0.612***	0.574***	0.616***
	(0.174)	(0.176)	(0.174)
ln City GDP	-1.005***	-0.988***	-0.998***
	(0.241)	(0.245)	(0.241)
Bank-Branch and Year-Quarter FEs	Yes	Yes	Yes
Observations	20,097	18,638	20,026
Adjusted R^2	0.447	0.442	0.446

$StateOwned_b$ and $JointEquity_b$ equal 0). Finally, we include bank-branch and year-quarter fixed effects to control for the unobserved heterogeneity.

Table 3 presents estimation results with standard errors clustered within bank branches. We find that for the time period of 2011–2015, bill acceptances are significantly higher in cities with lower loan growth rates. Specifically, column (1) shows that for an average bank

branch before 2015, a 1 standard deviation decrease in the annual city-level loan growth (5.27 p.p.) is associated with a cross-sectional 0.05% (-0.009×5.27) increase in the quarterly acceptance of bills. After 2015, this relationship between bill acceptance and loan growth is reversed, as evidenced by the positive and significant coefficient of $LoanGrowth_{ct}$. When the LDR regulation was removed in 2015, the bank loan supply was no longer capped and the incentive of banks to substitute CBs for loan supply diminished. The contrasting results before and after 2015 corroborate the role of bank credit tightening in fuelling the usage of CBs.

Compared to the city-level results, we do not find that bill acceptances are significantly higher for branches from banks with lower loan growth rates. The coefficients of bank loan loan growth rates are negative and statistically insignificant both before and after 2015. One possible reason is that LDRs are usually monitored at the city branch level rather than the nationwide headquarter level. Moreover, the loan growth at bank-level lacks variation than that measured at city-level (the standard deviation of bank loan growth rates is 2.39 p.p., compared to that of city loan growth rates 5.27 p.p.).

Table 3 also shows that our results are robust when we adopt restricted samples of branches and banks that accept bills before and after 2015 in columns (2) and (3), respectively. In addition, Table 3 suggests that with other bank-branch characteristics being controlled for, city commercial banks located in economically underdeveloped cities accept more bills. Meanwhile, the bank size and the nonperforming loan ratio are not significantly associated with bill acceptance activities.

4.3 Exogenous Tightening of Bank Credit Supply

Results in Table 3 show a correlation between bank loan growth and CB acceptance. The negative association could be driven by a reverse causality, that is, the usage of CBs may have crowded out bank loan as the bill market developed. Or some unobservable factors may jointly determine bank loan growth and CB acceptance. For instance, a negative shock to the economy may reduce customers' demand for upstream goods and services and thus reduce demand for bank credit. Meanwhile, the decreased demand raises customers' bargaining power relative to their suppliers (Klapper et al., 2012; Fabbri and Klapper, 2016; Giannetti et al., 2021). As a result, customer firms ask for more delayed payments and the usage of trade credit increases. To mitigate these concerns, we use the varying regulation tightness in LDR across banks and cities (defined in equations [1] and [2]) to identify the exogenous tightening of bank loan supply. At the same time, we use the removal of the

Table 4: Bill Acceptances and Loan Growth Rates: IV Estimation

This table reports the first- and second-stage results of the following IV estimation at bank-branch level:

$$lnCbAccepted_{cbt} = \beta_0 + \beta_1 LoanGrowth_{ct} + \beta_2 LoanGrowth_{bt} + \beta_X X_{cbt} + \epsilon_{cbt},$$

We use the pre-09 average LDRs at the bank-level, $LDR_{b,pre09}$, and at the city-level, $LDR_{c,pre09}$, to instrument loan growth rates at the bank-level, $LoanGrowth_{bt}$, and at the city-level, $LoanGrowth_{ct}$, respectively. As in Table 3, the city-branch-quarter sample covers all city branches that accept bills from 2011 to 2017 in our data. We conduct the estimation for two periods before and after 2015Q3. Standard errors are in parentheses and clustered by bank branches. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Before: 1st Stage		Before: 2nd Stage	After: 1st Stage		After: 2nd Stage
Dependent Variable:	(1) Bank Loan Growth	(2) City Loan Growth	(3) ln Maturity-Adjusted Bill Value	(4) Bank Loan Growth	(5) City Loan Growth	(6) ln Maturity-Adjusted Bill Value
$LDR_{b,pre09}$	-1.254*	-0.330		-0.908	-1.783**	
	(0.689)	(0.427)		(0.929)	(0.856)	
$LDR_{c,pre09}$	0.282	-4.998***		0.390	2.343**	
	(0.196)	(0.749)		(0.357)	(0.958)	
Bank Loan Growth (%)			-0.159			-0.636
			(0.197)			(1.502)
City Loan Growth (%)			-0.280***			0.556
			(0.069)			(0.458)
log Maturity	0.635***	-0.677	2.505***	0.317**	-0.526	2.934***
	(0.159)	(0.441)	(0.266)	(0.142)	(0.331)	(0.743)
State Owned	0.057	-0.266	-0.207	-0.267	-0.584	0.296
	(0.164)	(0.436)	(0.224)	(0.309)	(0.608)	(0.534)
Joint Equity	0.204	-0.142	0.276*	0.961***	0.048	0.866
	(0.146)	(0.292)	(0.147)	(0.266)	(0.453)	(1.368)
NPL	-0.864***	-0.207	0.069	-0.963***	-0.304	-0.257
	(0.072)	(0.187)	(0.187)	(0.106)	(0.260)	(1.366)
ln Asset	-0.466***	0.130	-0.052	-0.399***	0.074	-0.425
	(0.041)	(0.097)	(0.096)	(0.071)	(0.138)	(0.627)
ln City GDP	-0.048	-0.858***	0.402***	-0.094	0.295*	0.212
	(0.037)	(0.140)	(0.106)	(0.059)	(0.173)	(0.314)
Year-Quarter and Province FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,455	12,456	12,454	6,903	6,896	6,896
Adjusted R^2	0.206	0.309	.	0.260	0.165	.

LDR regulation in 2015 as a quasi-experiment for further identification.

We use the pre-09 LDR tightness to instrument the loan growth rates. Specifically, we use $LDR_{b,pre09}$ to instrument $LoanGrowth_{bt}$ and $LDR_{c,pre09}$ to instrument $LoanGrowth_{ct}$. Presumably, banks and cities with a higher LDR before 2009 were more restricted in lending from 2011 and 2015 and hence were more prone to the substitution between CBs and bank loan. Table 4 presents this IV estimation results in the before- and after-2015 subsamples separately. Columns (1) and (2) present the first-stage estimation results for the before-15 period. As expected, $LDR_{b,pre09}$ and $LDR_{c,pre09}$ are negatively associated with $LoanGrowth_{bt}$ and $LoanGrowth_{ct}$, respectively. After 2015, the negative relationship between $LDR_{b,pre09}$ and $LoanGrowth_{bt}$ becomes insignificant, while that between $LDR_{c,pre09}$ and $LoanGrowth_{ct}$ becomes positively significant in columns (4) and (5). Consistent with the CBRC reports, this result implies that the LDR regulation before 2015 constrains loan supply at both the bank level and the city level.

Column (3) shows the second-stage estimation results for the before-2015 sample. The fitted city-level loan growth rate takes a negative and significant coefficient, suggesting that a slowdown of city-level bank loan growth induced by the LDR cap leads to an increase in the CB acceptance. Specifically, a 1 standard deviation decrease of loan growth rates at the city level now increases bill acceptances by 1.48%, which is substantially higher than our earlier estimates in Table 3. Consistent with Table 3, we find that the fitted bank-level loan growth rate takes an insignificant coefficient.

Column (6) shows that the significant relationship between city-level loan growth rates and bill acceptance disappears after 2015, when the LDR regulation is abolished, consistent with results in Table 3. This further confirms that restrained bank credit supply via the LDR regulation in China stimulated the growth of CB acceptance. The substitution effect was also noticed by the regulatory body before the LDR regulation was abolished in 2015. Specifically, the CBRC warned commercial banks off aggressively accepting CBs. For instance, on Feb 9, 2012, the CBRC Zhejiang office stated that banks should not draw deposits from firms in the name of requiring collateral for bill acceptances. On July 17, 2015, the CBRC Hainan office prohibited banks from pushing firms to issue CBs to replace loans.[17] These policy statements confirm our interpretation.

[17] See Figures A.3 and A.4 for the screenshots of the CBRC policy statements.

4.4 Transmission from Bank Loan Tightening to Commercial Bill: Firm-Level Evidence

This section provides firm-level evidence for the transmission of bank loan tightening to trade credit usage in the form of CBs. Specifically, we estimate the following equation, where the dependent variable, $\ln CBIssue_{ict}$, is the natural logarithm of the maturity-weighted sum of bills firm i in city c issues in year t. We use the pre-09 city-level LDR, $LDR_{c,pre09}$, to instrument the city-level loan growth, $LoanGrowth_{ct}$[18]

$$\ln CBIssue_{ict} = \beta_0 + \beta_1 LoanGrowth_{ct} + \beta_x X_{ict} + \epsilon_{icbt}. \tag{4}$$

Control variables X_{ict} include the natural logarithms of the registered capital of issuers, $\ln RegisteredCapital_i$; the average maturity of bills issued, $\ln AvgMaturity_{ict}$; and the annual GDP of city c, $\ln GDP_{ct}$. We also control for the issuer's age, Age_{it}, state-owned status, SOE_{it}, and listed status, $List_{it}$. We include fixed effects for the issuer's 2-digit industry, year, and province.

The results are displayed in Table 5 with standard errors clustered within issuing firms. Similar to the results at the bank level, column (2) shows that before 2015, if the loan growth rate at the city where the issuer is located decreases by 1 standard deviation (5.27 p.p.), the annual bill issuance for issuer i increases by 0.22% (5.27×0.041). The statistically significant coefficient turns positive after 2015, echoing our earlier bank-level results and highlighting the effect of the LDR regulation.

Table 5 also shows that large, old, and unlisted firms located in economically underdeveloped cities issue more bills. For the simplicity of exposition, we present only the IV estimation results in the main body of the paper. We implement an OLS estimation of an equation that controls for year and issuer fixed effects similar to equation (3) (see Table C.3). Meanwhile, we also estimate another version of the model that incorporates the effects of suppliers' size, age, ownership and listing statuses on the bill issuance (see Table C.4). In that model, the city-level LDR before 2009 and loan growth rates during 2011–2015 for suppliers are included. It is possible that suppliers' cities could be less affected by the regulation than the customers', which prompts suppliers to finance customers. We do not find statistically significant evidence along this line. We also include the number of suppliers each customer has and the number of customers each supplier has in Table C.4. Our

[18] We do not include bank-level loan growth rates in the regression because they are insignificant in Tables 3 and 4. Meanwhile, we find that almost 30% customer firms have multiple accepting banks, which indicates what matters for a firm is the local lending market instead of a single bank.

Table 5: More Bill Issuances for Firms in Cities with Slower Loan Growth Rates, IV Estimation, Firm-Level

This table implements the following IV estimation

$$lnCbIssue_{ict} = \beta_0 + \beta_1 LoanGrowth_{ct} + \beta_x X_{ict} + \epsilon_{icbt},$$

The dependent variable $lnCbIssue_{ict}$ is the natural logarithm of maturity-adjusted sum of bill values issuer i in city c issued during year t. We use the city-level pre-09 LDR, $LDR_{c,pre09}$, to instrument the city-level loan growth rate. The firm-year sample covers all issuing firms from 2011 to 2017. We split the data into two sub-samples, before and after (including) 2015, and we list first- and second-stage results. Standard errors are in parentheses and clustered within issuers. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Before 2015		After 2015	
	1st Stage	2nd Stage	1st Stage	2nd Stage
Dependent Variable:	(1) City Loan Growth	(2) ln Maturity-Adjusted Bill Value	(3) City Loan Growth	(4) ln Maturity-Adjusted Bill Value
$LDR_{c,pre09}$	-5.763***		2.802***	
	(0.274)		(0.441)	
City Loan Growth (%)		-0.041**		0.152**
		(0.017)		(0.074)
ln Average Maturity	-0.282	2.154***	-0.003	2.746***
	(0.242)	(0.096)	(0.158)	(0.064)
ln Registered Capital	0.044***	0.314***	0.066***	0.245***
	(0.015)	(0.008)	(0.021)	(0.013)
Age	-0.296***	0.201***	-0.079	0.011
	(0.038)	(0.016)	(0.060)	(0.032)
State-Owned	0.123	0.062	0.270	-0.055
	(0.348)	(0.121)	(0.353)	(0.222)
Listed	-0.291	-0.910***	-0.037	-0.737***
	(0.186)	(0.124)	(0.202)	(0.113)
ln City GDP	-1.383***	-0.053	0.117	-0.047
	(0.045)	(0.032)	(0.074)	(0.042)
Issuer's Industry, Province, and Year FEs	Yes	Yes	Yes	Yes
Observations	31,636	31,692	18,110	18,110
Adjusted R^2	0.390	0.207	0.183	0.096

main result that customer firms located in credit tightening cities issue more bills remains robust in these alternative specifications.

CBs provide an substitutive financing channel for firms in addition to direct bank loans. We document how firms turn to CB financing when their access to bank loans is restricted, which is an unintended consequence of the credit tightening policy. Our next section explores the potential costs associated with this loan-to-CB substitution in terms of its real effect on firm investment and the allocation efficiency along the supply chain.

5 Real Consequences of Usage of Commercial Bills

Previous sections document that the tightening of bank credit supply can affect firms' issuance of CBs. We proceed to investigate whether the increased issuance of CBs has any real impact on suppliers. Presumably, if suppliers (i.e., the receivers of bills) are deep pockets (as they usually are in the literature, e.g., Petersen and Rajan, 1997 and Adelino et al., 2022), the tightening shock of bank credit would be absorbed by these suppliers, leaving the real economy unaffected (Kiyotaki and Moore, 1997). However, if suppliers are credit constrained, the increased receipt of CBs could have an adverse effect on their operation and investment. Therefore, we first look into the financial conditions of suppliers and compare them with those of customers in our sample.

5.1 Are Suppliers Deep Pocketed?

Table 2 finds that suppliers have a slightly smaller state-owned fraction and a similar listed fraction compared with customers. In addition, suppliers are on average smaller in registered capital and younger than customers. In what follows, we further show that these facts are also true when we compare suppliers to their paired customers. For each supplier-customer pair, we calculate the difference in each of the three measures:

$$\Delta X = X_{supplier} - X_{customer}, \tag{5}$$

where X refers to size, age, and the composite SA index to measure how financial constrained a firm is (Hadlock and Pierce, 2010). In the 2011–2017 NRIC sample, we use the natural logarithm of registered capital as the size measure, while in the 2011–2012 ASIF sample, we use the natural logarithm of total assets.

Figure 3 plots the density distributions of the differences in each measure in the two samples. We find that an average supplier is 62.7% smaller than its paired customer in the NRIC sample and 31.6% smaller in the ASIF sample. These differences are statistically significant at the 5% level. Meanwhile, an average supplier is 1.92 years younger than its customer in the NRIC sample and 1.32 years younger in the ASIF sample. As a result, the SA index of an average supplier is 0.14 higher than that of the customer (with an average index of -3.42), suggesting that the supplier is more financially constrained than the customer. This difference in the SA index is less significant in the ASIF sample. Overall, our results lean against the notion that suppliers in our data are deep pocketed. Instead, they are more financially constrained than their customers.

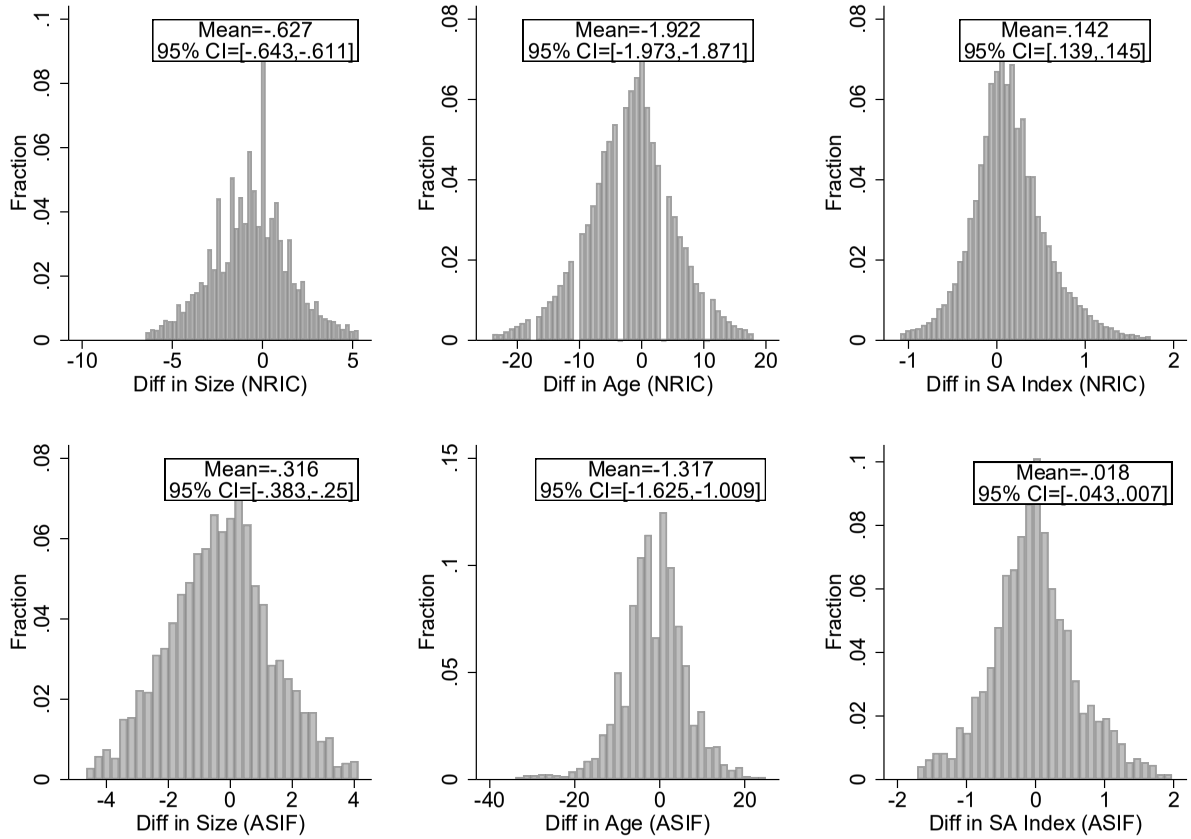


Figure 3: Average Size, Age, and SA Index of Suppliers Relative to Customers

This figure plots histograms of the size, the age, and the SA index of each supplier relative to its paired customer ($\Delta X = X_{supplier} - X_{customer}$ for each X variable). For the size measure, we use the natural logarithm of registered capital in the NRIC 2011–2017 sample and the natural logarithm of total assets in the ASIF 2011–2012 sample. The SA index in each sample is calculated accordingly. We mark the average of ΔX and its 95% confidence interval on the top center of each sub-figure.

5.2 Cash Sales versus Credit Sales

If suppliers are constrained, a pertinent question is whether the increased usage of CBs lowers the supplier's cash sales to its customer. If yes, it may weaken the supplier's cash position and further impair its investment. Alternatively, if customer firms substitute bills for regular trade credit sales, the increased usage of bills would have little or a positive impact on its supplier, as CBs can be regarded as a form of trade credit with better liquidity.

We obtain detailed balance sheet data on suppliers from the ASIF database. This allows us to differentiate credit sales, that is, sales via CBs versus those via the regular trade credit. We define supplier j's trade-credit-to-sales ratio in year t as

$$TCSalesRatio_{jt} = \frac{\text{Accounts Receivable}_{jt}}{Sales_{jt}}, \tag{6}$$

and cash-to-sales ratio as

$$CashSalesRatio_{jt} = 1 - TCSalesRatio_{jt} - BillSalesRatio_{jt}, \tag{7}$$

where $BillSalesRatio_{jt}$ is defined as the sum of maturity-weighted bill values divided by sales.[19]

The following regressions investigate the relationship between bill sales, cash sales, and regular trade credit sales:

$$CashSalesRatio_{jt} = \beta_0 + \beta_1 BillSalesRatio_{jt} + \epsilon_{jt}, \tag{8}$$

$$TCSalesRatio_{jt} = \beta_0 + \beta_1 BillSalesRatio_{jt} + \epsilon_{jt}. \tag{9}$$

We construct two samples: the supplier-year sample and the customer-supplier-year sample. In the first sample, we control for the supplier's industry and year FEs. In the second sample, we also control for the customer's industry FE.

Table 6 shows the estimation results. In column (1) of Panel A, we find that a 1 percentage point increase in the bill sales ratio is associated with a 1.12 percentage point decrease in the supplier's cash sales ratio. This association increases to 1.91 if the customer is in a different city from the supplier's (column [2]). Columns (3) to (4) present similar results for the customer-supplier-year sample. The result supports the hypothesis that sales via

[19] According to accounting rules, payment via CBs falls into the category of notes receivable, which are not included in accounts receivable. We acknowledge that the following exercise is at most indicative since we do not observe the total bill values for each supplier but only the value in our data.

Table 6: Bill Payments to Suppliers Crowd Out Cash Payments

This table presents estimation results of the following regressions for supplier j in year t

$$CashSalesRatio_{jt} = \beta_0 + \beta_1 BillSalesRatio_{jt} + \epsilon_{jt},$$
$$TCSalesRatio_{jt} = \beta_0 + \beta_1 BillSalesRatio_{jt} + \epsilon_{jt}.$$

$CashSalesRatio_{jt}$ and $TCSalesRatio_{jt}$ are fractions of supplier j's cash sales (sales via cash payments) and credit sales (sales via trade credit), respectively. $BillSalesRatio_{jt}$ is the fraction of sales via commercial bills. ASIF firms with non-missing balance sheet information enter the regressions. Panel A shows results for the first regression. Panel B shows results for the second regression. In each panel, the left sub-panel uses the supplier-year sample and the right uses the paired customer-supplier-year sample. Column *Diff. City* refers to a sub-sample that supplier j and customer i are in different cities. Standard errors are in parentheses and clustered within suppliers in the supplier-year sample and within customer and supplier pairs in the customer-supplier-year sample. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Panel A Dependent Variable: Cash Sales Ratio			
	Supplier-Year Sample		Customer-Supplier-Year Sample	
	(1) All	(2) Diff. City	(3) All	(4) Diff. City
Bill Sales Ratio	-1.123***	-1.906***	-1.192***	-2.451***
	(-56.43)	(-5.08)	(-21.49)	(-3.96)
Supplier's Industry and Year FEs	Yes	Yes	Yes	Yes
Customer's Industry FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	4,045	1,696	5,820	2,795
Adjusted R^2	0.477	0.111	0.357	0.192
	Panel B Dependent Variable: Trade Credit Sales Ratio			
	Supplier-Year Sample		Customer-Supplier-Year Sample	
	(1) All	(2) Diff. City	(3) All	(4) Diff. City
Bill Sales Ratio	0.123***	0.906*	0.192***	1.451*
	(6.16)	(2.41)	(3.47)	(2.35)
Supplier's Industry and Year FEs	Yes	Yes	Yes	Yes
Customer's Industry FE	No	No	Yes	Yes
Observations	4,045	1,696	5,820	2,795
Adjusted R^2	0.049	0.060	0.078	0.148

CBs crowd out the cash sales of suppliers.

Panel B shows the relationship between bill sales and trade credit sales. Column (1) shows that a 1 percentage point increase in a supplier's bill sales is associated with a 0.12 percentage point increase in its regular trade credit sales. The results in other columns are qualitatively similar and imply that the usage of commercial bills does not crowd out regular trade credit.

To sum up, the results in Table 6 suggest that the usage of CBs lowers the supplier's cash sales, and the economic magnitude of the effect is material. Our finding implies that sales via CBs substitute cash sales, which may impair the supplier's cash position. We proceed to examine whether the usage of CBs affects real investment of the supplier.

5.3 Crowding-Out Effect on Suppliers' Investment

Thus far, we have shown that suppliers are not deep pocketed. At least, they are not financially stronger than their customers. Also, accepting more payments in the form of CBs leads to less cash payment by their customers. As a result, the increased use of CBs induced by the tightening of bank credit to customers could potentially have an adverse impact on the suppliers' investments. This subsection investigates whether this is true in the data.

We employ the sample of supplier-customer pairs that can be successfully matched to the ASIF database. Having extracted investment and other financial information for our sample firms, we estimate the predicted bill issuance $\ln \hat{CBIssue}_{ijt}$ using the city-level pre-09 LDR tightness measure:[20]

$$\ln CBIssue_{ijt} = \beta_0 + \beta_1 LDR_{c,pre09} + \beta_{X^i} X_{it} + \beta_{X^j} X_{jt} + \epsilon_{ijt}, \tag{10}$$

where c denotes customer i's location city. Control variables X_{it} and X_{jt} include the natural logarithms of registered capital, firm age, SOE and listed indicators, and industry and province fixed effects for both customer i and supplier j. Note that $\ln CBIssue_{ijt}$ differs from the variable in equation (4) because it also varies across suppliers for each customer. We conduct this analysis at the customer-supplier pair level instead of the supplier level to avoid information loss from aggregating each supplier's bill values from customers in different cities.

We then use the estimated $\ln \hat{CBIssue}_{ijt}$ from equation (10) to examine the impact of commercial bills on the supplier's investments:

$$InvRate_{jt} = \beta_0 + \beta_1 \ln \hat{CBIssue}_{ijt} + \beta_2 LoanGrowth_{c't} + \beta_z Z_{jt} + \epsilon_{jt}, \tag{11}$$

where $InvRate_{jt}$ is the investment rate for supplier j. $LoanGrowth_{c't}$ controls for the impact

[20] We cannot use the predicted bill issuance from the IV estimation as in Table 4, because the predicted variable is correlated with the residual term from the second stage regression. This may cause bias when we estimate the subsequent investment equations.

of loan supply in the city c' where j is located on the supplier's investment. Z_{jt} includes the natural logarithms of sales, receivables, and total assets, and the leverage ratio of the supplier j. It also includes the supplier's industry, province, and year fixed effects. We also use the accumulated investment rate in the subsequent year, $AccInvRate_{jt+1}$, as an alternative dependent variable. The regressions include only the 2012 sample because the low quality of the 2010 ASIF data impedes the calculation of investment rate in 2011 (see Chen, Chen, Liu, Serrato, and Xu, 2021, for a similar treatment).

Our choice of $\ln \hat{CBIssue}_{ijt}$, instead of its raw value, as the regressor in equation (13) is important for the identification. A strand of the trade credit literature (Biais and Gollier, 1997; Cuñat, 2007) recognizes the role of trade credit in maintaining an ongoing business relationship between firms. Thus, other unobserved common factors could affect investments of both customers and suppliers, such as the future revenue prospect from this relationship. By using the predicted bill issuance as the regressor, we focus on the variation of bill issuance that comes only from the cross-city variation of $LDR_{c,pre09}$ and basic information when firms register instead of other confounding factors.

Table 7 displays our results. Column (1) lists the estimation result for equation (10). Consistent with earlier results, we find a higher city-level LDR in the customer's city is associated with more bill issuance. Columns (2) and (3) show that a larger amount of bills received is associated with lower investments of suppliers. To alleviate the concern that suppliers invest less because of a shortage in loan supply in their own cities, column (3) controls for the loan growth rate in the supplier's city. Column (4) uses the subsample that has the customer i and the supplier j located in different cities. Quantitatively, we find that a 1 standard deviation increase in the predicted bill issuance (64% increase around the mean and equivalently 5 million CNY) decreases the supplier's investment rate by 10 percentage points (0.152×0.64) or 6% of the standard deviation of $InvRate_{jt}$. For the accumulated investment at $t+1$, columns (4) and (5) show the negative effect is still there albeit with less statistical significance. With the limitation of space, we do not report the effect of CBs on the next period investment, $InvRate_{jt+1}$. One may argue that suppliers may benefit from the ongoing relationship and thus have a higher investment at $t+1$ or in later periods. However, we do not find evidence on this channel.

5.4 Suppliers' Financial Condition and the Crowding-Out Effect

In this section, we illustrate the heterogeneous crowding-out effect for suppliers with different degrees of financial constraints. Presumably, if the usage of CBs crowds out suppli-

Table 7: Crowding-Out Effect of Bill Issuance on Suppliers' Investment

This table examines the usage of CBs on the supplier's investment. In column (1), we estimate the following regression:

$$lnCBIssue_{ijt} = \beta_0 + \beta_1 LDR_{c,pre09} + \beta_{X^i} X_{it} + \beta_{X^j} X_{jt} + \epsilon_{ijt},$$

in the 2011–2012 sample. X_{it} (X_{jt}) include the registered capital, the age, the state-owned dummy, the industry FE, and the province FE for customer i (supplier j). In columns (2)-(5), we use the the predicted $ln\hat{CB}Issue_{ijt}$ and estimate the following specification:

$$InvRate_{jt} = \beta_0 + \beta_1 ln\hat{CB}Issue_{ijt} + \beta_z Z_{jt} + \epsilon_{jt},$$

in the 2011–2012 ASIF subsample, where Z_{jt} include the firm age, the state-owned and the listed indicators, the leverage, and the natural logarithms of assets for supplier j, and the loan growth rate in supplier's city. We also estimate the second equation using the next-period accumulated investment $AccInvRate_{jt+1}$ as the dependent variable. Investment rate is winsorized at the 1% level. Standard errors are in parentheses and clustered within customer and supplier pairs. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	$BillIssuance_t$	$InvRate_t$		$AccInvRate_{t+1}$	
	(1)	(2) All	(3) Diff. City	(4) All	(5) Diff. City
Predicted Bill Issuance		-0.152**	-0.251**	-0.173*	-0.295*
		(0.065)	(0.098)	(0.102)	(0.153)
$LDR_{c,pre09}$	0.120*				
	(0.071)				
Supplier's Age	0.004***	-0.006***	-0.004	-0.009***	-0.008**
	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)
State-Owned Supplier	0.124	-0.112	0.131	0.005	0.533
	(0.084)	(0.120)	(0.158)	(0.364)	(0.499)
Listed Supplier	-0.008	-0.230**	-0.113	-0.386***	-0.343
	(0.080)	(0.105)	(0.123)	(0.137)	(0.215)
Supplier's ln Registered Capital	0.092***				
	(0.004)				
Supplier's ln Asset		0.028*	0.034	-0.019	-0.012
		(0.016)	(0.025)	(0.029)	(0.043)
Supplier's Leverage		-0.182***	-0.029	-0.383***	-0.447**
		(0.066)	(0.159)	(0.093)	(0.197)
Loan Growth Rate in Supplier's City			-0.283		0.228
			(1.003)		(1.063)
Supplier's Industry and Province FE	Yes	Yes	Yes	Yes	Yes
Customer's Registry Controls	Yes	No	No	No	No
Year FE	Yes	No	No	No	No
Observations	29,133	2,950	1,300	2,722	1,233
Adjusted R^2	0.301	0.017	0.047	0.037	0.051

ers' investment, such effect should be more pronounced when the supplier is more financially constrained. We reestimate an equation with an interaction term for the predicted

Table 8: Crowding-Out Effect of Bill Issuance on Suppliers' Investment: The Role of Financial Constraints

This table presents estimation results of the following regression:

$$InvRate_{jt} = \beta_0 + \beta_1 lnC\hat{B}Issue_{ijt} + \beta_2 Constraint_{jt} + \gamma lnC\hat{B}Issue_{ijt} \times Constraint_{jt} + \beta_z Z_{jt} + \epsilon_{jt},$$

in the 2011–2012 ASIF subsample. Our financial constraint measures include the negative value of suppliers' age, whether they are non-state owned and unlisted, and whether their leverage ratio is below the median. We interact the predicted bill issuance (same as in Table 7) with each financial constraint measure. Our control variables Z_{jt} include the supplier's age, asset size, leverage, and the loan growth rate in the supplier's city. Investment rate is winsorized at the 1% level. Standard errors are in parentheses and clustered within customer and supplier pairs. ***, **, and * denote significance at the 1%, 5%, and 10%, levels respectively.

	Dependent Variable: $InvRate_t$		
	(1)	(2)	(3)
Predicted Bill Issuance	-0.227**	0.037	-0.075
	(0.088)	(0.110)	(0.081)
Predicted Bill Issuance × Young Supplier	-0.006*		
	(0.003)		
Young Supplier	0.052**		
	(0.026)		
Predicted Bill Issuance × Non-SOE & Unlisted Supplier		-0.199*	
		(0.116)	
Non-SOE & Unlisted Supplier		1.657*	
		(0.870)	
Predicted Bill Issuance × Low-Leverage Supplier			-0.167*
			(0.088)
Low-Leverage Supplier			1.086*
			(0.643)
Supplier's Control Variables as in Table 7	Yes	Yes	Yes
Supplier's Province and Industry FEs	Yes	Yes	Yes
Observations	2,907	2,907	2,907
Adjusted R^2	0.019	0.019	0.020

bill issuance, $\ln C\hat{B}Isusue_{ijt}$, and a financial constraint measure, $Constraint_{jt}$:

$$InvRate_{jt} = \beta_0 + \beta_1 \ln C\hat{B}Issue_{ijt} + \beta_2 Constraint_{jt} + \gamma \ln C\hat{B}Issue_{ijt} \times Constraint_{jt} + \beta_z Z_{jt} + \epsilon_{jt}. \quad (12)$$

Our financial constraint measures include the negative age of suppliers (thus, a larger value denotes a younger supplier) and dummy variables whether the supplier is non-state owned and unlisted and whether its leverage ratio is smaller than the median.[21]

[21] Allen et al. (2005) show that a higher leverage is associated with easier access to credit in China.

Table 8 displays the results. Column (1) shows that indeed younger firms reduce their investments more than old ones upon receiving the same amount of bills. Similarly, columns (2) and (3) show that non-state owned and unlisted firms, which are considered to have limited access to finance are also affected more. Overall, Table 8 supports the idea that the crowding-out effect on investment is more severe for financially constrained suppliers.

Our findings above are consistent with Murfin and Njoroge (2015), who argue that trade credit can adversely affect capital investments for the small suppliers of large retailers. We employ a broader sample from China and generalize their result from retail firms to a variety of manufacturing industries, and from the U.S. to a large emerging market. Moreover, our finding differs from Murfin and Njoroge (2015) in that we focus on a more liquid form of trade credit, CBs. If the secondary market of bills functioned smoothly, that is, if firms could easily cash out bills at banks or brokers, any effect from bank credit tightening would be well absorbed by the commercial bill market and there would be no material adverse real effect. However, this is not what we observed in the data.

5.5 Misallocation Effect

Previous sections have shown that the use of CBs results in a decline in the supplier's investment. If suppliers have higher investment efficiency than their customers before the bill issuance, the crowding-out effect will have an adverse consequence on the allocation efficiency. In this subsection, we proceed to investigate the efficiency implication of the loan-to-CB substitution induced by the LDR regulation.

In the spirit of Hsieh and Klenow (2009), we construct the return-to-capital measure for customer i

$$MRPK_{it} = \ln(\frac{Sales_{it}}{CapitalStock_{it}}), \tag{13}$$

and similarly for supplier j, $MRPK_{jt}$. The difference between supplier j and customer i is $\Delta MRPK_{ijt} = MRPK_{jt} - MRPK_{it}$.[22]

According to the misallocation literature, an efficient capital allocation requires the

[22]We use sales instead of value-added since firms produce gross output and the value-added variable is not available in the ASIF data after 2010. We also drop the capital share in the equation for simplicity and our later regressions control for the difference of this share across industries by including industry fixed effects for both the supplier j and the customer i. Nevertheless, our result on an enlarged pairwise dispersion of returns to capital due to CBs remains robust when capital shares are included.

equalization of capital returns between firms. Therefore, an economy improves its efficiency if capital (a short-term form in our case) flows from a low-return firm to a high-return one. However, in our data, we observe the opposite. Specifically, we find that suppliers have higher capital returns than their customers. Figure 4 shows that the return to capital of the supplier is 16% higher than that of the customer in the year of bill issuance. This difference is statistically significant with a 95% confidence interval ranging from 10% to 22%. This result suggests that capital is misallocated *before* the bill issuance and that the subsequent flow of trade credit, in the form of CBs, may have worsened the misallocation.

One may observe that the difference in returns in Figure 4 narrows to 11% one year after the bill issuance. This fact should not be viewed as evidence that the misallocation is alleviated by bill issuance since other factors could drive movements in $MPRK$. To understand whether a bill issuance induced by the LDR regulation widens or narrows the gap of capital returns between supplier j and customer i, we construct a "difference-in-difference" in $MPRK$ by tracking pairs of firms over time:

$$\Delta^2 MRPK_{ij,t,t+1} = \Delta MRPK_{ijt+1} - \Delta MRPK_{ijt}, \tag{14}$$

A larger $\Delta^2 MRPK_{ij,t,t+1}$ represents a more severe misallocation between suppliers and customers. Then, we estimate the following regression:

$$\Delta^2 MRPK_{ij,t,t+1} = \beta_0 + \beta_1 \ln \hat{CBIssue}_{ijt} + \beta_2 \Delta MRPK_{ijt} + \beta_X X_{ijt} + \epsilon_{ijt}, \tag{15}$$

where $\ln \hat{CBIssue}_{ijt}$ is the same as that in equation (11). The control variables of customer i and supplier j include their age, SOE status, industry and year fixed effects.

Table 9 shows the estimation results. In all three columns, we find that $\ln \hat{CBIssue}_{ijt}$ takes positive coefficients, suggesting that a greater amount of predicted bill issuance is associated with a widened gap of capital returns, $\Delta MRPK_{ij,t,t+1}$. Our sample size shrinks because fewer customer-supplier pairs appear in both t and $t+1$. In columns (2) and (3), when suppliers' and customers' industry, age, and state-owned status are controlled for, the coefficients are statistically significant. Specifically, in column (3), a 1 standard deviation increase in bill issuance is associated with an increase of the "difference-in-difference" return gap by 0.06 (or 7% of its standard deviation). Put another way, the fraction of supplier-customer pairs with $\Delta MRPK_{ijt+1} > 0$ (the case of misallocation) would decrease from 50% to 15% if there were no bill issuance. This result could be achieved by a higher capital investment for suppliers, absent the substitution of bill sales for cash sales in our earlier analysis.

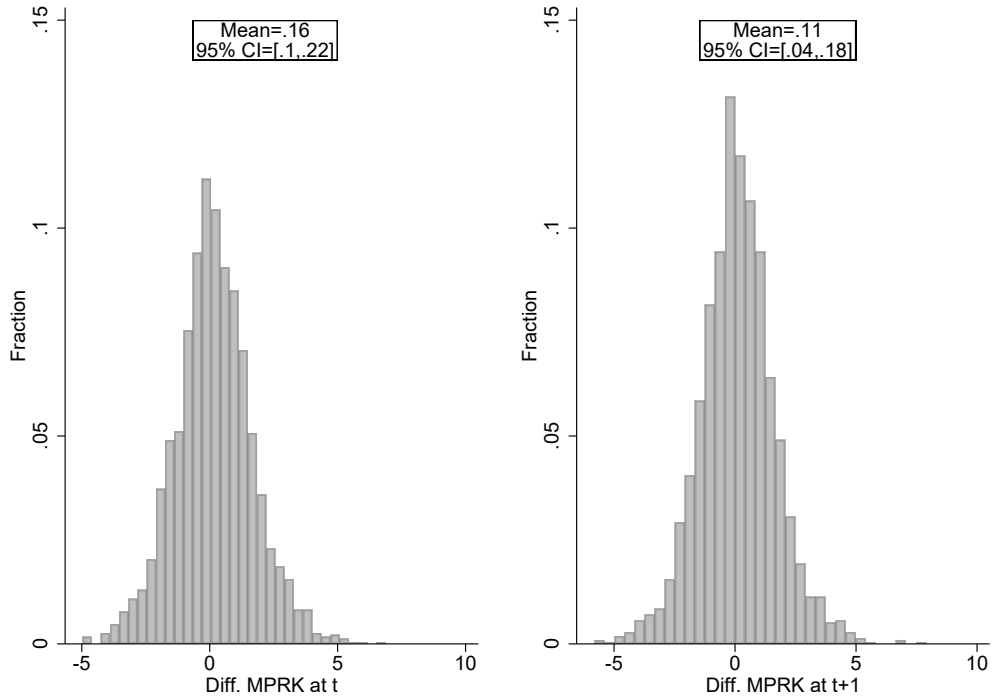


Figure 4: Differences in Returns to Capital Before and after the Bill Issuance, Supplier-Customer Comparison

This figure shows the distribution of the differences in return to capital, $\Delta MRPK$, between each supplier and its paired customer ($\Delta MRPK = MRPK_{supplier} - MRPK_{customer}$). We plot histograms in year t when bills are issued and in the subsequent year $t+1$ in the 2011–2012 ASIF sample. The $MRPK_{t+1}$ information for the year 2012 is from the 2013 ASIF data. We mark the average of the difference and its 95% confidence interval on the top center of each sub-figure.

The misallocation effect we document from the changing monetary policy is novel. It extends the query of several papers (e.g., Murfin and Njoroge, 2015; Adelino et al., 2022; Alfaro, García-Santana, and Moral-Benito, 2021) about the effect of trade credit on the real economy to the discussion of allocation efficiency. When bank credit tightens in a misallocated economy like China (e.g., Hsieh and Klenow, 2009; Song et al., 2011), the trade credit channel in the form of commercial bills further directs credit from suppliers with high capital returns toward customers with low capital returns, exacerbating the misallocation. This concept of misallocation is analogous to that of Allen et al. (2019), who show entrusted loans, in response to the same LDR regulation in China, are directed to less-productive real estate sectors.

Table 9: Misallocation Effect of Commercial Bill Issuance

This table implements the following regression

$$\Delta^2 MRPK_{ij,t,t+1} = \beta_0 + \beta_1 ln\hat{CBIssue}_{ijt} + \beta_2 \Delta MRPK_{ijt} + \beta_X X_{ijt} + \epsilon_{ijt},$$

where the dependent variable, $\Delta^2 MRPK_{ij,t,t+1}$, is the year-on-year change in the relative return capital of supplier j compared to customer i, $\Delta MRPK_{ijt}$. Return to capital, $MRPK$, is defined as the natural logarithm of sales divided by capital. $ln\hat{CBIssue}_{ijt}$ is the predicted bill issuance level as in Table 7. The sample includes customer-firm-year observations for customers and suppliers that can be successfully matched to ASIF during 2011–2013. Standard errors are in parentheses and clustered within customer and supplier pairs. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: $\Delta^2 MRPK_{ij,t,t+1}$		
	(1)	(2)	(3)
Predicted Bill Issuance	0.032	0.087**	0.088**
	(0.028)	(0.039)	(0.042)
$\Delta MRPK_{ijt}$	-0.129***	-0.133***	-0.134***
	(0.014)	(0.015)	(0.016)
Customer's and Supplier's Industry FEs	No	Yes	Yes
Customer's and Supplier's Ages and SOE Statuses	No	No	Yes
Year FE	Yes	Yes	Yes
Observations	1,778	1,778	1,753
Adjusted R^2	0.058	0.063	0.072

6 Robustness and Discussions

6.1 Alternative Channels

Alternative explanations may exist to explain the association between bank credit tightening and the increased use of CBs. One is the implementation of the Basel III accord. In response to the global Basel III initiative, the CBRC required systematically important banks to strengthen their regulatory capital ratios in 2012.[23] Could the increased use of CBs be explained by the strengthened capital requirements rather than the LDR regulation?

The key to understand whether bank capital regulation affects CB issuance is the risk weight assigned to banks' bill acceptances. In fact, for bill-acceptance banks, the risk weight of accepting CBs is the same as that of extending corporate loans; both are 100%.[24]

[23]China released the "Guidelines on Capital Management for Commercial Banks (CBRC 2012 No.1)" in June 2012. It required that systematically important banks keep a Tier 1 ratio of more than 9.5% and a capital ratio of more than 11.5%. For other banks, the minimums of tier 1 and capital ratios were 1% smaller. The timeline of rolling out this new requirement happened to be in our sample period, that is, starting from January 2012 to December 2013 for systematically important banks and to December 2016 for others.

[24]See the "Guidelines on Capital Management for Commercial Banks."

Therefore, banks cannot substitute CBs for loans to lower their risk-weighted assets and promote their capital ratios. Nevertheless, we formally test this hypothesis by instrumenting the loan growth rate by the pre-2011 capital ratios and then estimating how the instrumented loan growth affects CB issuance for the subsample starting from 2012. Specifically, we estimate the following equation:

$$\ln \text{CBAccepted}_{cbt} = \beta_0 + \beta_1 \hat{LoanGrowth}_{bt} + \beta_2 \hat{LoanGrowth}_{ct} + \beta_X X_{cbt} + \epsilon_{cbt}, \tag{16}$$

where $\hat{LoanGrowth}_{bt}$ and $\hat{LoanGrowth}_{ct}$ are instrumented by the bank- and city-level pre-2011 core Tier 1 capital ratios, $CoreRatio_{b,pre11}$ (excluding 2009). Alternatively, we use bank- and city-level pre-2011 capital ratios, $CapRatio_{b,pre11}$ (excluding 2009), as instruments. The results are presented in Table 10. We find that banks with lower pre-2011 core capital ratios slow down loan growth (Panel A, column [1]), while cities with lower ratios not (column [2]). Results from the total capital ratios are similar (columns [4] and [5]). In the second stage regressions, however, the instrumented loan growth rates do not have a significant impact on CB issuance (columns [3] and [6]).

Alternatively, the increase in CBs could be explained by the increased credit demand from the construction sector during the sample period. According to Chen, He, and Liu (2020), most of the 2009 stimulus plan in China was for long-term infrastructure projects and was financed by bank loans to the local government financing vehicles. These loans could stimulate bill issuance in two ways. First, the credit tightening could be more severe for cities with more stimulus loans in 2009, and as a result, the issuance of CBs in these cities increased. Second, with increased demand, the upstream firms of these infrastructure projects could have issued more bills to their suppliers to finance their purchases. This second channel is, however, unlikely since our sample covers a wide range of industries other than those upstream industries of construction.[25]

We thus use the cross-city variation of the stimulus plan to test whether the first channel explains our finding. We borrow the city-level excessive loan growth rate in 2009, $BL^{Stimulus}_{c,2009}$, from Chen et al. (2020). This variable is defined as the excessive ratio of bank loans over GDP in 2009 compared to the five-year average from 2003 to 2008 for each city. We download the data from Zhiguo He's website and estimate the following regression:

$$\ln \text{CBAccepted}_{cbt} = \beta_0 + \beta_1 \hat{LoanGrowth}_{ct} + \beta_X X_{cbt} + \epsilon_{cbt}, \tag{17}$$

[25]These upstream firms are mainly from nonminerals (2-digit China Industry Classification [CIC] code: 31) and primary and secondary metal smelting and refining (2-digit CIC codes: 32 and 33).

Table 10: Alternative Explanations of Loan-to-CB Substitution

Panel A of this table tests the alternative explanation that the loan-to-CB substitution is induced by regulatory capital requirements in the Basel III accord. The sample is from 2012 to 2017. Columns (1)–(3) use the average bank- and city-level core Tier 1 ratio before 2011 (excluding 2009) as instruments for bank loan growth. Columns (4)–(6) use the average bank- and city-level total capital ratio before 2011 (excluding 2009) as instruments. Panel B tests whether the loan-to-CB substitution is explained by the "hangover effect" from the 2009 stimulus plan. We use $BL_{c,2009}^{Stimulus}$ to instrument the city-level loan growth rates. $BL_{c,2009}^{Stimulus}$ is the city-level excessive bank loans over GDP in 2009. Column (2) reports the second-stage estimation results. The dependent variable is the amount of commercial bills aggregated to bank-quarter with bill maturity as the weight. We employ the bank-quarter sample period from 2011 to 2017. Standard errors are in parentheses and clustered within bank branches in both panels. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

	Panel A. Alternative I Basel Regulation					
	IV: Pre-11 Core Ratios			IV: Pre-11 Capital Ratios		
	1st Stage		2nd Stage	1st Stage		2nd Stage
	(1) Bank Loan Growth	(2) City Loan Growth	(3) ln Maturity-Adjusted Bill	(4) Bank Loan Growth	(5) City Loan Growth	(6) ln Maturity-Adjusted Bill
Bank-Level IV	0.076***	0.008		0.007***	0.001	
	(0.010)	(0.013)		(0.002)	(0.001)	
City-Level IV	0.074	-0.740		0.061	0.585*	
	(0.206)	(0.513)		(0.197)	(0.325)	
Bank Loan Growth (%)			0.114			0.149*
			(0.099)			(0.086)
City Loan Growth (%)			-0.267			-0.059
			(0.314)			(0.090)
Bank and City Controls as in Table 4	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,877	19,681	14,049	19,921	19,725	17,192
Adjusted R^2	0.230	0.445	0.068	0.226	0.445	0.281

	Panel B. Alternative II Hangover		
	1st Stage	2nd Stage	
	(1) City Loan Growth	(2) ln Maturity-Adjusted Bill	
$BL_{c,2009}^{Stimulus}$	-0.011*		
	(0.006)		
City Loan Growth		-0.343	
		(0.284)	
Bank and City Controls as in Table 4	Yes	Yes	
Year-Quarter FE	Yes	Yes	
Observations	18,259	18,259	
Adjusted R^2	0.061	.	

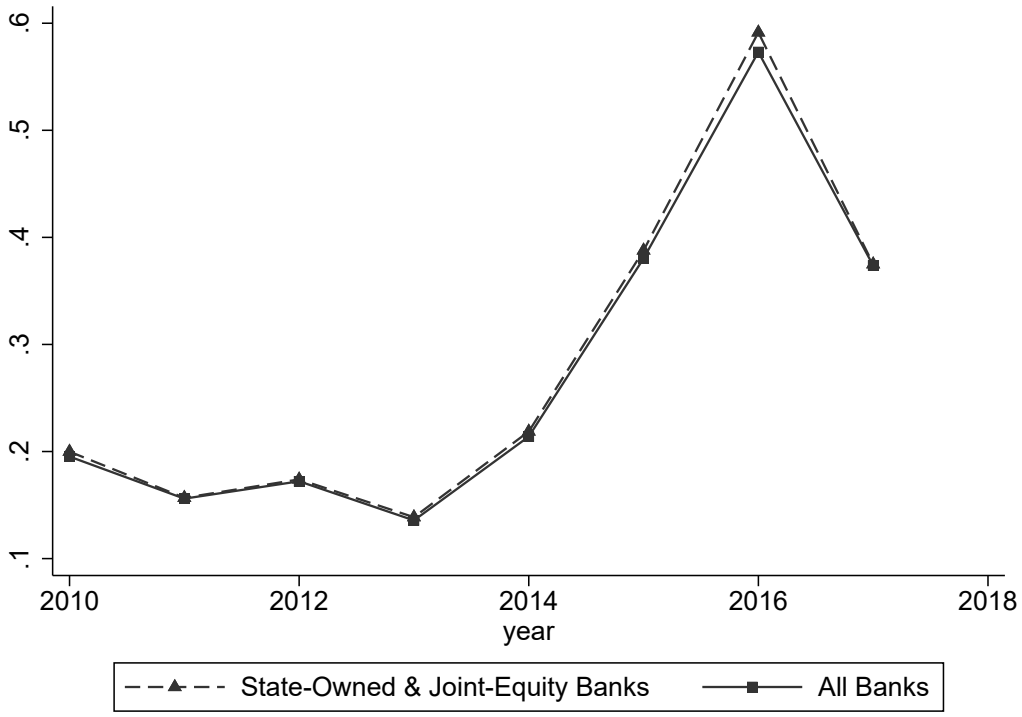


Figure 5: Ratios of Bill Discounting Volume Divided by the Acceptance Volume

This figure shows the percentage of total discounting volume divided by the total accepting volume of bills disclosed by listed banks in China during the period of 2011-2017. Data for each bank is hand collected from bank annual reports.

where $\hat{LoanGrowth_{ct}}$ is instrumented by $BL_{c,2009}^{Stimulus}$. Our results in Table 10, Panel B show that loan growth rates during 2011 to 2017 are indeed lower for cities with higher stimulus loans in 2009, but the stimulus loans do not explain the increase of CB issuance.

6.2 Effect of Bill Liquidity on the Crowding-Out Effect

We consider whether lack of liquidity in the CB market explains the adverse effect of CB usage on suppliers' investments. In addition to its effect on the bill acceptance business, the LDR regulation discouraged banks from discounting CBs, which is counted as one form of bank loans. To illustrate this point, we calculate the ratios of the discounting volume to the acceptance volume for state-owned and joint-equity banks and for all listed banks from 2010 to 2017.[26] Figure 5 shows that the ratio remained at a low level of 17% before 2015 and increased to more than 40% after 2015. When the LDR cap was in place, banks

[26]We separate the two groups since a subset of small banks, other than state-owned and joint-equity ones, were not listed in earlier years and their balance sheet information were thus missing.

were reluctant to discount bills, hampering the liquidity of the bill market.

We hypothesize that the crowding-out effect of CBs on investment should be more pronounced when the bill is harder to cash out. We estimate the following regression equation to examine how bill liquidity affects investment:

$$InvRate_{jt} = \beta_0 + \beta_1 \ln \hat{CBIssue}_{ijt} + \beta_2 Liquidity_{ijt} + \gamma \ln \hat{CBIssue}_{ijt} \times Liquidity_{ijt} + \beta_z Z_{jt} + \epsilon_{jt}, \quad (18)$$

where β_2 indicates how the liquidity of the bill issued by customer i to supplier j affects the supplier's investment and γ indicates whether the crowding-out effect of the bill issuance is attenuated or exacerbated by the bill's liquidity level.

Inspired by Gorton (2020), we use three liquidity measures: whether the customer is state-owned, whether it is listed, and whether the accepting bank is state-owned. Using the bill-level data, we confirm that bills issued by state-owned customers, listed customers, and accepted by state-owned banks have a lower discount rate, i.e., are more liquid, after controlling for maturity, face values, and year-quarter fixed effects.

The results in Table 11 support the existence of an attenuation effect of the bill liquidity on the suppliers' investment. We find that (i) the crowding-out effect of bills on the contemporaneous investment is alleviated if the customer is state-owned (Panel A, column [1]), (ii) its effect on the accumulated investment from t to $t+1$ is alleviated if the accepting bank is state-owned (Panel B, column [3]), (iii) there is no statistically significant attenuation effect if bills are issued by listed firms (Panels A and B, column [2]). In an alternative specification using the raw value of bill issuance in equation (18), our results are more pronounced. For both investment variables, the interaction terms between the state-owned customer and the bill value are positive and significant. Our analysis hence implies a new channel on how state-owned firms and banks potentially distort resource allocation.

6.3 Suppliers' Response in Borrowing from Their Own Suppliers

Existing literature shows that in response to more trade credit being required by customers, suppliers may turn to their own suppliers for borrowing (see, e.g., Boissay and Gropp, 2013). Put differently, there could be a chain of shocks that pass from the downstream firm to its upstream supplier and so on. This channel is also relevant for discussing the real consequences of bill issuance.

Table 11: Bill Liquidity and the Crowding-Out Effect on Suppliers' Investment

This tables implements the following OLS regression

$$InvRate_{jt} = \beta_0 + \beta_1 ln\hat{CBI}ssue_{ijt} + \beta_2 Liquidity_{ijt} + \gamma ln\hat{CBI}ssue_{ijt} \times Liquidity_{ijt} + \beta_z Z_{jt} + \epsilon_{jt}$$

$Liquidity_{ijt}$ measures include dummies of state-owned customer, listed customer and state-owned accepting bank. Control variables Z_{jt} are the same as in Table 7. We also use the next-period accumulative investment rate, $AccInvRate_{jt+1}$, as dependent variables. Our sample is at the customer-supplier-year level. We suppress coefficients of $LoanGrowth_{ct}$ and Z_{jt} for the ease of exposition. Investment rate is winsorized at the 1% level. Standard errors are in parentheses and clustered within the customer and supplier pairs. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Panel A Dependent Variable: $InvRate_t$		
		Liquidity Measure	
	(1) SOE Customer	(2) Listed Customer	(3) SOE Acc. Bank
Bill Issuance	-0.160**	-0.158**	-0.188***
	(0.066)	(0.067)	(0.077)
Liquidity	-2.585***	-0.057	-0.715
	(0.855)	(1.802)	(0.760)
Bill Issuance × Liquidity	0.322***	0.008	0.108
	(0.120)	(0.231)	(0.106)
	Panel B Dependent Variable: $AccInvRate_{t+1}$		
		Liquidity Measure	
	(1) SOE Customer	(2) Listed Customer	(3) SOE Acc. Bank
Bill Issuance	-0.176*	-0.184*	-0.258*
	(0.104)	(0.104)	(0.124)
Liquidity	-3.016	-4.165	-2.128**
	(1.984)	(3.799)	(1.055)
Bill Issuance × Liquidity	0.345	0.544	0.290**
	(0.269)	(0.493)	(0.148)

We investigate whether a supplier firm in our sample turns to its upstream firm for more trade credit when the supplier firm receives CBs from its customer. We replace $InvRate_{ijt}$ by $\ln Payable_{ijt}$ in the regression equation (11) and estimate the new equation. The results are reported in Table 12. Column (1) shows that a 1% increase in the predicted bill value received by the supplier induces a 0.16% increase in its payables to its own suppliers. In column (2), we interact the bill value with two indicators, $SameCity$ and $DiffCity$, which represent supplier-customer pairs located in the same city and in different cities, respectively. Both interactions take positive and significant signs, suggesting that transmission to upstream suppliers exists for the general sample. In column (3) when

Table 12: Suppliers Borrowing More Trade Credit from Their Own Suppliers

This table studies whether receiving more commercial bills, $lnCB\hat{I}ssue_{ijt}$, induces the supplier to borrow more from its upstream supplier. The dependent variable is the natural logarithm of suppliers' accounts payable. Other control variables are the same as we used in Table 7. Main explanatory variables are the predicted bill issuance from first-stage regressions where pre-09 city-level LDR is the instrument, and interactions of the predicted bill issuance with the Same City and Diff. City indicators. Standard errors are in parentheses and clustered within the customer and supplier pairs. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: ln Supplier's Accounts Payable		
	(1)	(2)	(3)
Predicted Bill Issuance	0.160***		
	(0.052)		
Predicted Bill Issuance × Same City		0.161***	
		(0.053)	
Predicted Bill Issuance × Diff. City		0.188***	
		(0.053)	
Supplier's ln Account Receivable			0.034**
			(0.017)
Supplier's City Loan Growth	-0.250	-0.292	-0.409
	(0.506)	(0.506)	(0.512)
Supplier Control Variables as in Table VII	Yes	Yes	Yes
Supplier Province, Industry and Year FEs	Yes	Yes	Yes
Observations	4,588	4,588	4,588
Adjusted R^2	0.684	0.685	0.706

we replace the predicted CB amount by the supplier's receivables, we continue to find a positive coefficient. Collectively, our evidence suggests that the adverse credit shock of customer firms propagates to upstream suppliers in the form of trade credit.

7 Conclusion

This paper studies how credit tightening shocks in the banking sector are transmitted to the real sector via supply chains. We use transaction-level data on bank-accepted CBs in China from 2011 to 2017 to measure firms' usage of trade credit and identify the propagation of credit tightening via bank-customer-supplier links. We estimate the tightness of the LDR regulation in China to identify the tightening of bank loan supply and exploit the removal of the regulation in 2015 as a quasi-experiment for identifications. We find that bank credit tightening in the period of 2011–2015 accounts for the rapid growth of the CB market. Firms use CBs to pay their suppliers, which helps them delay cash payments, when the credit supply from their lending banks is in shortage.

Different from the extant literature, we find that suppliers in our sample are not deep pocketed. On average, they are younger, smaller, and more financially constrained than their paired customers. Yet these suppliers accept CBs and de facto provide trade credit to their customers. Ultimately, lending to customers via CBs crowds out cash sales and leads to lower capital investment for suppliers. We further find a stronger investment crowding-out effect for more constrained suppliers that receive less liquid bills. Finally, we find that customers on average have lower operating efficiency than suppliers in terms of return to capital. The supplier-customer gap in efficiency widens when more bills are issued, suggesting that trade credit in the form of CBs exacerbates resource misallocation in China.

References

Acharya, V. V., J. Qian, Y. Su, and Z. Yang (2020). In the shadow of banks: Wealth management products and issuing banks' risk in China. *NYU Stern School of Business*.

Adelino, M., M. A. Ferreira, M. Giannetti, and P. Pires (2022). Trade credit and the transmission of unconventional monetary policy. *The Review of Financial Studies*. hhac040.

Alfaro, L., M. García-Santana, and E. Moral-Benito (2021). On the direct and indirect real effects of credit supply shocks. *Journal of Financial Economics 139*(3), 895–921.

Allen, F., J. Qian, and M. Qian (2005). Law, finance, and economic growth in China. *Journal of Financial Economics 77*(1), 57–116.

Allen, F., Y. Qian, G. Tu, and F. Yu (2019). Entrusted loans: A close look at China's shadow banking system. *Journal of Financial Economics 133*(1), 18–41.

Amiti, M. and D. E. Weinstein (2018). How much do idiosyncratic bank shocks affect investment? Evidence from matched bank-firm loan data. *Journal of Political Economy 126*(2), 525–587.

Ashton, T. S. (1945). The bill of exchange and private banks in Lancashire, 1790-1830. *The Economic History Review 15*(1/2), 25–35.

Barrot, J.-N. (2016). Trade credit and industry dynamics: Evidence from trucking firms. *The Journal of Finance 71*(5), 1975–2016.

Barrot, J.-N. and R. Nanda (2020). The employment effects of faster payment: Evidence from the federal quickpay reform. *The Journal of Finance 75*(6), 3139–3173.

Bernanke, B. S. and M. Gertler (1995). Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perspectives 9*(4), 27–48.

Biais, B. and C. Gollier (1997). Trade credit and credit rationing. *Review of Financial Studies 10*(4), 903–937.

Boissay, F. and R. Gropp (2013). Payment defaults and interfirm liquidity provision. *Review of Finance 17*(6), 1853–1894.

Chen, K., J. Ren, and T. Zha (2018). The nexus of monetary policy and shadow banking in China. *American Economic Review 108*(12), 3891–3936.

Chen, Q., Z. Chen, Z. Liu, J. C. S. Serrato, and D. Xu (2021). Regulating conglomerates in China: Evidence from an energy conservation program. Technical report, National Bureau of Economic Research.

Chen, Z., Z. He, and C. Liu (2020, July). The financing of local government in China: Stimulus loan wanes and shadow banking waxes. *Journal of Financial Economics 137*(1), 42–71.

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

Chodorow-Reich, G. and A. Falato (2022). The loan covenant channel: How bank health transmits to the real economy. *Journal of Finance 77*(1), 85–128.

Costello, A. M. (2020). Credit market disruptions and liquidity spillover effects in the supply chain. *Journal of Political Economy 128*(9), 3434–3468.

Cuñat, V. (2007). Trade credit: Suppliers as debt collectors and insurance providers. *Review of Financial Studies 20*(2), 491 – 527.

Fabbri, D. and L. K. Klapper (2016). Bargaining power and trade credit. *Journal of Corporate Finance 41*, 60–80.

Gan, J. (2007). Collateral, debt capacity, and corporate investment: Evidence from a natural experiment. *Journal of Financial Economics 85*(3), 709–734.

Garcia-Appendini, E. and J. Montoriol-Garriga (2013). Firms as liquidity providers: Evidence from the 2007–2008 financial crisis. *Journal of Financial Economics 109*(1), 272–291.

Giannetti, M., M. Burkart, and T. Ellingsen (2011). What you sell is what you lend? Explaining trade credit contracts. *The Review of Financial Studies 24*(4), 1261–1298.

Giannetti, M., N. Serrano-Velarde, and E. Tarantino (2021). Cheap trade credit and competition in downstream markets. *Journal of Political Economy 129*(6), 000–000.

Gorton, G. B. (2020). Private money production without banks. *NBER Working Paper 26663*.

Hachem, K. and Z. M. Song (2021). Liquidity regulation and credit booms. *Journal of Political Economy 129*, 2721–2765.

Hadlock, C. J. and J. R. Pierce (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies 23*(5), 1909–1940.

Hsieh, C.-T. and P. J. Klenow (2009). Misallocation and manufacturing TFP in China and India. *The Quarterly Journal of Economics 124 (4)*, 1403–1448.

Ivashina, V., L. Laeven, and E. Moral-Benito (2022). Loan types and the bank lending channel. *Journal of Monetary Economics 126*, 171–187.

Jacobson, T. and E. Von Schedvin (2015). Trade credit and the propagation of corporate failure: An empirical analysis. *Econometrica 83*(4), 1315–1371.

Jiménez, G., A. Mian, J.-L. Peydró, and J. Saurina (2020). The real effects of the bank lending channel. *Journal of Monetary Economics 115*, 162–179.

Kiyotaki, N. and J. Moore (1997). Credit chains. *Mimeo, London School of Economics*.

Klapper, L., L. Laeven, and R. Rajan (2012). Trade credit contracts. *The Review of Financial Studies 25*(3), 838–867.

Love, I., L. A. Preve, and V. Sarria-Allende (2007). Trade credit and bank credit: Evidence from recent financial crises. *Journal of Financial Economics 83*, 453–469.

Murfin, J. and K. Njoroge (2015). The implicit costs of trade credit borrowing by large firms. *Review of Financial Studies 28*, 112–145.

Nilsen, J. (2002). Trade credit and the bank lending channel. *Journal of Money, Credit and Banking 34*, 226–253.

Payment and Clearing Association of China (2016). *Commercial bills: Theory and practice*. Beijing, China: China Financial Press.

Petersen, M. A. and R. G. Rajan (1997). Trade credit: Theories and evidence. *Review of Financial Studies 10*(3), 661–691.

Santarosa, V. A. (2015). Financing long-distance trade: the joint liability rule and bills of exchange in eighteenth-century France. *The Journal of Economic History 75*(3), 690–719.

Song, Z., K. Storesletten, and F. Zilibotti (2011). Growing like China. *American Economic Review 101*, 196–233.

Song, Z. and W. Xiong (2018). Risks in China's financial system. *Annual Review of Financial Economics 10*, 261–286.

Zhu, X. (2021). The varying shadow of china's banking system. *Journal of Comparative Economics 49*(1), 135–146.

Appendix

A LDR Regulation Policy Archives from the CBRC Website

A.1 Compliance at the Bank-City Branch Level

Figures A.1 and A.2 show that the compliance of the LDR ratio is at the bank-city branch level. We translate text into English following each screenshot.

发布时间：2012-03-31　　打印　微博　微信　更多

上海银监局督促在沪所有外资法人银行
存贷比如期达标

根据《中国银行业监督管理委员会关于<中华人民共和国外资银行管理条例实施细则公布后有关问题的公告>》（银监发〔2006〕82号）的要求，在沪外资法人银行应当于2011年12月31日前符合《中华人民共和国商业银行法》第三十九条第（二）项“贷款余额与存款余额的比例不得超过75%”的规定。据统计，截至2011年末，在沪外资法人银行整体存贷比水平已降至70%以下，同时，所有在沪外资法人银行在2011年12月31日前均实现存贷比达标。监管达标的同时，在沪外资法人银行整体经营状况得到大幅提升，资产规模超千亿的银行增至5家，并具备较强的综合化经营能力，同时，盈利水平较2010年也有大幅增长。

为督促在沪所有外资法人银行存贷比如期达标，上海银监局采取了综合性监管手段，强化在沪外资法人银行流动性风险管理，督促合理安排存贷款结构，确保存贷比按期达标。在上海银监局指导下，在沪外资法人银行于2011年初制定了存贷比达标计划，并结合市场流动性状况合理预估存贷款变化趋势。达标压力较大的几家银行，也从存款吸收和贷款控制两个方面进一步拟定有效措施，实现了达标目标。同时，上海银监局督促银行落实以月度日均存贷比为基础的内部监测和考核机制，注重达标长效机制建设，通过调整资产负债结构、分币种管理、到期日管理、客户集中度管理等多种手段促进科学的存贷比管理。

手机扫一扫打开此页

Figure A.1: Evidence of the City-Level LDR Regulation, Shanghai
The screenshot is from the China Banking Regulation Commission website. The QR code in the bottom center can be scanned for linking to the webpage.

According to the requirements in the Announcements of Issues Regarding the Foreign Bank Regulation of People's Republic of China (CBRC 2006-82), foreign banks in China should meet the requirement Item No.2 of Article No. 39

of China Foreign Commercial Bank Law that "the amount of outstanding loans to deposits ratio (LDR) should not exceed 75%" by December 31, 2011. According to statistics at the end of 2011, the overall LDR ratio of foreign banks in Shanghai has fallen below 70%. All foreign banks in Shanghai have met the LDR regulation by December 31, 2011. Meanwhile, the operating performance of foreign banks in Shanghai has been largely improved. Five banks have asset sizes greater than RMB 100 billion, are solid in various operating capacities, and have significantly increased their profits since 2010.

CBRC Shanghai employed comprehensive supervision of foreign banks to ensure they meet the LDR regulation. CBRC Shanghai emphasized the need for banks to manage their liquidity risk and optimize the loan-to-deposit structure. With guidance from CBRC Shanghai, foreign banks in Shanghai drafted plans to meet the LDR requirement at the beginning of 2011 and forecasted the time trend of LDR ratios based on market liquidity. Banks that initially found it hard to comply with the regulation also implemented measures to increase deposits and cut loan issuance to meet the requirement eventually. *CBRC Shanghai urged banks to monitor LDR ratios daily in a sustainable way.* CBRC Shanghai also recommended LDR management tools such as asset and liability management, currency-by-currency management, maturity management, and customer concentration management.

—CBRC Shanghai office

Figure A.2: Evidence of the City-Level LDR Regulation, Xi'an

The screenshot is from the China Banking Regulation Commission website. The QR code in the bottom center can be scanned for linking to the webpage.

First, *(Bank of Beijing Xi'an Branch) learned from the experience from H1 this year and strengthened the LDR management. They include the LDR ratio in a list of key examination indicators and incentivize the sales team to focus on deposit creation and profit making.* Second, they adjust the performance evaluation by lowering the bonus for maintaining old customers to motivate the sales team to find new clients. Third, they improved the standardized procedure of corporate business and investment banking for an orderly and efficient development of the bank's business.

—CBRC Xi'an office

A.2 Loan-to-CB Substitution

Figures A.3 and A.4 illustrate how the CBRC local offices warn commercial banks not to circumvent the LDR regulation by substituting bills for loans. We translate texts in the two screenshots respectively as follows.

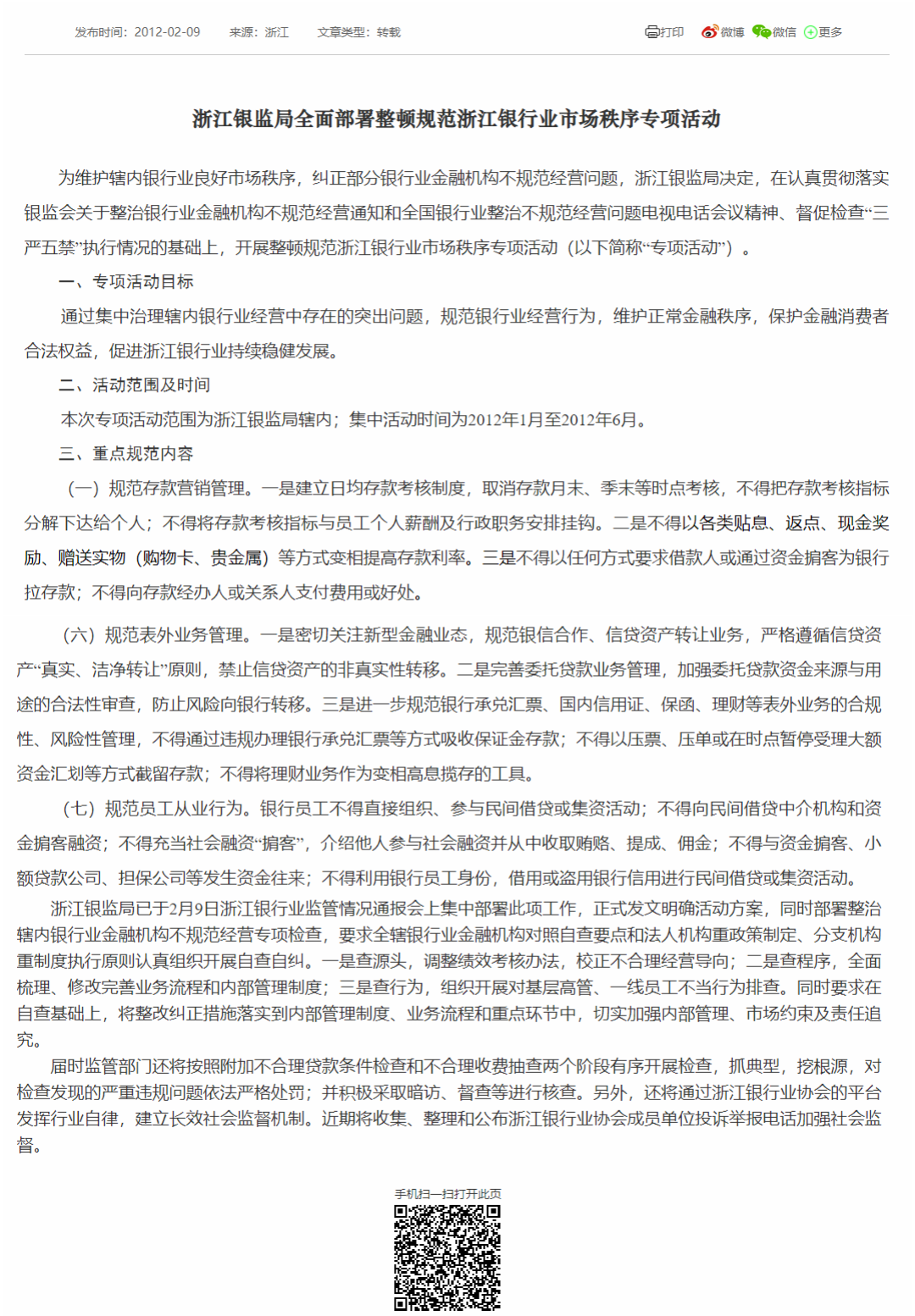
Figure A.3: Evidence of the Loan-to-CB Substitution, Zhejiang

The screenshot is from the China Banking Regulation Commission website. The QR code in the bottom center can be scanned for linking to the webpage.

> At the economic condition analysis meetings in Q1 this year, *the CBRC clearly stated that banks are prohibited from substituting commercial bills issued against issuers' will for loan initiations.* CBRC Hainan promptly started to implement the rule using multiple measures. First, CBRC Hainan hosted supervision meetings to deliver the regulatory requirement. Specifically, CBRC Hainan requires banks to strengthen the management and inspection of bank-accepted bill business. Banks should accept bills based on firms' actual business transactions. Second, CBRC Hainan required banks to strengthen the management of non-interest intermediary businesses. Banks cannot evaluate employees' performance in the bank-accepted commercial bill business to curb misconduct in this area. Third, banks should monitor bank-accepted bills monthly to detect abnormal circumstances timely. Lastly, CBRC Hainan will randomly check banks'

commercial bill businesses in special inspections. Any misconduct will be dealt with seriously.

—CBRC Hainan Office



发布时间：2012-02-09　来源：浙江　文章类型：转载　打印　微博　微信　更多

浙江银监局全面部署整顿规范浙江银行业市场秩序专项活动

为维护辖内银行业良好市场秩序，纠正部分银行业金融机构不规范经营问题，浙江银监局决定，在认真贯彻落实银监会关于整治银行业金融机构不规范经营通知和全国银行业整治不规范经营问题电视电话会议精神、督促检查"三严五禁"执行情况的基础上，开展整顿规范浙江银行业市场秩序专项活动（以下简称"专项活动"）。

一、专项活动目标

通过集中治理辖内银行业经营中存在的突出问题，规范银行业经营行为，维护正常金融秩序，保护金融消费者合法权益，促进浙江银行业持续稳健发展。

二、活动范围及时间

本次专项活动范围为浙江银监局辖内；集中活动时间为2012年1月至2012年6月。

三、重点规范内容

（一）规范存款营销管理。一是建立日均存款考核制度，取消存款月末、季末等时点考核，不得把存款考核指标分解下达给个人；不得将存款考核指标与员工个人薪酬及行政职务安排挂钩。二是不得以各类贴息、返点、现金奖励、赠送实物（购物卡、贵金属）等方式变相提高存款利率。三是不得以任何方式要求借款人或通过资金掮客为银行拉存款；不得向存款经办人或关系人支付费用或好处。

（六）规范表外业务管理。一是密切关注新型金融业态，规范银信合作、信贷资产转让业务，严格遵循信贷资产"真实、洁净转让"原则，禁止信贷资产的非真实性转移。二是完善委托贷款业务管理，加强委托贷款资金来源与用途的合法性审查，防止风险向银行转移。三是进一步规范银行承兑汇票、国内信用证、保函、理财等表外业务的合规性、风险性管理，不得通过违规办理银行承兑汇票等方式吸收保证金存款；不得以压票、压单或在时点暂停受理大额资金汇划等方式截留存款；不得将理财业务作为变相高息揽存的工具。

（七）规范员工从业行为。银行员工不得直接组织、参与民间借贷或集资活动；不得向民间借贷中介机构和资金掮客融资；不得充当社会融资"掮客"，介绍他人参与社会融资并从中收取贿赂、提成、佣金；不得与资金掮客、小额贷款公司、担保公司等发生资金往来；不得利用银行员工身份，借用或盗用银行信用进行民间借贷或集资活动。

浙江银监局已于2月9日浙江银行业监管情况通报会上集中部署此项工作，正式发文明确活动方案，同时部署整治辖内银行业金融机构不规范经营专项检查，要求全辖银行业金融机构对照自查要点和法人机构重政策制定、分支机构重制度执行原则认真组织开展自查自纠。一是查源头，调整绩效考核办法，校正不合理经营导向；二是查程序，全面梳理、修改完善业务流程和内部管理制度；三是查行为，组织开展对基层高管、一线员工不当行为排查。同时要求在自查基础上，将整改纠正措施落实到内部管理制度、业务流程和重点环节中，切实加强内部管理、市场约束及责任追究。

届时监管部门还将按照附加不合理贷款条件检查和不合理收费抽查两个阶段有序开展检查，抓典型，挖根源，对检查发现的严重违规问题依法严格处罚；并积极采取暗访、督查等进行核查。另外，还将通过浙江银行业协会的平台发挥行业自律，建立长效社会监督机制。近期将收集、整理和公布浙江银行业协会成员单位投诉举报电话加强社会监督。

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Figure A.4: Evidence of the Loan-to-CB Substitution, Zhejiang

The screenshot is from the China Banking Regulation Commission website. We crop the first and last thirds of the article and combine them together for shortening the length. See the full article via scanning the QR code in the bottom center.

To maintain a good market order for the banking sector and rectify the irregular operation of some financial intermediations, the CBRC Zhejiang decided to carry out special activities to regulate the banking sector (Special Activities hereafter). Before this, CBRC made an announcement and had conference calls about rectifying irregular operations in the banking sector.

1. The Goal

   Regulate the banking sector in Zhejiang province by solving critical problems of the current bank operations. Maintain a financial order, protect financial consumers' legal rights and facilitate a steady and healthy development of the banking sector in Zhejiang.

2. Scope and Time Period

   Banks and other financial institutions under supervision of CBRC Zhejiang; January-June, 2012.

3. Major Contents

   (a) Regulate deposit marketing management. First, establish a deposit assessment daily and abolish the month-end and quarter-end assessments. Banks cannot decentralize the deposit assessment to individual officers or link the deposit assessment with employees' compensation and promotion. Second, banks are not allowed to raise deposit rates in alternative ways such as discounting interest, rebatement, cash bonuses, or using gifts (e.g., shopping cards, precious metals). Third, banks cannot boost deposits by demanding deposits from borrowers or acting as cash brokers. Banks cannot pay fees or rewards to connected persons in the deposit business.

   (b) Regulate off-balance sheet business. First, banks should closely observe new developments in the financial sector. Banks' operations with credit agencies should follow the norm. The credit transfer business should be genuine and clean. Faked credit transfers are prohibited. Second, improve entrusted loan management and strengthen the assessment of funding sources and usage to detect any credit risks that may propagate to the rest of the banking sector. Third, *further regulate compliance and risk management of bank-accepted commercial bills, letters of credit, guarantees, and wealth management products, among others. Banks are prohibited from boosting cash deposits by issuing bank-accepted*

commercial bills. Banks must refrain from withholding deposits by delaying bill discounting or suspending cash transfers. Banks are not allowed to use wealth management products as alternative ways to increase high-interest deposits.

(c) Bank officers should follow the professional norm. Bank officers are prohibited from organizing or participating in private lending or fundraising. Bank officers cannot act as cash brokers to help to finance private credit intermediations. Also, bank officers cannot act as brokers for social financing. Such brokerage activities include (i) introducing others to social fundraising and accepting bribes, rebatement, or commissions and (ii) transacting with fund brokers, small loan companies, or guarantee firms. Bank officers cannot take advantage of their employee identities to borrow or steal bank credit for private lending and fundraising.

—CBRC Zhejiang Office

B Comparing the Bill Data to the ASIF Data

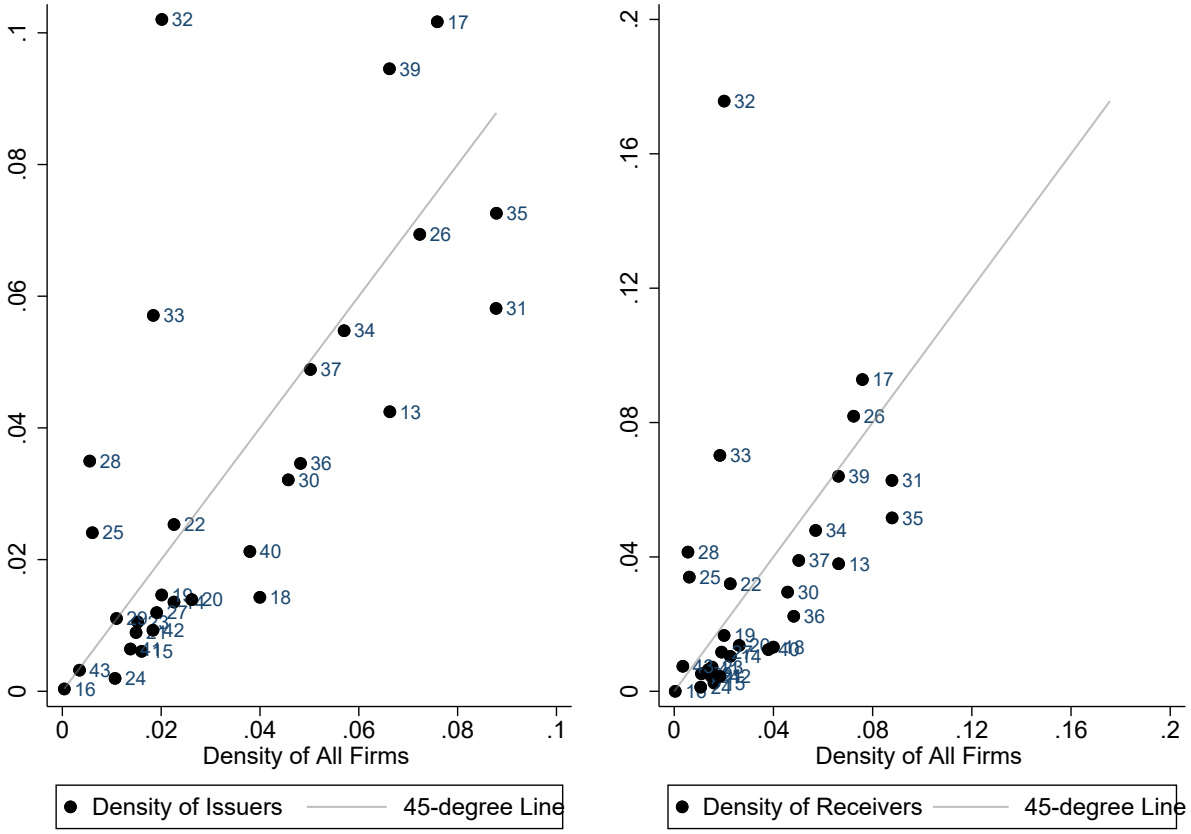

Figure B.5: Industry Composition Comparison between the Bill Data and the ASIF Data

This figure plots fractions (%) of firms from each 2-digit CIC industry in our bill data (the vertical axis) against that in the ASIF data (the horizontal axis) during the period of 2011-2012. Panel A is for customers (i.e., issuers), while Panel B is for suppliers (i.e., receivers). The 2-digit marker is the CIC industry classification codes.

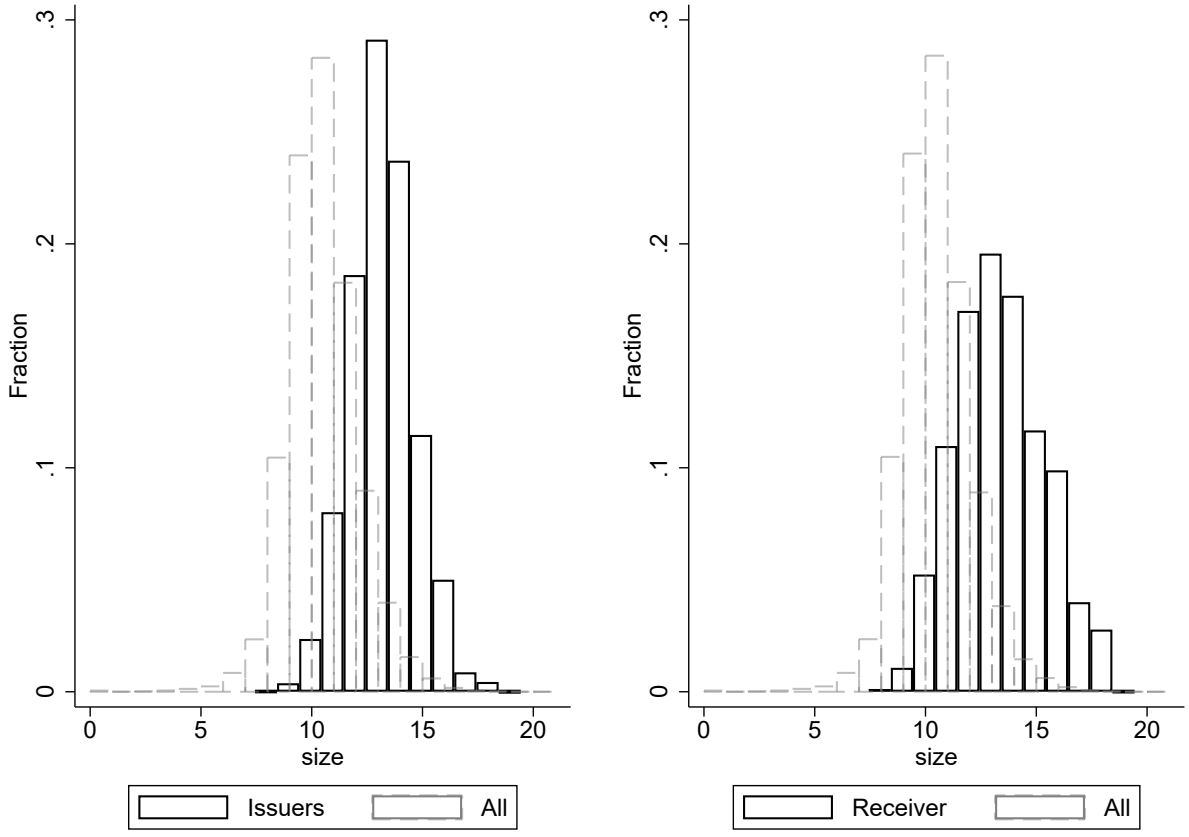

Figure B.6: Firm Size Comparison between the Bill Data and the ASIF Data

This figure plots the size distribution (in natural logarithms of asset) of firms that both show up in the bill data and ASIF data against all firms in the ASIF data during the period of 2011–2012. The left panel compares customers (i.e., the issuers) to all ASIF firms. The right panels compares suppliers (i.e.,the receivers) to all ASIF firms.

C Additional Figures and Tables

Table C.1: Data Sources and Variable Definitions

Variable	Definition
Commercial Bill Dataset	
Transaction-level Variables	
Order Value	The reported amount of bill values for each transaction
Maturity	The time length between the issuing date and the due date
Adjusted Order Value	$\frac{\text{maturity}}{365} \times$ order value
Duration	The time length between the transaction date and the due date
Discount Rate	The percentage cost when the bill is discounted
Number of Bills	The number of bills transacted for each transaction
Number of Suppliers	The number of receivers the issuer has for each year
Number of Customers	The number of issuers the receiver has for each year
National Registry of Industry and Commerce(NRIC)	
Registered Capital	Amount of capital the firm pay in upon registry
Age	Year t net the opening year of the firm
Sate-owned	A dummy which takes one if the firm is state-owned
Listed	A dummy which takes one if the firm is listed
Industry	2-digit Chinese Industry Classification (CIC) codes
Located City	Cities at the prefecture-level or province-level (i.e., Shanghai, Beijing, Chongqing, and Tianjin)
Annual Survey of Industrial Firms (ASIF)	
Asset	Total assets of the firm
ROA	(Total profit-income tax payable)/total assets
Asset Turnover	Main business revenue/total assets
Leverage Ratio	Total liability/total assets
Investment Rate	(Total fixed assets$_t$-total fixed assets$_{t-1}$)/net total fixed assets$_{t-1}$
Receivable-to-Asset Ratio	Accounts receivable/total assets
Payable-to-Asset Ratio	Accounts payable/total assets
Payable-to-Sales Ratio	Accounts payable/total sales
Bill Sales Ratio	Sum of maturity-adjusted bill value a firm receives/total sales
Trade Credit Sales Ratio	Accounts receivable/total sales
Cash Sales Ratio	1 - bill sales ratio - trade credit sales ratio
Wind Database	
City-level Loan Growth Rate	City loan balance$_t$/city loan balance$_{t-1}$ - 1
Asset	Total assets of the bank
Registered Capital	Registered capital of the bank
Non-interest Income Ratio	Bank's non-interest income/operating income
LDR	Amount of outstanding loans/deposit balance
LDR$_{b,pre09}$	$\frac{1}{3}\left(LDR_{2006} + LDR_{2007} + LDR_{2008}\right)$, which is the averaged

Continued on next page

Table C.1: (continued from previous page)

Variable	Definition
	LDR ratio from 2006 to 2008 for bank b
$LDR_{c,pre09}$	$\frac{1}{3}\left(LDR_{2006} + LDR_{2007} + LDR_{2008}\right)$, which is the averaged LDR ratio from 2006 to 2008 for city c
Tier 1 Ratio	Tier 1 capital/total risk weighted assets
Core Ratio	Core capital/total risk weighted assets (before 2012)
Capital Ratio	Bank capital/total risk weighted assets
Peoples' Bank of China	
Outstanding Undiscounted Bill	Value of commercial bills are issued but neither discounted nor due in the corresponding month
Bill Financing	Value of commercial bills that the real sector discounts at commercial banks
China Banking Regulatory Commission	
$mshare_{bct}$	Number of banking locations of bank b in city c in year t divided by total number of banking locations in city c

Table C.2: Volumes of Acceptance and Discounting, Our Data versus Aggregates, Billion CNY

Aggregate acceptance numbers are the sum of acceptance values disclosed by 25 publicly listed banks, including all state-owned and joint-equity ones. Aggregate discounting numbers are sum of discounted bill values from the table of Sources & Uses of Funds of Financial Institutions from PBoC.

Year	Our Data	Aggregate	Coverage
	Acceptance		
2011	394	4640	8.49%
2012	767	5657	13.56%
2014	608	6153	9.88%
2015	603	5994	10.06%
2016	643	5376	11.96%
2017	201	4573	4.40%
2011-2017	3216	32393	9.93%
	Discounting		
2011	395	1512	26.09%
2012	767	2043	37.54%
2014	605	2917	20.74%
2015	605	4576	13.22%
2016	643	5471	11.75%
2017	202	3887	5.20%
2011-2017	3217	20407	15.76%

Table C.3: Bill Issuances for Firms in Cities with Different Loan Growth Rates, OLS Estimation, Firm-Level

This table implements the following OLS regression:

$$lnCbIssue_{ict} = \beta_0 + \beta_1 LoanGrowth_{ct} \times Pre15 + \beta_2 LoanGrowth_{ct} \times Post15 + \beta_x X_{ict} + \epsilon_{ict}$$

here c, i, and t represent for city, issuer, province, and year. The sample includes issuers that issue bills from 2011 to 2017. The dependent variable lnCbIssue$_{ict}$ is the natural logarithm of maturity-adjusted sum of bill values issuer i in city c issued during year t. Variables are at the annual frequency. $Pre15$ equals 1 if t is smaller than 2015 and 0 otherwise. Column (1) includes all observations. Column (2) includes firms that issue bills both before and after 2015. Standard errors are in parentheses and clustered by issuers. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	All Sample	Firms Issuing Bills Both Before and After 2015
	(1)	(2)
City Loan Growth (%) × Pre15	-0.007*	-0.012**
	(0.004)	(0.006)
City Loan Growth (%) × Post15	0.003	0.004
	(0.004)	(0.004)
No. of Suppliers	0.409***	0.401***
	(0.022)	(0.029)
Issuer FE	Yes	Yes
Year FE	Yes	Yes
Observations	23,341	13,227
Adjusted R^2	0.489	0.508

Table C.4: More Bill Issuances for Firms in Cities with Slower Loan Growth Rates, Sample of Paired Receivers and Issuers

This table implements the following IV estimation

$$lnCbIssue_{ijcc't} = \beta_0 + \beta_1 LoanGrowth_{ct} + \beta_2 LoanGrowth_{c't} + \beta_x X_{ict} + \beta_{x'} X'_{jc't} + \epsilon_{icc'bt},$$

The dependent variable $lnCbIssue_{ijcc't}$ is the natural logarithm of maturity-adjusted sum of bill values issuer i in city c to receiver j in city c' issued during year t. We use the city-level pre-09 LDRs, $LDR_{c,pre09}$ and $LDR_{c',pre09}$, to instrument the city-level loan growth rates for the issuer's city c and the receiver's city c'. Control variables include the natural logarithm of average bill maturity, as well as issuer's and receiver's natural logarithm of registered capital, age, state-owned and listing statuses, and industry and province fixed effects. The unit of observations is issuer-receiver-year. We split the data into two sub-samples, before and after (including) 2015, and we list first- and second-stage results. We suppress the display of coefficient estimates of β_X and $\beta_{X'}$ for simplicity. Standard errors are in parentheses and clustered within issuers. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Before: 1st Stage		Before: 2nd Stage	After: 1st Stage		After: 2nd Stage
	(1) Issuer's City Loan Growth	(2) Receiver's City Loan Growth	(3) ln Maturity-Adjusted Bill Value	(4) Issuer's City Loan Growth	(5) Receiver's City Loan Growth	(6) ln Maturity-Adjusted Bill Value
$LDR_{c,pre09}$	-8.233***			2.862***		
	(0.237)			(0.341)		
$LDR_{c',pre09}$		-0.091***			0.011***	
		(0.003)			(0.003)	
Issuer's City Loan Growth (%)			-0.017*			0.211
			(0.010)			(0.128)
Receiver's City Loan Growth (%)			-0.051			-15.958
			(0.819)			(20.330)
No. of Suppliers for Issuer	-0.008	-0.000	0.029***	0.058***	0.000**	0.007
	(0.009)	(0.000)	(0.004)	(0.014)	(0.000)	(0.007)
No. of Customers for Receiver	-0.009**	-0.000***	0.022***	0.010	0.000***	0.055***
	(0.004)	(0.000)	(0.002)	(0.007)	(0.000)	(0.011)
Issuer's and Receiver's Controls	Yes	Yes	Yes	Yes	Yes	Yes
Issuer's and Receiver's Province FEs	Yes	Yes	Yes	Yes	Yes	Yes
Issuer's and Receiver's Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39,748	39,397	39,397	22,310	21,986	21,969
Adjusted R^2	0.384	0.375	0.227	0.190	0.185	0.058