The Real Effects of Entrusted Lending in China*

(Preliminary and Incomplete)

Qi Sun†

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Abstract

We develop a two-sector equilibrium model of entrusted lending in China, in which state sector firms with privileged access to credit provide entrusted loans to private sector firms with limited access to credit. We show that in a stationary state entrusted lending improves capital allocation by channeling funds to more productive private firms. However, during a bank credit expansion, new bank loans have been allocated more disproportionately toward state firms through an amplification effect induced by entrusted lending. On the other hand, the channel of entrusted lending boosts the transmission efficiency of credit stimulus by enlarging the impact of credit expansion on investment and output growth. We also show that a partial liberalization of the state sector's borrowing constraint could lead to a lower efficiency of capital allocation, by a crowding out effect of raising the marginal cost of bank lending.

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†School of Finance, Shanghai University of Finance and Economics, 100 Wudong Road, Shanghai, China, 200433. e-mail: sunqi@sufe.edu.cn

1 Introduction

Entrusted lending, the largest component of shadow banking in China, plays important roles in providing and reallocating credit among firms. Figure 1 shows the time series of aggregate entrusted loans as a percentage of total social financing.[1] On average, entrusted loans account for 8 percent of the total credit or 12 percent of bank loans. Moreover, entrusted loans increase dramatically since 2009.[2] The prevailing use of entrusted loans has rooted in China's dual-track financial system or the strategy of gradual interest rate liberalization. On the one hand, most of bank loans are concentrated in state-owned enterprises and the interest rate of bank loans is regulated at a low level to subsidize state firms. On the other hand, the market track of shadow banking has been established to channel credit to firms at market interest rates. Lenders of entrusted loans are often state firms or politically connected private firms that have privileged access to cheap bank credit, and borrowers are often more productive firms but with limited access to credit.

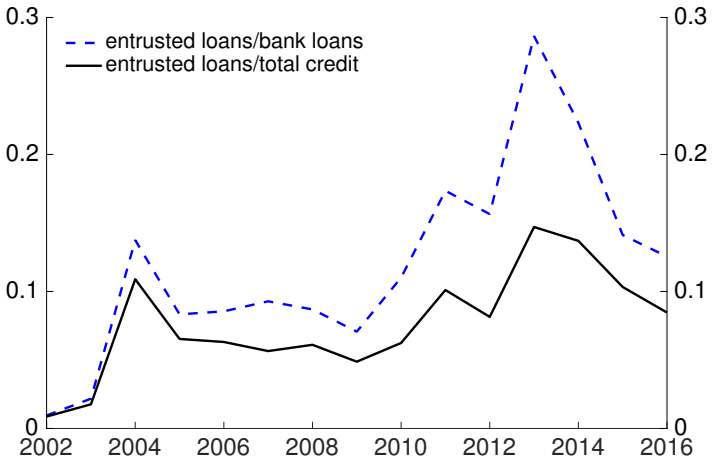

Figure 1: **Entrusted Lending**

[1]Total social financing measures the aggregate amount of funds provided by China's domestic financial system to the real economy, including but not limited to: bank loans, entrusted loans, corporate bonds, and equity.

[2]In this paper, we focus on the entrusted lending prior to 2012. As documented by Chen, Ren, and Zha (2017), entrusted lending after 2012 were largely involved with banks' risk taking behaviors, and a significant portion of entrusted loans were ultimately funded by banks. See more details in Appendix C.

This paper has two goals. First, we want to understand and quantify the role of entrusted lending in credit allocation and transmission. Given that state-owned (connected) firms have privileged access to credit but with lower productivity, in theory, some of credit would be reallocated to more productive private firms. However, in the data we do not directly observe the amount of such credit reallocation or such data is not available. For both economists and policymakers, quantifying the credit reallocation between the state sector and the private sector can be useful. For example, the policymakers may want to know exactly how much credit would be reallocated from the state sector to the private sector if they implement the credit expansion by partially relaxing the financial constraint of the state sector. In this paper, we use our structural model to indirectly estimate the credit reallocation between the state sector and the private sector.

Second, we examine the policy implications of the model. During the period of 2009-2010, China undertook a massive (both fiscal and credit) stimulus program to combat the global financial crisis. Although the program has successfully helped the economy to rebound quickly from the crisis, it has unintended consequences. Recent work has provided important empirical evidence regarding the real and financial consequences of the stimulus program.[3] But there is still no quantitative study of examining the real impacts of the credit stimulus on industrial firms. Our paper takes a step towards this direction. In addition, we argue that our structural model is particularly useful to control for the indirect credit transmission among firms in the study of credit allocation under stimulus.

We build a two-sector firm dynamics model in which firms in upstream sector provide intermediate goods as well as entrusted loans to downstream firms. Based on the stylized fact that state-owned firms are concentrated in the upstream sector, we assume that the upstream sector is consist of state-owned firms and the downstream sector contains private firms. To capture the feature that state-owned firms have privileged access to credit while private firms have limited access to credit, we assume that upstream firms can access to bank

[3]e.g., Bai, Hsieh, and Song (2016), Cong et al. (2017)), and Chen, He, and Liu (2017).

loans with a subsidized interest rate while downstream firms face a competitive interest rate and a tighter collateral constraint. Further, the discount factor of upstream firms is lower than that of downstream firms—the lenders of entrusted loans are more patient than the borrowers.

Upstream firms (net lender of entrusted loan) trade off between capital accumulation and entrusted lending. The supply of entrusted loans is linked to the real production of the lenders. When the lender of entrusted loans is hit by a low productivity shock, it reduces capital and engages more in entrusted lending. Downstream firms (net borrower of entrusted loan) make choices between bank loans and entrusted loans. While bank loans are limited by a collateral constraint, entrusted loans bear a higher interest rate. When the cost of bank financing rises, firms turn to entrusted loans as substitutes for bank loans. Thus, the demand of entrusted loan is determined by the fundamentals of downstream firms as well as the aggregate supply of bank loans.

We conduct two counterfactual exercises to understand two macro-facts observed after the 2009-2010 stimulus program: the decrease in the efficiency of capital allocation—measured by the standard deviation of the log marginal revenue product of capital (MRPK), and the divergence of leverage between state sector firms and private sector firms.

To distinguish the different channels of how the stimulus program affects the credit allocation among firms, we summarize the credit stimulus into two stages. First, there was a large-scale bank credit expansion during the stimulus year 2009. We estimate that the detrended bank credit expansion rate of the manufacturing sector was about 16%.[4] Second, the credit stimulus had been extended after 2010 as a partial financial liberalization in the sense that the financial constraint of government-connected firms has been relaxed, while

[4]Based on the calculation by Chen, He, and Liu (2017), about 4.7 trillion RMB extra new bank loan was extended to the Chinese economy in 2009, within which the local government obtained roughly 2.3 trillion of extra new bank loans, the non-residential sector (mainly manufacturing) received about 1 trillion of extra new bank loans, and the rest 1.4 trillion went to the residential sector (mainly in the form of mortgage loan). It should be noted that in the baseline model we only focus on credit allocation of the manufacturing sector. We extend the model to include the government sector in Section 5.2.

that of unconnected firms has not.[5]

In the first counterfactual exercise, we show that capital misallocation increased after the 2009 bank credit expansion, mainly through the channel of lower interest rate and also by the amplification effect of entrusted lending. To be specific, when the supply of bank loan increases, the market interest rate of bank loan decreases. Given a lower interest rate, low-productivity firms with non-binding financial constraints increase their borrowing, but high-productivity firms with relatively binding constraints borrow less. As a result, new credit has been allocated toward less productive firms, and hence the MRPK dispersion increases. This is the channel of lower interest rate and is the main cause of the rising MRPK dispersion.[6] The amplification effect of entrusted lending is induced by the entrusted loan lender's interest rate arbitrage behavior. When the bank credit becomes cheaper, the profit of interest arbitrage increases, and the lender of entrusted loan has a higher incentive to borrow and to resell the credit. Therefore, bank credit has been allocated even more toward the low-efficiency state firms which are the net lenders of entrusted loans.

On the other side, in terms of the transmission efficiency of credit stimulus, entrusted lending enlarges the impact of credit expansion on investment and output growth. The intuition is as follows. First, with the channel of entrusted lending (interest arbitrage), the lender of entrusted loan borrows more. Because of the agency friction of entrusted lending, the firm does not spend all the new borrowing on entrusted lending. The firm needs to trade off between financial investment (entrusted loans) and capital investment. As a result, the firm resells more credit and also invests more in capital. Thus, the entrusted loan lender's investment and output increases more compare to the case without entrusted lending. Second, the borrower of entrusted loan obtains additional funds through the channel

[5]The 2009-2010 stimulus program was largely financed by local government financing vehicles (LGFVs), which borrowed and spent on the behalf of local governments. However, after the official stimulus program ended in 2010, those LGFVs continued to operate, and have been increasingly used to help government-favored firms' access to credit. According to Bai, Hsieh, and Song (2016), it was a partial financial liberalization in the sense that connected firms received special assistances in obtaining cheap funds, while unconnected firms did not.

[6]A similar mechanism of a lower interest rate leads to a higher dispersion has been studied by Gopinath et al. (2017).

of entrusted lending and expands the production as well.

In the second counterfactual exercise, we quantitatively examine the impacts of the partial financial liberalization on capital allocation, by extending the simple model illustrated in Bai, Hsieh, and Song (2016).[7] We show that after a partial relaxation of the borrowing constraint of state firms, financial resources are reserved back from credit-deprived private firms to state firms. While the leverage of state firms increases, the leverage of private firms decreases due to a crowding out effect of raising the marginal cost of bank lending. We also demonstrate the sensitivity of the crowding out effect with respect to the marginal cost of bank lending. We show that with a calibrated number of the marginal cost of bank lending, the model can explain the increase of between-sector MRPK dispersion observed in the data, but cannot fully predict the leverage divergence between state firms and private firms.

Related Literature (incomplete, need to add non-china cases). This paper is related to the literature of entrusted lending in China. Allen et al. (2017) document the unique characteristics of entrusted loans: "There are two types – affiliated and non-affiliated. The latter involve a much higher interest rate than the former and official bank loan rates. Both involve firms with privileged access to cheap capital to channel funds to less privileged firms and increase when credit is tight." Chen, Ren, and Zha (2017) link the firm-level data of entrusted loans with the trustees (mainly banks) who arrange the loans. They study the role of banks in entrusted lending, and use entrusted lending as an example to illustrate banks' risk taking behaviors.

This paper also contributes the literatures of shadow banking and monetary policy in China. Chen, Ren, and Zha (2017) show that China's rising shadow banking was inextricably linked to banks' balance-sheet risk and hampered the effectiveness of monetary policy on the banking system during the period of monetary policy contractions. While Chen, Ren, and Zha (2017) focus on banks' risk-taking behaviors (purchasing the beneficiary rights of

[7]Bai, Hsieh, and Song (2016) conjecture that connected firms' borrowing could crowd out funding to unconnected firms by raising the bank's marginal cost of lending.

entrusted loans and bringing them onto the balance sheet), we study the real side of entrusted lending, i.e., the credit reallocation between the SOE sector and the POE sector. We focus on the entrusted lending prior to 2012, during which entrusted loans were mainly made among industrial firms. To distinguish our paper from Chen, Ren, and Zha (2017), we also provide empirical evidence that the banks' risk-taking behaviors emphasized in Chen, Ren, and Zha (2017) mainly happened after 2012.[8]

Wang et al. (2016) argue that the dual-track liberalization approach—introducing the market shadow bank track along side of the control bank credit track—can lead to efficiency gain through correction of credit misallocation and reduction in capital idolization. Pareto improvement can be achieved as banks and state-owned enterprises (SOEs) participate in shadow banking and share the efficiency gain. Chang et al. (2016) build a two-sector DSGE model in which SOEs are financed by government-guaranteed bank loans, which are subject to reserve requirements, while private firms rely on unregulated "off-balance sheet" financing. Under their calibration, optimal reserve requirement adjustments complement interest rate policy in maintaining macroeconomic stability and improving welfare. Liu, Wang, and Xu (2017) demonstrate that the interest-rate liberalization may reduce aggregate productivity and welfare, unless other policy reforms are also implemented to alleviate SOEs' distorted incentives or improve private firms' credit access. One important difference between this paper and these papers is that we focus on the financial linkage between firms with different financial access, and the goal of the paper is to understand the real effects of entrusted lending in allocating credit. Bleck and Liu (2017) develops a model to analyze the financial interaction between two sectors (real estate vs. others) with different degree of financial friction under credit expansion.

This paper is related to the studies of China's economic stimulus program during the period of 2009-2010. Bai, Hsieh, and Song (2016) have a comprehensive discussion of the details and the real consequences of the program. Chen, He, and Liu (2017) examine the fi-

[8]In Appendix C.

nancial consequences of the stimulus program. Huang, Pagano, and Panizza (2016) study the crowding out effect of local government debt. Cong et al. (2017) study the credit allocation under the stimulus and show that new credit was allocated disproportionately more toward state-owned firms. Deng et al. (2014) emphasize the "state-control" of the stimulus program, and argue that the efficacy of China's monetary stimulation derives from state control over its banking and corporate sectors. However, the existing studies of the stimulus program mainly focus on the empirical evidence. There is still a lack of quantitative models to study the allocation effects of the stimulus program.[9]

Motivated by previous empirical findings, we take a step forward to developing a quantitative model to investigate the allocation effects of the stimulus program. Our model prediction is consistent with empirical evidence of Cong et al. (2017) that new credit was allocated disproportionately more toward state-owned firms. But we extend their results further by showing exactly how much credit has been allocated to state-owned firms and to private firms respectively, and more importantly, how much has been *reallocated* from state firms to private firms. Our model supports Deng et al. (2014)'s emphasis that the "state-control" of the Chinese economy could potentially increase the transmission efficiency of credit stimulus. We also quantify the crowding out channel proposed in Bai, Hsieh, and Song (2016), by demonstrating the sensitivity of the crowding out effect with respect to the marginal cost of bank lending.

We build the model on the literatures of misallocation and financial frictions. Pioneered by Rogerson et al. (2004) and Hsieh and Klenow (2009), the misallocation literature have documented various sources of misallocation, such as financial frictions, capital adjustment costs, uncertainty, as well as firm-specific distortions (e.g., due to economic policies or other institutional features). But the literature have yet to identify any particular factor, for example financial friction only, that can account for the magnitudes of misallocation found

[9]There are two exceptions. Cong et al. (2017) use a qualitative model to examine the credit allocation under stimulus, and Bai, Hsieh, and Song (2016) provide a static model to illustrate how connected firms' borrowing could crowd out funding to unconnected firms by raising the bank's marginal cost of lending. In this paper, we extend their models into a quantitative framework.

in the data. Thus, this paper is not intend to explain the misallocation observed in the Chinese data, but to shed light on the role of entrusted lending in capital allocation.

2 Motivating Facts

In this section, we summarize the micro-facts of entrusted lending that the model builds on, and the macro-facts of the Chinese economy that we intend to explain using the model.

2.1 Micro-Facts of Entrusted Loans

Entrusted loan, by its name, is a type of firm-to-firm lending. In China, direct borrowing and lending between commercial enterprises are not allowed. All entrusted loans require a trustee, a qualified financial institution acting as an intermediate to facilitate the loan transaction. However, different from bank loans, the trustee does not determine who to lend to or on what terms the loan is made. The trustee only earns a commission for its service, and it does not bear the risk of the loan.[10]

Entrusted loan is also different from another type of firm-to-firm lending: trade credit. First, entrusted loans are officially included in total social financing. That is, entrusted lending is one of the monetary policy targets and it matters for the macroeconomy more directly than trade credit. Second, entrusted loans are not tied to specific transactions of goods. Two firms without any real business connection can make an entrusted loan arrangement. Third, the average maturity of entrusted loans, 1.5 years, is much longer than that of trade credit, 30 days. Overall, entrusted loans are closer substitutes for bank loans than trade credit.

The People's Bank of China (PBOC) has allowed entrusted loans since 2001, and the

[10]There might be exceptions in practice and they are in the regulatory grey area. For example, some commercial banks have purchased the beneficiary rights of entrusted loans and brought them onto their balance sheet. See Chen, Ren, and Zha (2017) for a detailed discuss of how liquidity constrained banks brought shadow banking products onto the balance sheet. However, as shown in Appendix C, those banks' risk-taking behaviors happened after 2012. This paper mainly considers the entrusted lending prior to 2012.

aggregate data of entrusted loans is available since 2002. We plot the time series of entrusted loans in Figure 1. Entrusted loans, as a fraction of total social financing, first increased in 2004 when the central bank removed the lending rate ceiling, then kept relatively stable until 2009. Entrusted lending increased dramatically since 2009, and cooled down after 2015 due to the new regulations on entrusted loans.

The firm-level data of entrusted loans is still limited, however. In the literature, researchers manually collect the firm-level data by reading firms' annual reports and the announcements of issuing entrusted loans. By the regulations of China Securities Regulatory Commission (CSRC), listed companies are required to make disclosure in annual reports about entrusted loans they received or provided. However, it should be noticed that this firm-level data mainly contains entrusted loans provided by the publicly listed companies, while the aggregate data of entrusted loans published by the central bank includes all the legally registered entrusted loans.

Based on the empirical studies of Allen et al. (2017), Chen, Ren, and Zha (2017), and Ruan (2017), we list the key characteristics of entrusted loans that will be featured in the model.

1. There are two types of entrusted loans: affiliated vs. non-affiliated. Most affiliated loans are made by a parent firm to a subsidiary, and some are between a customer and a supplier or between partners of joint ventures. Non-affiliated loans have higher interest rate than affiliated loans, and require more collateral/guarantee.

2. The lenders of entrusted loans are more likely (80%) state-owned firms with privileged access to cheap credit, while the borrowers are private firms with limited access to credit.

2.2 Macro-Facts of the Chinese Economy

We briefly describe the background of China's four-trillion stimulus program in 2009-2010, and then summarize the facts we intend to explain using the model. Most discussions of the stimulus program in this section are drawn from the previous studies of Bai, Hsieh, and Song (2016), Chen, He, and Liu (2017), and Cong et al. (2017).

In response to the global recession, in November 2008 the Chinese government announced a four trillion RMB fiscal stimulus program to be implemented by 2010. The program was largely financed through the local government financing vehicles (LGFVs), and the main sources of funds came from banks. Meanwhile, in parallel to the fiscal package, the government encouraged an increase in credit supply to the real economy by banks. The central bank took two measures. First, in the last quarter of 2008, the PBOC lowered commercial banks' reserve requirement ratio from 17.5% to 13.5% for medium-sized and small banks, and from 17.5% to 15.5% for large banks. Second, the PBOC reduced the prime lending rate from 7.47% to 5.31%.

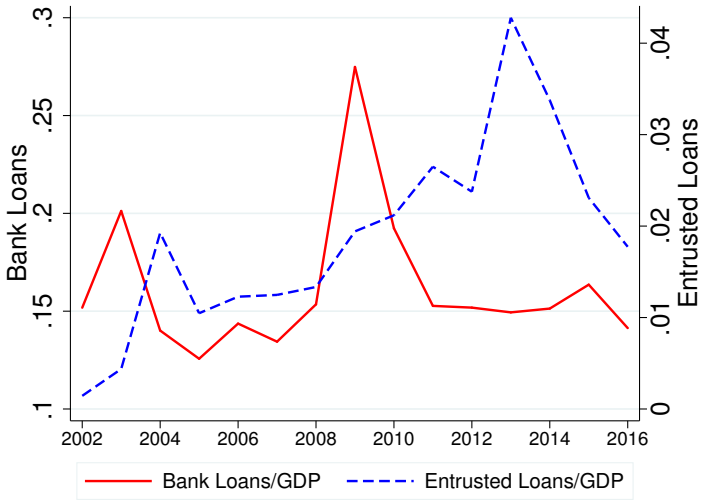

Figure 2: **Bank Loans vs. Entrusted loans**

Bank Credit Expansion Figure 2 plots the annual new bank loans scaled by GDP. According to the estimate by Chen, He, and Liu (2017), a total of 4.7 trillion RMB *extra* new

bank loan was extended to the Chinese economy in 2009. The total abnormal new bank loan (4.7 trillion) is the difference between the actual 2009 new bank loan (9.6 trillion) and the estimated 2009 normal new bank loan (4.9 trillion, based on the average bank loan/GDP ratio in 2004 to 2008). Given the total outstanding of bank loans was 30 trillion at the end of 2008, the actual expansion rate of bank loans in 2009 was about 32%, and the abnormal (detrended) expansion rate of bank loans was about 16%. However, this is the aggregate credit expansion to the whole economy. Our paper focuses on the industrial firms. Thus, we next turn to estimate the abnormal growth rate of bank loans of the manufacturing sector.

Using individual loan data from the China Banking Regulatory Commission, Gao, Ru, and Tang (2017) show that the new loans to manufacturing sector increased from around 4.3 trillion in 2008 to 6.2 trillion in 2009. Given the outstanding bank loan of manufacturing sector was 7.9 trillion in 2010, the expansion rate of bank loans to manufacturing sector was close to 32%, if assuming the annual growth rate of outstanding loan is 15%.[11] Since we do not have a complete time series of new loans issued to the manufacturing sector, we cannot calculate the detrended expansion rate directly. As a result, we will use the abnormal expansion rate of total bank loans to the whole economy (16%) as a proxy for the detrended expansion rate of the manufacturing sector. As a robust check, if we use the estimate of Chen, He, and Liu (2017) that extra new bank loans received by the non-residential sector (mainly manufacturing) was about 1 trillion RMB, the detrended growth rate of bank loans of the manufacturing sector was also about 16%.

Partial Financial Liberalization Although there was a large bank credit expansion to the industries firms during the stimulus period 2009-2010, the allocation of credit was significantly biased to state-owned firms. Cong et al. (2017)) provide empirical evidence that state-owned firms, which display lower marginal product of capital at the outset of the program, experienced larger increase in firm borrowing than private firms during the stimulus years.

[11]The PBOC published loan data by industry only after 2010. We estimate the loan outstanding of 2008 using the number in 2010, by assuming that the annual growth rate of outstanding loans of the manufacturing sector equals the growth rate of the total outstanding loans of the whole economy.

Further, the disproportionate allocation of credit has continued after the end of the stimulus program in 2010. On the one hand, after the massive economic stimulus, in anticipation of inflation and an overheated real estate market, the People's Bank of China began to tighten money supply and bank loans in the second half of 2010. Commercial banks were prohibited from expanding loans to risky industries such as real estate and mining. The tightening of bank lending placed enormous financial pressure on firms in risky industries, thus spurring the strong demand for external financing which has been an important driving force behind the rapid growth of shadow banking.[12]

On the other side, the LGFVs continued to operate since the end of the stimulus program in 2010. The central government has made several attempts to limit local governments' ability to obtain new funds via LGFVs, but with little success.[13] With the powerful tool of the LGFVs, local governments have used their new access to financial resources to facilitate favored firms' access to capital. Connected firms received local governments' special assistances in obtaining cheap funds and in avoiding the central bank's lending regulations, while unconnected firms did not. In the terminology of Bai, Hsieh, and Song (2016), it was a partial financial liberalization, in the sense that the financial constraint of connected firms has been relaxed, but the constraint of unconnected firms did not change or even became tighter.

The Real Effects To look at the impacts of the partial financial liberalization on firm financing, in Figure 3, we plot the leverage of state-owned firms and private firms, respectively. In calculating leverage, we use the aggregate data of industrial firms from the National Bureau of Statistics (NBS), since the data of year 2009 and 2010 are missing at the firm-level. The ownership classification of firms is also obtained from the NBS. One striking finding from

[12]Chen, He, and Liu (2017) argue that it is the four-trillion-yuan stimulus package fueled by bank loans that has led to the rapid growth of shadow banking activities in China. The local governments in China financed the stimulus plan mainly through bank loans in 2009, and resorted to non-bank debt financing after 2012 given the mounting rollover pressure from bank debt coming due. However, entrusted lending is not the main refinancing tool for local governments.

[13]Bai, Hsieh, and Song (2016) describe how local governments found new ways to skirt the regulations.

Figure 3 is the divergence of leverage between SOEs and POEs after 2008. The leverage of SOE sector increased dramatically after 2008, while the leverage of POE sector declined. The average leverage of SOE (POE) sector was 0.56 (0.59) during the period 2005-2008, and 0.61 (0.54) during the period 2009-2015.

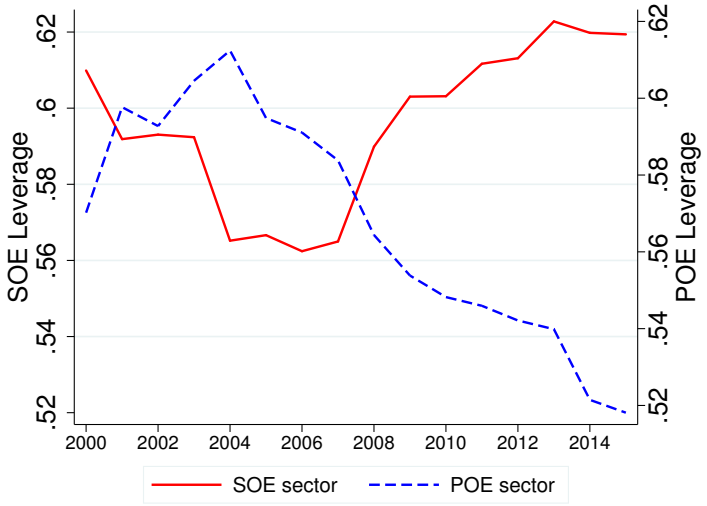

Figure 3: **The Divergence of Firm Leverage**

To examine the impacts of credit policies on capital allocation, we calculate the MRPK dispersion using a balanced panel of Chinese industrial firms from 2005 to 2013.[14] Table 1 reports the results. The average standard deviation of $\log(MRPK)$ was 0.87 during sample period of 2005-2008, and 0.94 during sample period of 2011-2013. That is, the MRPK dispersion increased by 0.07 standard deviations after the 2009-2010 stimulus program. The between-sector (SOE vs. POE) dispersion increased by 0.014 standard deviations.

To sum up, the macro-facts we intend to target/explain are:

1. There was a 16% detrended bank credit expansion for industrial firms in 2009, and the new credit had been disproportionately allocated to state sector firms.

2. The 2009 credit expansion was followed up by a credit tightening of risky industries since 2010. However, the LFGVs continued to facilitate favored firms' access for cheap

[14]The year of 2009 and 2010 is missing in the data. Bai, Hsieh, and Song (2016) use the same dataset and find a similar pattern of the MRPK dispersion.

Table 1: **The Rising of MRPK Dispersion**

	2005	2006	2007	2008	2011	2012	2013
sd(log($MRPK_{all}$))	0.89	0.86	0.87	0.86	0.91	0.94	0.97
sd(log($MRPK_{btw}$))	0.21	0.20	0.20	0.20	0.21	0.21	0.23

credit.

3. After the massive policy interventions, the leverage of SOE sector increased while that of POE sector decreased, and the MRPK dispersion of industrial firms increased by 0.07 standard deviations.

In this paper, we first develop a quantitate model of entrusted lending based on the micro-facts. Then, using the structural model, we conduct counterfactual exercises to explain the macro-facts.

3 The Model

In this section, we describe the model and define the equilibrium of entrusted lending. In the model, there are two types of firms: firms in upstream and firms in downstream.[15] Firms in upstream sector use capital and labor to produce intermediate goods. Firms in downstream sector purchase intermediate goods, and use intermediate goods along with capital and labor to produce final goods. The reason of adapting this vertical production structure is motivated by the data fact that many entrusted loans are made between a supplier and a customer. The model described in this section is general enough to include two types of entrusted loans documented in the literature.[16] However, it should be noted that this production connection

[15]Li, Liu, and Wang (2015) study a vertical structure featured in China's economy: SOEs monopolize key upstream industries, whereas downstream industries are largely open to private firms. While their paper focuses on the industry structure, this paper examines the financial linkage.

[16]Another common type of entrusted loan is made by a parent firm to a subsidiary. The parent firm usually sets up a finance company to raise funds as a corporate group and then to allocate the funds among

is not necessary to generate entrusted loans. In the quantitative analysis, we consider the case in which there is no production connection between lenders and borrowers of entrusted loans.

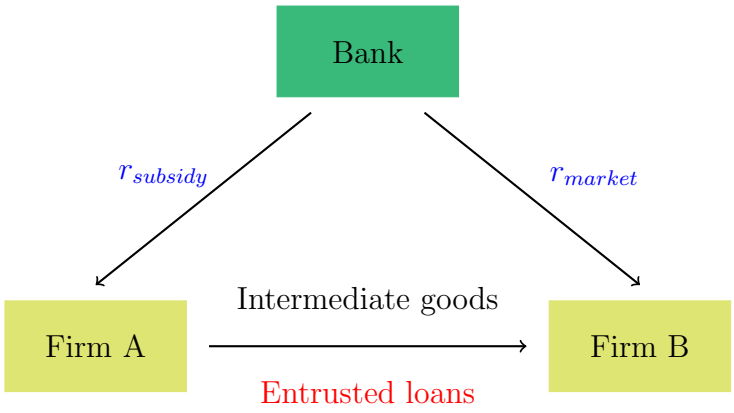

Figure 4: **The structure of the economy**

On the side of financing, upstream firms have privileged access to bank loans with a subsidized interest rate, while downstream firms face a market interest rate. Motivated by the fact that POEs are more productive than SOEs, we assume that the downstream firms have higher productivity than the upstream firms. As will be shown later, there exists a wedge of the shadow cost of funds between the upstream and downstream firms. In equilibrium, the upstream firms would resell credit to downstream firms in the form of entrusted loans. Figure 4 illustrates the structure of the economy. To simplify the notation, we will label upstream firms as Firm A (firms in Sector A) and downstream firms as Firm B (firms in Sector B). Also, state-owned firms refer to Firm A, and private firms refer to Firm B.

3.1 Firm A

There is a γ measure of upstream firms (Firm A) in each period t. In this model we do not consider firm exit and entry. Thus, γ is constant. The technology with which firm i in the

subsidiaries. As will become clear later, this is a special case of the model described in the paper, in which the parent firm does not have real production (only makes financial investments) and the subsidiary firm does not have access to bank loans (only borrows through entrusted loans). Our baseline model does not capture the third type of entrusted loan which is made between partners of joint ventures, a horizontal production structure. In Appendix A.2, we extend the model to study the horizontal case.

upstream sector operate is

$$y_{it} = z_{it}(K_{it}^{1-\alpha} L_{it}^{\alpha})^{\eta}, \tag{1}$$

where y_{it} denotes the amount of intermediate goods produced by firm i, z_{it} represents the idiosyncratic productivity shock faced by the firm, K_{it} represents capital, and L_{it} represents labor. The variable α is the labor share, and the variable $\eta < 1$ is the degree of returns to scale. To simplify the model, we assume that intermediate goods are perfectly substitutable.[17] Thus, there is only one intermediate goods market needed to be cleared. Let p_t denote the price of intermediate goods, then the total revenue of the firm i is $R_{it} = p_t y_{it}$.

Firm A has access to bank credit with a subsidized interest rate $r_{st} = (1-\tau)r_{mt}$, where r_{mt} is the market interest rate, and τ is the subsidy rate which captures direct interest subsidies and implicit guarantees from the government. To limit the borrowing of Firm A, banks impose a collateral constraint

$$B_{it+1} \leq \theta_1 K_{it+1}, \tag{2}$$

where B_{it+1} is the amount of bank loans and θ_1 is the collateral rate. The capital K_{it+1} serves as collateral. The economic interpretation of θ_1 is not just the fraction of capital that can be collateralized, but also reflects the credit rationing from the banks. One key assumption of the paper is that the collateral rate of SOEs is larger than that of POEs. That is, SOEs have better access to bank loans than POEs.

On the side of asset accumulation, Firm A has two choices. Firm A can accumulate physical capital according to the law of motion:

$$I_{it} = K_{it+1} - (1-\delta)K_{it}, \tag{3}$$

where I_{it} is the investment, and δ is the depreciation rate of capital. Firm A can also engage in providing entrusted loans F_t to downstream firms and record them as financial assets

[17] In Appendix A.1, we consider the case of monopolistic competition. As in Midrigan and Xu (2014), the problem of Firm A with decreasing returns to scale and perfectly substitutable inputs is equivalent to that arising in a monopolistic competition model with constant markups and differentiated inputs.

on its balance sheet. In equilibrium, entrusted loans earn an interest rate of r_{ft}. Table 2 demonstrates the balance sheet of Firm A.

Table 2: **The balance sheet of Firm A**

Assets	Liabilities
Physical capital K_{it}	Bank loans B_{it}
Financial assets F_{it}	Net worth $A_{it} = K_{it} + F_{it} - B_{it}$

The objective of the firm is to maximize the discounted future dividend payouts. Given the subsidized interest rate of bank loans r_{st}, the interest rate of entrusted loans r_{ft}, and the price of intermediate goods p_t, Firm A makes individual decisions after observing the state variables K_{it}, F_{it}, B_{it}, and the productivity shock z_{it}. Denote $V(K_{it}, F_{it}, B_{it}; z_{it})$ the value of the firm at time t, and denote β_1 the discount factor of the owner of the firm, the value function of Firm A can be written recursively as:

$$
\begin{aligned}
V(K_{it}, F_{it}, B_{it}; z_{it}) &= \max_{K_{it+1}, F_{it+1}, B_{it+1}:} \left\{ D_{it} + \beta_1 \mathbb{E}\big[V(K_{it+1}, F_{it+1}, B_{it+1}; z_{it+1})\big] \right\} \\
&\text{subject to:} \\
\varphi(D_{it}) + I_{it} + F_{it+1} - (1 + r_{ft})F_{it} &= p_t y_{it} - w_t L_{it} + B_{it+1} - (1 + r_{st})B_{it} - \chi(F_{it}) - \phi(K_{it}) \quad (4) \\
y_{it} &= z_{it}(K_{it}^{1-\alpha} L_{it}^{\alpha})^{\eta} \quad (5) \\
I_{it} &= K_{it+1} - (1 - \delta)K_{it} \quad (6) \\
B_{it+1} &\leq \theta_1 K_{it+1}. \quad (7)
\end{aligned}
$$

The variable D_{it} is the dividend payout. The firm can issue equity if $D_{it} < 0$, but it is costly to do so. The function $\varphi(D_{it})$ captures the equity financing cost. The variable w_{it} denote the wages. In the data, entrusted loans could have agency problems. For example, some SOEs might provide entrusted loans to related parties which involves asset tunneling. In this paper, we do not model this agency cost of entrusted loans in a structural way, but

in a reduced form using the cost function $\chi(F_{it})$.[18] [19] Finally, accumulating capital is also costly, which is captured by the function $\phi(K_{it})$. All the functional forms will be specified in Section 4.

To reduce the number of state variables, as in Buera, Kaboski, and Shin (2011) and Midrigan and Xu (2014), we assume that the firm chooses physical capital K_{it} and financial assets F_{it} after the realization of the shock z_{it}. Define $A_{it} = K_{it} + F_{it} - B_{it}$ as the net worth of the firm, under the new assumption of timing, we only need to track A_{it} as a new state variable. The modified firm's problem can be divided into two stages. First, at the beginning of period t, given the predetermined level of net worth A_{it} and the observed level of productivity z_{it}, the firm chooses capital K_{it}, labor L_{it}, and entrusted loans F_{it} to maximize its profit Π_{it}. This is equivalent to the static allocation problem in Hsieh and Klenow (2009), except the firm has an additional choice of entrusted loans. Second, after maximizing the profit, the firm then makes payout and saving decisions. It pays out D_{it} and saves A_{it+1} for the next period.

We rewrite the value function as:

$$\begin{aligned} V(A_{it}; z_{it}) &= \max : \left\{ D_{it} + \beta_1 \mathbb{E}[V(A_{it+1}; z_{it+1})] \right\} \\ &\text{subject to:} \\ \varphi(D_{it}) + A_{it+1} &= \Pi_{it}(A_{it}; z_{it}) + (1 + r_{st}) A_{it}, \end{aligned} \tag{8}$$

[18] All entrusted loans are legally required to have a trustee, usually a bank, to administer and service the loan. The trustee earns a fee for managing the loan, but does not bear the risk of the loan. A simple way to model the role of trustee is to introduce a haircut of the entrusted loan, which is similar to the reduced-form agency cost in the model. However, given the dataset we have, it is difficult to separate the agency cost and the premium charged by the trustee. Thus, we abstract the trustee from the model. See Chen, Ren, and Zha (2017) for studying the role of banks in intermediating entrusted loans.

[19] Also, the model does not distinguish agency costs from potential default costs of entrusted loans. The cost function $\chi(F_{it})$ captures all the costs associated with entrusted loans.

where the profit function $\Pi_{it}(A_{it}; z_{it})$ is derived from the following problem:

$$\Pi_{it}(A_{it}; z_{it}) = \max : \left\{ p_t y_{it} - w_t L_{it} - (r_{st} + \delta) K_{it} + (r_{ft} - r_{st}) F_{it} - \chi(F_{it}) - \phi(K_{it}) \right\}$$

subject to:

$$K_{it} \leq \frac{A_{it} - F_{it}}{1 - \theta_1}. \tag{9}$$

In the above equations, we substitute B_{it} using the definition of net worth $A_{it} = K_{it} + F_{it} - B_{it}$, and substitute I_{it} using $I_{it} = K_{it+1} - (1 - \delta) K_{it}$.

Denote μ_{it} the Lagrangian multiplier of the borrowing constraint (9), the first order conditions of the firm's problem are

$$\frac{1}{\varphi'(D_{it})} = \beta_1 \mathbb{E}\left[\frac{1}{\varphi'(D_{it+1})} \left(1 + r_{st+1} + \frac{\mu_{it+1}}{1 - \theta_1} \right) \right] \tag{10}$$

$$r_{ft} = r_{st} + \frac{\mu_{it}}{1 - \theta_1} + \chi'(F_{it}) \tag{11}$$

$$\frac{\partial p_t y_{it}}{\partial K_{it}} = r_{st} + \delta + \mu_{it} + \phi'(K_{it}) \tag{12}$$

$$\frac{\partial p_t y_{it}}{\partial L_{it}} = w_t. \tag{13}$$

Equation (10) characterizes the firm's decision of net worth accumulation. Equation (11) characterizes the supply of entrusted loans. Equation (12) and (13) summarizes the choice of capital and labor, respectively. Notice that the borrowing constraint (9) is occasionally binding and a binding constraint in the future affects the current capital allocation.

3.2 Firm B

The downstream sector contains one (normalized) measure of Firm B. The production function of Firm B is specified as

$$y_{jt} = z_{jt} \left((K_{jt}^{1-\alpha} L_{jt}^{\alpha})^{1-\epsilon} (M_{jt})^{\epsilon} \right)^{\eta}, \tag{14}$$

where M_{jt} denotes the intermediate inputs, and ϵ denotes the share of intermediate inputs.

Firm B can borrow from banks, but with limited access. Rather than facing a subsidized interest rate, Firm B faces a competitive interest rate of bank loans. Also, the collateral rate of Firm B is smaller than that of Firm A, that is, $\theta_2 < \theta_1$. Beside bank loans, Firm B can also borrow through entrusted loans. The borrowing constraint of entrusted loans is

$$F_{jt} \leq \zeta K_{jt} + \psi M_{jt}, \tag{15}$$

in which intermediate goods can serve as collateral in entrusted lending. The variable ζ is the collateral rate of capital, and ψ is the collateral rate of intermediate goods. For the model without intermediate goods $\psi = 0$.

Table 3: **The balance sheet of Firm B**

Assets	Liabilities
Physical capital K_{jt}	Bank loans B_{jt}
	Entrusted loans F_{jt}
	Net worth $A_{jt} = K_{jt} - B_{jt} - F_{jt}$

Table 3 shows the balance sheet of Firm B. The timing of Firm B's decisions is the same as that of Firm A. After the realization of the productivity shock z_{jt}, given the prices, the firm first chooses capital, labor, intermediate goods, and entrusted loans to maximize its profits. Then, it makes dividend and saving decisions. The value function of Firm B can be written as:

$$\begin{aligned} V(A_{jt}; z_{jt}) &= \max : \left\{ D_{jt} + \beta_2 \mathbb{E}[V(A_{jt+1}; z_{jt+1})] \right\} \\ &\text{subject to:} \\ \varphi(D_{jt}) + A_{jt+1} &= \Pi_{jt}(A_{jt}; z_{jt}) + (1 + r_{ft}) A_{jt}, \end{aligned} \tag{16}$$

and the profit function of Firm B is:

$$\Pi_{jt}(A_{jt}; z_{jt}) = \tag{17}$$
$$\max : \left\{ y_{jt} - w_t L_{jt} - p_t M_{jt} - (r_{ft} + \delta) K_{jt} + (r_{ft} - r_{mt}) B_{jt} - \phi(K_{jt}) \right\}$$

subject to:

$$K_{jt} \leq \frac{A_{jt} + F_{jt}}{1 - \theta_2} \tag{18}$$
$$F_{jt} \leq \zeta K_{jt} + \psi M_{jt}. \tag{19}$$

In the problem of Firm B, the price of final goods is normalized to one. Equation (18) is borrowing constraint of bank loans, and Equation (19) is the borrowing constraint of entrusted loans.

The first order conditions are:

$$\frac{1}{\varphi'(D_{jt})} = \beta_2 \mathbb{E}\left[\frac{1}{\varphi'(D_{jt+1})} \left(1 + r_{mt+1} + \frac{\mu_{jt+1}}{1 - \theta_2} \right) \right] \tag{20}$$
$$r_{ft} = r_{mt} + \frac{\mu_{jt}}{1 - \theta_2} - \xi_{jt} \tag{21}$$
$$\frac{\partial y_{jt}}{\partial K_{jt}} = r_{mt} + \delta + \mu_{jt} - \zeta \xi_{jt} + \phi'(K_{jt}) \tag{22}$$
$$\frac{\partial y_{jt}}{\partial L_{jt}} = w_t \tag{23}$$
$$\frac{\partial y_{jt}}{\partial M_{jt}} = (1 - \psi \xi_{jt}) p_t \tag{24}$$

where μ_{jt+1} is the Lagrangian multiplier of the constraint (18), and ξ_{jt} is the Lagrangian multiplier of the constraint (19). Equation (20) characterizes Firm B's decision of net worth accumulation. Equation (21) characterizes the demand of entrusted loans. Equation (22), (23), (24) summarize the choice of capital, labor, and intermediate goods, respectively. Since intermediate goods can be used as collateral in entrusted lending, a binding constraint of entrusted loans in the future increases the current demand of intermediate goods.

3.3 Equilibrium

There are four markets in the model: the market of bank loans, entrusted loans, labor, and intermediate goods. The market clearing conditions are:

$$\gamma \int B_{it}(r_{st}) + \int B_{jt}(r_{mt}) = \bar{B}_t \tag{25}$$

$$\gamma \int L_{it}(w_t) + \int L_{jt}(w_t) = \bar{L}_t \tag{26}$$

$$\gamma \int y_{it}(p_t) = \int M_{jt}(p_t) \tag{27}$$

$$\gamma \int F_{it}(r_{ft}) = \int F_{jt}(r_{ft}). \tag{28}$$

where $\gamma \int B_{it}(r_{st})$ is the demand of bank loan from upstream firms, and $\int B_{jt}(r_{mt})$ is the demand from downstream firms. The variable $\bar{B}_t$ is the supply of bank loans. Similarly, $\gamma \int L_{it}(w_t)$ and $\int L_{jt}(w_t)$ are the demand of labor, and $\bar{L}_t$ is the supply of labor. The supply of intermediate goods is $\gamma \int y_{it}(p_t)$ and the demand of intermediate goods is $\int M_{jt}(p_t)$. The net supply of entrusted loans from upstream firms is $\gamma \int F_{it}(r_{ft})$ and the net demand of entrusted loans from downstream firms is $\int F_{jt}(r_{ft})$. From the market clearing conditions, we can solve the equilibrium interest rate r_{mt} and r_{ft}, wage rate w_t, and price of intermediate goods p_t.

Now, we can define the equilibrium. A *stationary equilibrium* consists of allocations for Firm A, $K_{it}(z_{it}, A_{it})$, $B_{it}(z_{it}, A_{it})$, $F_{it}(z_{it}, A_{it})$, $L_{it}(z_{it}, A_{it})$, $D_{it}(z_{it}, A_{it})$, and $A_{it+1}(z_{it}, A_{it})$, and for Firm B, $K_{jt}(z_{jt}, A_{jt})$, $B_{jt}(z_{jt}, A_{jt})$, $F_{jt}(z_{jt}, A_{jt})$, $L_{jt}(z_{jt}, A_{jt})$, $M_{jt}(z_{jt}, A_{jt})$, $D_{jt}(z_{jt}, A_{jt})$, and $A_{jt+1}(z_{jt}, A_{jt})$, a joint distribution $G_i(z_{it}, A_{it})$ for Firm A and $G_j(z_{jt}, A_{jt})$ for Firm B, and a set of prices r_{mt}, r_{ft}, w_t, p_t, that satisfy (i) taking as given prices, the policy functions solve the optimization problem of Firm A and B, (ii) the market clearing conditions, (iii) the firm distribution remains constant through time.

4 Quantitative Analysis

We parameterize the model to match the salient features of the Chinese economy that low-productivity state-owned firms have privileged access to cheap credit and high-productivity private firms have limited access to credit. We calibrate the parameters of Firm A to match the data moments of state-owned firms and calibrate the parameters of Firm B to match the moments of private firms. We do not calibrate all the parameters separately for Firm A and Firm B. Instead, we use the same set of parameters for each type of firm, except the parameters that are crucial to identify the different features of firms. The parameters that are separately calibrated are: the level of productivity, the collateral rate, and the discount factor.

We utilize two dataset: the firm-level data from China's Annual Survey of Industry conducted by the National Bureau of Statistics (NBS data) and the aggregate credit data from People's Bank of China (PBOC data). The NBS data contains the balance sheet information of all industrial firms in China that are identified as state-owned or as non-state firms with sales revenue above RMB 5 million. We use the following firm-level variables: sales, total assets, total liabilities, capital, employment, wage, intermediate inputs, ownership structure, and the following aggregate variables: the aggregate amount of entrusted loans and bank loans, and the interest rate of those two loans.

To highlight the key mechanism of the model, we first calibrate a model without intermediate goods and with a fixed supply of bank loans. We label it as benchmark model. Then, in the model extensions, we add additional elements of the model one by one back into the benchmark model and examine their impacts on the model implications.

We classify parameters to two categories. The first category includes preference and technology parameters that are difficult to identify with the dataset we use. The second category includes the key parameters that determine the allocation of credit and firm dynamics. Table 4 lists the preset parameters, and Table 5 lists the calibrated parameters and moments.

Table 4: **Preset Parameters**

Capital depreciation rate, δ	0.1
Decreasing returns to scale, η	0.8
Labor share, α	0.5
Persistence of productivity shock, ρ_z	0.7
Volatility of productivity shock, σ_z	0.4
The subsidy rate, τ	0.25
The discount factor of Firm A, β_1	0.9
The discount factor of Firm B, β_2	0.8

Table 5: **Benchmark Calibration**

Parameters		
Productivity, $\bar{z}_2/\bar{z}_1$		1.5
The size measure, γ		1.35
The total supply of bank loans, $\bar{B}$		15.5
Collateral rate (bank loans of Firm A), θ_1		0.85
Collateral rate (bank loans of Firm B), θ_2		0.52
Collateral rate (entrusted loans), ζ		0.29
Agency cost of entrusted loans, ν		0.007
Equity financing cost, κ		0.005
Capital adjustment cost, ϕ		0.01
Target Moments (before 2008)	Data	Model
$\text{MRPK}_{poe}/\text{MRPK}_{soe}$	1.5	1.52
SOE share of revenue	0.32	0.32
Prime lending rate	0.04	0.04
Leverage (SOE)	0.55	0.55
Leverage (POE)	0.57	0.57
Entrusted loans/bank loans	0.15	0.15
Interest rate of entrusted loans	0.12	0.12
Financial assets ratio	0.20	0.22
Std of leverage	0.27	0.25

*The benchmark model excludes intermediate goods.

Preset Parameters The period is one year. The capital depreciate rate $\delta = 0.1$ and the span of control parameter $\eta = 0.8$. We set the labor share $\alpha = 0.5$ as in the literature (e.g., Bai, Hsieh, and Qian (2006)). In the model, Firm A is more patient than Firm B. The discount factor of Firm A is set to 0.9, and that of Firm B is set to 0.8. Bai, Hsieh, and

Qian (2006) find a high and fairly stable aggregate rate of return to capital in China over the period 1978-2004, ranging from 20 to 25 percent in most years. Tang, Xu, and Zhang (2017) show that the rate of return roses during the period 2004-2010. As in Song and Wu (2014), we impose a conservative value of the rate of return, which implies a discount factor of 0.8 for private firms (Firm B), and 0.9 for state firms (Firm A).[20] We set the persistence of productivity shock $\rho_z = 0.7$, and the volatility of the shock $\sigma_z = 0.4$. The benchmark interest subsidy rate for Firm A is set to 0.25. We also conduct sensitivity tests for those preset parameters.

Calibrated Parameters We normalize the mean of Firm A's productivity $\bar{z}_1 = 1$, and calibrate the mean of Firm B's productivity $\bar{z}_2 = 1.5$ such that the MRPK of Firm A is 50% less than that of Firm B. Bai, Hsieh, and Song (2016) estimate the value of MRPK for state and non-state firms and find that state firms' MRPK is 50% less than that of private firms. The size measure γ is calibrated such that the capital share of Firm A in the model equal the revenue share of SOEs in the data.[21]

We calibrate the total supply of bank loans such that in equilibrium the interest rate of SOEs is 1.25 times the prime lending rate 0.04.[22] The three collateral parameters, the collateral rate of bank loans, θ_1, θ_2, and the collateral rate of entrusted loans, ζ, are jointly calibrated to match the financial leverage of SOEs and POEs, and the aggregate ratio of

[20]Liu and Siu (2011) assess the impact of institutions on Chinese firms' corporate investment in an investment Euler equation framework, and shows that the model derived discount rate for a non-state firm is approximately 10 percentage points higher than that of an otherwise equal state firm. Notice that the discount factor difference in our model is large than 10%. The main reason is that we directly calibrate the discount factor to the firm's financial positions. The large difference is driven by the financing wedge between SOEs and POEs. All results in this paper are robust by using a different set of discount factor. For example, $\beta_1 = 0.9$ and $\beta_2 = 0.85$. See Table 13 in Appendix B.

[21]This calibration implies that the average firm size of Sector A is smaller than that of Sector B. This is because both sectors have an infinite number of firms, and the relative firm size in each sector is mainly determined by the productivity. If we assume that the firm number of Sector A is finite, the average firm size of Sector A can be bigger. However, in that case, there will exist strategic interactions between firms in Sector A, which is out of the scope of this paper.

[22]The nominal benchmark lending rate of one-year loan was 7.47% at the end of 2007, and 5.31% at the end of 2008, 5.8% at the end of 2010, and 6% at the end of 2012. We deflate the nominal interest rate using the average CPI (3.41%) during the period of 2007-2013. Thus, the real benchmark lending rate was range from 4% to 1.9%. We choose 4% (before the credit expansion) as the prime lending rate in the model.

entrusted loans to bank loans.

The agency cost function is specified as $\chi(F_{it}) = \frac{1}{2}\nu F_{it}^2$, where the parameter ν measures the size of agency frictions in providing entrusted loans. We calibrate ν to match the interest rate of entrusted loans. The supply equation of entrusted loans (11) implies that the interest rate of entrusted loans is increasing in the size of agency cost parameter ν.

The equity financing cost function is $\varphi(D_t) = D_t + \frac{1}{2}\kappa D_t^2$. The variable κ measures the rigidity of adjusting equity. We calibrate the parameter κ to match the financial assets ratio of an average firm. The higher the parameter κ, the stronger precautionary motive of holding financial assets.[23]

The capital adjustment cost function is $\phi(K_{it}) = \frac{1}{2}\psi K_{it}^2$. In the model, the firm's choice of capital is static and it is jointly made with the choice of debt. Thus, this capital adjustment cost should be interpreted broadly as the cost of adjusting the firm's balance sheet. We calibrate the capital adjustment cost parameter such that the volatility of financial leverage in the model equals the one observed in the data. A higher level of capital adjustment cost prevents the firm from adjusting capital and debt frequently, and this leads to a lower volatility of the balance sheet adjustment, i.e., a lower volatility of leverage.

4.1 Model Evaluation

In this section, we confront the model with more data moments that are not targeted in the calibration. We calculate the SOE share of output and debt using the NBS aggregate data, and other firm-level moments using a balanced sample of industrial firms during the period of 2005 to 2013. When calculating the firm-level moments, we pool the SOE firms and POE firms together. Table **??** summarizes the statistics. (to be added)

[23]Financial assets in the data is defined as liquid assets minus inventory. In the current calibration, we include account receivables in the financial assets, and account payables in the total liabilities. In an alternative way, we can subtract trade credit, and redefine the ratio of financial assets and financial leverage.

4.2 Aggregate Implications

We next discuss the effects of entrusted lending on the aggregate capital allocation. First, we consider the allocation of the benchmark model. Then, we eliminate the entrusted lending in the benchmark model, and re-examine the credit allocation. We consider both within-sector allocation and between-sector allocation.

We use the MRPK dispersion, i.e., the standard deviation of $\log(MRPK)$, to measure capital misallocation. In the model calibration, we do not target the level of the MRPK dispersion in the data. Our model includes financial friction and capital adjustment cost, but other idiosyncratic distortions, such as taxes, labor market regulations, are not considered. The goal of the paper is not to explain the level of dispersion observed in the data, but to examine the impacts of entrusted lending on the capital allocation.[24]

The Role of Entrusted Lending To study the roles of entrusted loans in credit allocation, we consider a model without entrusted loans. Based on the benchmark model, we remove entrusted loans as a choice for both Firm A and Firm B. That is, Firm A cannot provide entrusted loans and Firm B cannot borrow through entrusted loans. We simulate the new model under the same parameters of the benchmark model. In Table 6, we show the within-sector dispersion as well as the between-sector dispersion, for the model with and without entrusted loans.

Entrusted loans improve the capital allocation significantly. Without entrusted loans, the overall MRPK dispersion increases from 0.379 to 0.438 by 16%. Also, the leverage of both firms decreases dramatically. On the one hand, as savings of financial assets, entrusted loans help the lender to diversify its asset allocation. Without entrusted loans, the lender loses a financial instrument of maintaining a profitable portfolio, and thus reduces borrowing from banks and invests less. On the other hand, as sources of funds, entrusted loans relax the borrowers' financing constraint, and thus without entrusted loans the borrowers faces a

[24]Gopinath et al. (2017) adopt a similar strategy of calibrating the model. The standard deviation of $\log(MRPK)$ in the their baseline model (0.26) is lower than in the data (0.88).

Table 6: **The Role of Entrusted Lending**

	Benchmark	Without Entrusted Loans	Percent Change
mean($MRPK_1$)	0.232	0.230	-1%
mean($MRPK_2$)	0.353	0.371	+5%
sd(log($MRPK_1$))	0.282	0.313	+11%
sd(log($MRPK_2$))	0.382	0.468	+23%
sd(log($MRPK_{all}$))	0.379	0.438	+16%
sd(log($MRPK_{btw}$))	0.191	0.205	+7%
mean(Bank loans B_1)	6.196	4.994	-19%
mean(Bank loans B_2)	7.136	4.075	-43%
mean(Leverage$_1$)	0.550	0.487	-11%
mean(Leverage$_2$)	0.571	0.300	-47%

tighter constraint. As a result, the within-sector MRPK dispersion of Firm A increases from 0.282 to 0.313 by 11%, the within-sector dispersion of Firm B increases from 0.382 to 0.468 by 23%.

Furthermore, entrusted loans facilitate credit transfer from less efficient firms to more efficient firms, and this improves the between-sector capital allocation. Table 6 shows that without entrusted loans, the between-sector dispersion increases from 0.191 to 0.205, by 7%. Finally, it can be calculated that the between-sector allocation improvement contributes about $\frac{0.205^2-0.191^2}{0.438^2-0.379^2} = 12\%$ of the total improvement in capital allocation.

The Interest Subsidy Firm A receives interest rate subsidy (implicit guarantee) for bank loans. All else equal, this creates an interest arbitrage opportunity. Firm A can borrow from banks with a low interest rate and resell the credit to Firm B with a higher interest rate. However, entrusted lending involves convex agency costs, and this limits the firm's motive of providing entrusted loans. Table 7 shows the equilibrium of entrusted lending for the cases with and without the interest subsidy for Firm A.

As shown in Table 7, the average leverage of Firm A decreases from 0.55 to 0.54, while the average leverage of Firm B increases from 0.57 to 0.58. Without the interest rate subsidy, Firm A borrows less and the equilibrium interest rate of bank loans decreases by 19%. As

Table 7: **The Interest Subsidy**

	Benchmark	Without Subsidy	Percent Change
mean($MRPK_1$)	0.232	0.234	+1%
mean($MRPK_2$)	0.353	0.350	-1%
sd(log($MRPK_1$))	0.282	0.276	-2%
sd(log($MRPK_2$))	0.381	0.388	+2%
sd(log($MRPK_{all}$))	0.379	0.374	-1%
sd(log($MRPK_{btw}$))	0.191	0.179	-6%
mean(Leverage$_1$)	0.550	0.541	-2%
mean(Leverage$_2$)	0.571	0.576	+2%
InterestRate(bank)	0.067	0.054	-19%
InterestRate(entrusted)	0.120	0.1202	+0.2%

a result of lower interest rate, Firm B borrows more from banks to accumulate capital. The increase in capital then boosts Firm B's borrowing capacity, and Firm B also borrows more through entrusted loans. The interest rate of entrusted loans increases because of the equilibrium effect. On the one hand, the demand of entrusted loans increases. On the other hand, the motive of supplying entrusted loans decreases because Firm A faces a higher borrowing cost. Overall, the demand effect is stronger and thus the interest rate of entrusted loans increases.

The capital allocation improves when the interest rate subsidy is eliminated. Without the interest subsidy, the within-sector dispersion of Firm A decreases from 0.282 to 0.276 by 2%. The between-sector MRPK dispersion decreases significantly from 0.191 to 0.179 by 6%. However, the overall dispersion does not decline much, only by 1%. This is also due to the equilibrium effect. After removing the interest subsidy, the equilibrium interest rate of bank loans decreases, and a lower interest rate of bank loans leads to a higher dispersion.[25] As a result, although the within-sector dispersion of Firm A decreases (due to the remove of interest subsidy), the within-sector dispersion of Firm B increases (due to the equilibrium effect).

[25]The intuition is that, when the interest rate declines, low-productivity firms with non-binding borrowing constraints borrow more, while high-productivity firms with binding constraints borrow relatively less.

5 Counterfactual Exercises

Before going to the counterfactual exercises, we recall the macro-facts that we intend to explain. First, there was a 16% expansion of bank credit for industrial firms in 2009, and the new credit had been disproportionately allocated to state sector firms. Second, the credit expansion continued as a partial financial liberalization in the sense that the financial constraint of government-connected firms had been relaxed, but the constraint of unconnected firms did not change or even became tighter. Third, after those policy interventions, the leverage of SOE sector increased while that of POE sector decreased, and the MRPK dispersion of industrial firms increased by 0.07 standard deviations.

We conduct two counterfactual exercises to examine the impacts of credit policies on capital allocation and firm leverage. In the first counterfactual exercise, we study the model in which there is an expansion of bank loans. That is, given the benchmark model, we increase the supply of bank loans. Since during the sample period China still had a lending rate floor, a big enough credit expansion would drive the equilibrium interest rate below the floor rate. Thus, we consider two cases: one with a binding interest rate and the other without an interest rate floor. In the second exercise, we consider a partial financial liberalization, that is, we relax the borrowing constraint of Firm A while maintaining that of Firm B.

5.1 Credit Expansion

From the calculation in Section 2.2, there was a 16% bank credit expansion in 2009. Thus, to mimic the data, we set a credit expansion rate of 16% in the model. That is, we increase the total supply of bank loans by 16%. However, we find that in this case the equilibrium interest rate (0.9%) would be smaller the floor rate (1.4%). Notice that in 2009 the lending rate in China was still regulated, and the floor rate 1.4% was the lowest interest rate at which a firm could legally borrow from.[26] As a result, we report two cases. One with a binding

[26]There was no lending rate ceiling since 2004, but existed a lending rate floor of 0.9 times the baseline rate until 2013. Based on the interest rate calculation of the pervious footnote, the *lowest* real lending rate in 2009 was about 1.4%=5.31%*0.9-3.41%.

interest rate, and the other without a lower bound. In Appendix B, we also consider the case of a 10% credit expansion.

Table 8: **Credit Expansion**

		Binding Floor		Without Floor	
	Before	After	Changes	After	Changes
mean($MRPK_1$)	0.232	0.212	-9%	0.211	-9%
mean($MRPK_2$)	0.353	0.339	-4%	0.338	-4%
sd(log($MRPK_1$))	0.282	0.338	+20%	0.344	+22%
sd(log($MRPK_2$))	0.382	0.409	+7%	0.412	+8%
sd(log($MRPK_{all}$))	0.379	0.430	+13%	0.434	+15%
sd(log($MRPK_{btw}$))	0.191	0.218	+14%	0.221	+16%
InterestRate(bank)	0.067	0.014	-79%	0.009	-87%
InterestRate(entrusted)	0.120	0.121	+1%	0.121	+1%
mean(Bank loans B_1)	6.196	7.363	+19%	7.476	+21%
mean(Bank loans B_2)	7.136	7.831	+10%	7.888	+11%
mean(Entrusted loans F_1)	1.701	1.977	+16%	2.002	+18%
mean(Entrusted loans F_2)	2.296	2.669	+16%	2.702	+18%
mean(Leverage$_1$)	0.550	0.579	+5%	0.582	+6%
mean(Leverage$_2$)	0.571	0.592	+4%	0.595	+4%
mean(Output Y_1)	5.424	6.000	+11%	6.052	+12%
mean(Output Y_2)	15.70	16.56	+5%	16.63	+6%
mean(Capital K_1)	7.289	8.663	+19%	8.795	+21%
mean(Capital K_2)	13.72	15.06	+10%	15.17	+11%

Table 8 shows the results before and after the expansion of bank loans. Since the two cases are quite similar in terms of real effects, we focus on the binding case. After the credit expansion, the interest rate of bank loans decreases. Both types of firms increase their scale of production through borrowing from banks. They borrow more and invest more. However, the capital expansion of Firm A is larger than that of Firm B, 19% vs. 10%. This is because the Firm A's borrowing constraint of bank loan is relatively less tighter than that of Firm B before the credit expansion.

Capital misallocation increases after the credit expansion. The overall MRPK dispersion increases from 0.379 to 0.430, by 0.051 standard deviations, which accounts for 73% $= \frac{0.051}{0.07}$ of the increase observed in the data. The within-sector MRPK dispersion increases by 20%

for Firm A and 7% for Firm B, which is consistent with the finding of Gopinath et al. (2017) that a lower interest rate leads to a higher dispersion. Intuitively, when the interest rate declines, low-productivity firms with non-binding borrowing constraints borrow more, while high-productivity firms with binding constraints cannot. As a result, the within-sector MRPK dispersion increases.

Furthermore, the between-sector dispersion increases by 14%, and it contributes about $27\% = \frac{0.218^2 - 0.191^2}{0.43^2 - 0.379^2}$ of the total dispersion increased in the model. To show the economics behind the increase in the between-sector dispersion, we decompose the amount of the new bank loans. We ask the question how the new bank credit has been allocated between Firm A and Firm B, and how additional credit has been transmitted from Firm A to Firm B. Figure 5 shows that Firm A receives about 64% of the new bank credit, and Firm B receives 28%.[27] Thus, the allocation of new credit is not proportional, given that Firm A faces favorable financing conditions. Also notice that there are 8% of the new credit left on the table since the interest rate is binding at the floor rate.

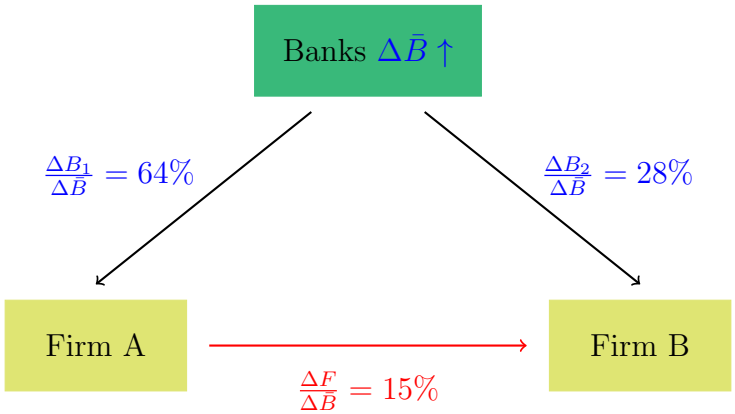

Figure 5: **The decomposition of new credit**

In addition to the bank lending channel, there is an indirect credit transmission from Firm A to Firm B, which accounts for 15% of the new credit. This indirect credit transmission itself improves the capital allocation since Firm B is more productive. However, overall, Firm

[27] In a stationary state before the credit expansion, Firm A receives 54% of the total outstanding credit while Firm B receives the other 46%.

A receives 49% of the new credit, and Firm B receives 43%. Thus, even accounting for the credit transfer through entrusted lending, the new credit is still disproportionately allocated to Firm A, and thus the between-sector dispersion increases.[28]

Credit Expansion without Entrusted Lending The next question we address is: If entrusted lending is not allowed, what is the impact of the credit expansion on capital allocation? This question is different from the one studied in Section 4.2 in which we consider the scenario that entrusted lending is not allowed in the stationary state. Now, we focus on the transition from one stationary state to another. That is, we want to investigate whether entrusted lending *amplifies* the credit transmission or not.

Table 9 shows the amplification effects of entrusted lending. The first column reports the percent change of each variable after a credit expansion of the model with entrusted lending (for the case without an interest rate floor which is drawn from the last column of Table 8). The second column reports the results of the model without entrusted lending in which we calibrate the initial conditions to be the same as the model with entrusted lending. We also report each firm's shares of the new credit for both models.

With entrusted lending, the change of MRPK dispersion is larger, both in percentages and in levels (although we do not report in the table). In other words, the credit expansion lends to an even worse capital allocation if there is entrusted lending. Also, the responses of capital and output to the credit expansion are stronger in the case with entrusted lending. And this is true for both Firm A and Firm B.

To see the economic intuitions behind this amplification effect, we also show the decomposition of the new credit. In the case with entrusted lending, 70% of new bank loans has been allocated to Firm A, and 30% has been allocated to Firm B. But in the case without entrusted lending, it is 55% vs. 45%. This means that with entrusted lending, bank loans are more disproportionately allocated toward Firm A during a credit expansion.

[28]Notice that before the credit expansion the total output of Firm A is 7.3 and that of Firm B is 15.7. Suppose credit was evenly allocated based on output, Firm A should receive $39\% = \frac{7.3*1.35}{7.3*1.35+15.7}$ and Firm B receive 61%.

Table 9: **The Amplification Effect of Entrusted Lending**

	With	Without
Δsd(log($MRPK_1$))	22%	14%
Δsd(log($MRPK_2$))	8%	7%
Δsd(log($MRPK_{all}$))	15%	10%
Δsd(log($MRPK_{btw}$))	16%	6%
Δmean(Capital K_1)	21%	10%
Δmean(Capital K_2)	11%	6%
Δmean(Output Y_1)	12%	5%
Δmean(Output Y_2)	6%	2%
Share of credit $\Delta B_1/\Delta\bar{B}$	70%	55%
Share of credit $\Delta B_2/\Delta\bar{B}$	30%	45%
Share of credit $\Delta F/\Delta\bar{B}$	19%	0%

With entrusted lending, credit can be transferred from Firm A to Firm B. The existence of this indirect channel of reselling credit encourages Firm A to borrow more from banks. Given the additional borrowing, Firm A invests more in capital and also resells more credit to Firm B. On the other side, as for Firm B, with entrusted lending, it can borrow more and invest more in capital. Thus, as a result, the responses of capital and output to the credit expansion for both type of firms are stronger in the case with entrusted lending.

To sum up, the amplification effect of entrusted lending during the credit expansion is similar to the financial accelerator effect of banks studied in the literature. After all, Firm A plays the role of a financial intermediary. Although entrusted lending worsens the credit allocation among firms during the credit expansion, it boosts the efficiency of the credit stimulus by amplifying the impact of credit expansion on output growth.

5.2 Partial Financial Liberalization

As discussed in Section 2.2, although the official stimulus program was concluded in 2010, the local governments continued to use their new access to financial resources to facilitate favored firms' access to capital. Connected firms received local governments' special assis-

tances in obtaining cheap funds and in avoiding the central bank's regulations, while private firms did not. Bai, Hsieh, and Song (2016) provide a static model to illustrate how connected firms' borrowing could crowd out funding to unconnected firms by raising the bank's marginal cost of lending.[29] In this counterfactual, we extend their static model into a dynamic framework, and quantitatively examine the impacts of the partial financial liberalization on capital allocation. To capture the mechanism of a potential crowding out effect, we modify the benchmark model by assuming costly supply of bank loans. We assume that connected firms (Firm A) face a fixed lending rate—the prime lending rate r_p, while non-connect firms (Firm B) face a market rate r_m.

We next discuss the bank's optimization problem to derive the supply function of bank loans. There is a representative bank who maximizes profits by taking in deposits and lending out loans. For simplicity, we assume that the deposit rate equals the prime lending rate, and the supply of bank loans to connected firms is regulated and is taken as given by the bank. The bank's problem is:

$$\max_{B_{2t}} : \left\{ r_{pt} B_{1t} + r_{mt} B_{2t} - r_{pt}\big(B_{1t} + B_{2t}\big) - \frac{\omega}{2}\big(\max\{B_{1t} + B_{2t} - \bar{B}_t, 0\}\big)^2 \right\}, \tag{29}$$

where B_{1t} and B_{2t} represents the supply of bank loans to Firm A and Firm B, respectively. The term $r_{pt}B_{1t} + r_{mt}B_{2t}$ represents the revenue from selling loans, $r_{pt}\big(B_{1t} + B_{2t}\big)$ is the cost of raising deposits, and $\frac{\omega}{2}\big(\max\{B_{1t} + B_{2t} - \bar{B}_t, 0\}\big)^2$ is the cost of intermediating loans. $\bar{B}_t$ is the regulated level of bank loans, such that if the actual supply of bank loans exceeds the regulated level, it occurs a cost. The parameter ω measures the marginal cost of supplying an extra unit of loans. If $\omega = 0$, it implies that bank loans have an elastic supply at the prime interest rate r_p. If $\omega = \infty$, the supply of bank loans is fixed at the target level $\bar{B}_t$. Otherwise, the supply function of bank loans is an upward sloping curve of the market interest rate.

From the first order condition of the bank's optimization problem, we derive the supply

[29] Ru (2018) finds that China Development Bank's industrial loans to state-owned enterprises crowd out private firms in the same industry but crowd in private firms in downstream industries.

function of bank loans, and combine it with the demand function of bank loans $B_{1t} + B_{2t} = \gamma \int B_{it}(r_{pt}) + \int B_{jt}(r_{mt})$, then we have the new market clearing condition of bank loans:

$$r_{mt} = r_{pt} + \omega \left(\max \left\{ \gamma \int B_{it}(r_{pt}) + \int B_{jt}(r_{mt}) - \bar{B}_t, 0 \right\} \right). \tag{30}$$

Finally, the partial financial liberalization works as a relax of the borrowing constraint of Firm A while keeping the constraint of Firm B unchanged.[30] To be specific, we raise the collateral rate of Firm A from 0.85 to 0.90, to match the leverage increase of the SOE sector in the data. Table 10 shows the results of a partial liberalization of Firm's A borrowing constraint for three cases of the bank's marginal cost of lending $\omega = 0, \omega = 0.03, \omega = \infty$. We first discuss the case of fixed supply of bank loans which potentially generates the largest crowding out effect, then discuss the main differences between the three cases.

Credit Reallocation After the partial liberalization, Firm A's demand of bank loans increases, and this drives up the interest rate of bank loans. The market interest rate increases from 0.04 to 0.098. Recall that the bank lending rate is fixed for Firm A, and thus the rise of the market interest rate reflects the crowding out effect caused by the partial financial liberalization. Given the higher interest rate of bank loans, Firm B reduces its borrowing from banks and also invests less in capital. Furthermore, since the amount of collateral assets declines, Firm B's ability of borrowing through entrusted loans also declines. In terms of magnitude, when the collateral rate of Firm A increases from 0.85 to 0.90, by 6%, Firm A's borrowing from banks increases from 6.468 to 6.979, by 8%, while Firm B's bank borrowing decreases from 7.467 to 6.778, by 9%. Further, the credit transfer between Firm A and Firm B decreases from 2.466 to 2.142, by 13%. That is, financial resources are reallocated from Firm B back to Firm A.

[30] In the Appendix B, we also consider the case of raising the interest subsidy rate of Firm A, that is, raising the level of implicit guarantees provided by the government, and we find that it has a weaker crowding out effect than that of raising the collateral rate of Firm A.

Table 10: **Partial Financial Liberalization**

	Before	After		
		$\omega = 0$	$\omega = 0.03$	$\omega = \infty$
sd(log($MRPK_1$))	0.295	0.300	0.300	0.300
sd(log($MRPK_2$))	0.395	0.396	0.387	0.364
sd(log($MRPK_{all}$))	0.391	0.396	0.397	0.399
sd(log($MRPK_{btw}$))	0.191	0.197	0.204	0.225
InterestRate(bank)	0.040	0.040	0.055	0.098
InterestRate(entrusted)	0.1205	0.1203	0.1200	0.1192
mean(Bank loans B_1)	6.468	6.979	6.979	6.979
mean(Bank loans B_2)	7.467	7.470	7.280	6.778
mean(Entrusted loans F_1)	1.826	1.828	1.753	1.587
mean(Entrusted loans F_2)	2.466	2.468	2.367	2.142
mean(Leverage_1)	0.553	0.595	0.601	0.617
mean(Leverage_2)	0.581	0.581	0.575	0.562
mean(Output Y_1)	5.564	5.627	5.627	5.627
mean(Output Y_2)	16.11	16.11	15.88	15.26
mean(Firm Value $V_1 + B_1$)	26.17	26.55	26.46	26.26
mean(Firm Value $V_2 + B_2$)	36.04	36.04	35.26	33.09

Gains vs. Losses We next investigate the gains and losses of the partial financial liberalization. As can be seen from the last column of Table 10, the output of Firm A increases from 5.564 to 5.627 by 1%, while the output of Firm B decrease from 16.11 to 15.26 by 5%. The percent of Firm A's increase is smaller than the percent of Firm B's decrease. Moreover, the firm value (debt plus equity) of Firm A increases by 0.3%, while the firm value of Firm B decrease by 8%. That is, gains are smaller than losses.

Efficiency of Allocation The partial financial liberalization reduces the efficiency of capital allocation. The overall MRPK dispersion increases from 0.391 to 0.399, by 2%. More importantly, the efficiency losses are from the between-sector dispersion. The between-sector dispersion increases by 0.034 standard deviations. On the other hand, the within-sector dispersion of Firm A increases only slightly and that of Firm B even decreases by 8% due to the higher interest rate of bank loans. Overall, the partial financial liberalization leads a modest

increase in the total MRPK dispersion, mainly caused by the increase in the between-sector dispersion.

The Divergence of Firm Leverage In the first counterfactual exercise (Section 5.1), the leverage of Firm A and Firm B both increases after a credit expansion, which contradicts with the data that there is a divergence of firm leverage. In this counterfactual of a partial financial liberalization, the leverage of Firm A is targeted by the model to calibrate the magnitude of the relaxation of Firm A's borrowing constraint, while the leverage of Firm B is predicted by the model. The last column of Table 10 shows that the leverage of Firm B decreases from 0.581 to 0.562 by 0.019, but still cannot match the decreases observed in the data (-0.05).

The Marginal Cost of Bank Lending The magnitude of the crowding out effect depends on the parameter ω, the marginal cost of bank lending. When $\omega = 0$, there is no crowding out effect, but only a slightly crowding in effect through the entrusted lending. When Firm A can access to a better financing condition, the marginal cost of supplying entrusted loans becomes lower. Then, the interest rate of entrusted loans decreases, and therefore Firm B benefits indirectly from the partial financial liberalization of Firm A. Notice that in this case, the MRPK dispersion increases even if there is no crowding out effect. This is because that Firm A gets a relaxation of its borrowing constraint while Firm B does not. When $\omega = 0.03$, a reasonable number of the marginal cost of bank lending,[31] the between-sector MRPK dispersion increases by 0.013 standard deviations, which is close to the one observed in the data (0.014).

[31]It implies that when the excess demand of bank loans increases by 1 unit (by 6% of regulated level of bank loans), the interest rate of bank loans increase by 0.03.

Local Government Debt We include the local government debt in studying the crowding out effect. The modified bank's problem becomes

$$\max_{B_{2t}} : \left\{ r_{pt}(B_{1t}+B_{gt})+r_{mt}B_{2t}-r_{pt}\big(B_{1t}+B_{gt}+B_{2t}\big)-\frac{\omega}{2}\big(\max\{B_{1t}+B_{gt}+B_{2t}-\bar{B}_t,0\}\big)^2 \right\}, \quad (31)$$

where B_{gt} is the amount of government debt.

In this modified problem, increases in government debt would further crowd out private firms' borrowing. We estimate the change of government debt during the stimulus program ΔB_{gt}. According to Chen, He, and Liu (2017), the local government obtained roughly 2.06 trillion of extra new loans from commercial banks in 2009. We also calculate the change of the targeted level of bank loan $\Delta\bar{B}_t$. During the stimulus period, the reserve requirement ratio of commercial banks has been reduced by 2%. We estimate that the reduce of the requirement ratio released liquidity about 0.96 trillion, which is the total deposits (48 trillion) times the reduce in the requirement ratio (0.02). Thus, the net increase of bank loans is $\Delta B_{gt} - \Delta\bar{B}_t$ = 1.1 trillion, which is 18% of the outstanding debt of manufacturing sector at the end of 2008 (6 trillion).

In this modified counterfactual exercise, we require the bank to increase the net supply of bank loan by 18%, in addition to raising the collateral rate of Firm A from 0.85 to 0.90. Also, we set the marginal cost of bank lending $\omega = 0.03$. As discussed in the last paragraph, when $\omega = 0.03$, the model without government debt can explain the increase of between-sector dispersion observed in the data.

Table 11 reports the results. As can be seen from the table, including government debt helps to explain the leverage divergence between the SOE sector and the POE sector. The leverage of the POE sector decreases from 0.581 to 0.540, by 0.041, which is closer to the changes observed in the data (-0.05). However, in this case, the model overshoots the between-sector dispersion.

Table 11: **Partial Financial Liberalization (including government debt)**

	Before	After	Percent Change
sd(log($MRPK_1$))	0.295	0.300	+2%
sd(log($MRPK_2$))	0.395	0.356	-10%
sd(log($MRPK_{all}$))	0.391	0.401	+3%
sd(log($MRPK_{btw}$))	0.191	0.234	+23%
Interest rate of bank loans	0.040	0.1167	+192%
Interest rate of entrusted loans	0.1205	0.1192	-1%
mean(Bank loans B_1)	6.468	6.979	+8%
mean(Bank loans B_2)	7.467	6.416	-14%
mean(Entrusted loans F_1)	1.826	1.615	-12%
mean(Entrusted loans F_2)	2.466	2.181	-12%
mean(Leverage$_1$)	0.553	0.614	+11%
mean(Leverage$_2$)	0.581	0.540	-7%
mean(Output Y_1)	5.564	5.627	+1%
mean(Output Y_2)	16.11	14.95	-7%
mean(Firm Value $V_1 + B_1$)	26.17	26.29	+0.5%
mean(Firm Value $V_2 + B_2$)	36.04	31.97	-11%

In this table, we include government debt in the bank's optimization problem and set the marginal cost of bank lending $\omega = 0.03$.

5.3 Back to the Macro-Facts

To sum up the counterfactual exercises, we come back to the macro-facts presented in Section 2.2. The China's economy during the sample period is far more complicated than the model can describe. In this paper, we only focus on two events: a bank credit expansion during the year 2009 and a continued partial financial liberalization after 2010. Table 12 summarizes the macro facts in the data and those predicted by the model.

We learn from the counterfactual exercises that (1) The bank credit expansion is the driving force of the increases in the MRPK dispersion, through the channel of lower interest rate and the amplifying effect of the entrusted lending. (2) The divergence of firm leverage supports the mechanism of a partial financial liberalization, but the crowding out effect induced by the partial financial liberalization is modest and depends on the marginal cost of

bank lending.

Table 12: **Data vs. Model**

	Data	Credit Expansion	Partial Liberalization
Δsd(log($MRPK_{all}$))	0.07	0.051	0.008
Δsd(log($MRPK_{btw}$))	0.014	0.027	0.034
Δmean(Leverage$_1$)	0.05	0.029	0.064
Δmean(Leverage$_2$)	-0.05	0.021	-0.019

6 Conclusion

In this paper we develop a quantitative model to study the role of entrusted loans in allocating credit. Existing researches, for example Chen, Ren, and Zha (2017), have studied the implications of entrusted lending in monetary policies. But the literature have not yet examined the effects of entrusted lending in allocating resources. We find that entrusted lending plays a significant role in allocating credit among firms. Based on the model calibration, entrusted lending improves the aggregate capital allocation by 16% in a stationary state. However, entrusted lending amplifies capital misallocation during a bank credit expansion.

We also conduct two counterfactual exercises to examine the model implications. We find that: (1) After a bank credit expansion, the MRPK dispersion increases, mainly through the channel of lower interest rate, and also by the amplifying effect of entrusted lending. New loans have been allocated even more towards state firms in the presence of entrusted lending. (2) After a partial relaxation of the borrowing constraint of state firms, the leverage of state firms increases but the leverage of private firms decreases due to a crowding out effect. Financial resources are reserved back from credit-deprived private firms to state firms and thus the efficiency of capital allocation becomes lower.

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A Extension of the Benchmark Model

A.1 Monopolistic Competition

In the model of monopolistic competition, the static problem of Firm A becomes:

$$\Pi_{it}(A_{it}; z_{it}) = \max : \left\{ p_{it}q_{it} - w_t L_{it} - (r_{st} + \delta)K_{it} + (r_{ft} - r_{st})F_{it} - \chi(F_{it}) - \phi(K_{it}) \right\}$$

subject to:

$$p_{it} = P_t \left(\frac{q_{it}}{Q_t}\right)^{-\frac{1}{\varepsilon}} \tag{32}$$

$$q_{it} = \hat{z}_{it} K_{it}^{1-\alpha} L_{it}^{\alpha} \tag{33}$$

$$K_{it} \leq \frac{A_{it} - F_{it}}{1 - \theta_1}. \tag{34}$$

Given the aggregate price P_t and quantity Q_t, this problem is equivalent to the Firm A's problem in Section 3.1, by defining $\varepsilon = \frac{1}{1-\eta}$, $\hat{z}_{it} = (z_{it})^{\eta}$.

We assume there is a representative agent, which assembles individual goods $\{q_{it}\}_i$ into a bundle of intermediate goods Q_t. Its problem is:

$$\text{zero profit} = \max : \left\{ P_t Q_t - \int p_{it} q_{it} \right\} \tag{35}$$

subject to:

$$Q_t = \left(\int (q_{it})^{\frac{\varepsilon - 1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon - 1}}. \tag{36}$$

This implies the demand function of goods i:

$$p_{it} = P_t \left(\frac{q_{it}}{Q_t}\right)^{-\frac{1}{\varepsilon}}. \tag{37}$$

The bundle Q_t is perfectly divisible. Given P_t, each firm j in the downstream sector purchases a M_{jt} fraction of the bundle. The Firm's B problem is the same as in Section 3.2.

A.2 Horizontal Production Structure

In this appendix, we assume a horizontal production structure in which firms in Sector A produce goods A, and firms in Sector B produce goods B. There is a representative worker, who supplies a fixed amount of labor $\bar{L}_t$.

The worker's problem is:

$$\begin{aligned} v_t &= \max : \left\{ u(c_t) + \beta \mathbb{E}\big[v_{t+1}\big] \right\} \\ \text{subject to:} & \\ & c_t = \Big[\lambda (c_t^A)^{-\epsilon} + (1-\lambda)(c_t^B)^{-\epsilon} \Big]^{-\frac{1}{\epsilon}} \qquad (38) \\ & c_t^A + p_t^B c_t^B + b_{t+1} = w_t \bar{L}_t + d_t + (1+r_t) b_t \qquad (39) \end{aligned}$$

where, c_t^A and c_t^B are the consumption of goods A and B, b_{t+1} is the bond holding, $w_t \bar{L}_t$ is the wage income, and d_t is the aggregate dividend paid by the corporate sector. The price of goods A is normalized to one, and the price of goods B is p_t^B. From the first order conditions, we have

$$\begin{aligned} r_t &= \frac{u_A(c_t)}{\beta \mathbb{E} u_A(c_{t+1})} - 1 \qquad (40) \\ p_t^B &= \Big(\frac{1-\lambda}{\lambda} \Big) \Big(\frac{c_t^A}{c_t^B} \Big)^{\epsilon+1} \qquad (41) \end{aligned}$$

The first equation pins down the deposit rate (prime lending rate) and the second equation describes the relative price of goods.

The market clearing conditions of the two goods are: $c_t^A = Y_1 - I_1 - cost_1$, and $c_t^B = Y_2 - I_2 - cost_2$.

B Robustness Checks

Table 13: **The Discount Factor**

	$\beta_1 = 0.90$ $\beta_2 = 0.80$	$\beta_1 = 0.90$ $\beta_2 = 0.85$	$\beta_1 = 0.93$ $\beta_2 = 0.85$
mean($MRPK_1$)	0.224	0.227	0.229
mean($MRPK_2$)	0.347	0.344	0.341
sd(log($MRPK_1$))	0.304	0.294	0.290
sd(log($MRPK_2$))	0.392	0.374	0.391
sd(log($MRPK_{all}$))	0.399	0.382	0.382
sd(log($MRPK_{btw}$))	0.202	0.192	0.180
Interest rate of bank loans	0.045	0.054	0.067
Interest rate of entrusted loans	0.121	0.119	0.084
mean(Bank loans B_1)	6.652	6.450	6.363
mean(Bank loans B_2)	7.419	7.692	7.809
mean(Leverage$_1$)	0.562	0.583	0.553
mean(Leverage$_2$)	0.580	0.532	0.564
mean(Output Y_1)	5.657	5.555	5.511
mean(Output Y_2)	16.06	16.62	16.67
mean(Capital K_1)	7.826	7.589	7.487
mean(Capital K_2)	14.27	14.79	15.02
mean(Entrusted loans F_1)	1.811	1.453	1.755
mean(Entrusted loans F_2)	2.445	1.961	2.370

To make comparisons between models with different discount factors, we set $\bar{B}_t = 16.4$. All other parameters are the same as in the benchmark model.

Table 14: **Credit Expansion (10%)**

	Benchmark	Credit Expansion	Percent Change
mean($MRPK_1$)	0.232	0.218	-6%
mean($MRPK_2$)	0.353	0.343	-3%
sd(log($MRPK_1$))	0.282	0.319	+13%
sd(log($MRPK_2$))	0.382	0.400	+5%
sd(log($MRPK_{all}$))	0.379	0.412	+9%
sd(log($MRPK_{btw}$))	0.191	0.209	+10%
Interest rate of bank loans	0.067	0.031	-46%
Interest rate of entrusted loans	0.120	0.1208	+1%
mean(Bank loans B_1)	6.196	6.956	+12%
mean(Bank loans B_2)	7.136	7.610	+7%
mean(Leverage$_1$)	0.550	0.569	+4%
mean(Leverage$_2$)	0.571	0.585	+4%
mean(Output Y_1)	5.424	5.806	+7%
mean(Output Y_2)	15.70	16.30	+4%
mean(Capital K_1)	7.289	8.183	+12%
mean(Capital K_2)	13.72	14.63	+7%
mean(Entrusted loans F_1)	1.701	1.885	+11%
mean(Entrusted loans F_2)	2.296	2.545	+11%

In this table, we consider a 10% credit expansion, rather than 16%.

Table 15: **Partial Financial Liberalization (through interest subsidy)**

	Before	After	Percent Change
sd(log($MRPK_1$))	0.295	0.296	+0.3%
sd(log($MRPK_2$))	0.395	0.364	-8%
sd(log($MRPK_{all}$))	0.391	0.394	+1%
sd(log($MRPK_{btw}$))	0.191	0.221	+16%
Interest rate of bank loans	0.040	0.099	+148%
Interest rate of entrusted loans	0.1205	0.1194	-1%
mean(Bank loans B_1)	6.468	6.483	+2%
mean(Bank loans B_2)	7.467	6.748	-10%
mean(Leverage$_1$)	0.553	0.574	+4%
mean(Leverage$_2$)	0.581	0.560	-4%
mean(Output Y_1)	5.564	5.571	+0.1%
mean(Output Y_2)	16.11	15.21	-6%
mean(Firm Value $V_1 + B_1$)	26.17	26.91	+1%
mean(Firm Value $V_2 + B_2$)	36.04	33.04	-8%
mean(Entrusted loans F_1)	1.826	1.566	-14%
mean(Entrusted loans F_2)	2.466	2.115	-14%

In this table, we consider the case of raising the interest subsidy rate of Firm A, that is, raising the level of implicit guarantees provided by the government. The subsidy rate τ has been raised from 0.25 to 0.5.

C Decompose the funding sources of entrusted loans

In this section, we decompose the funding sources of entrusted loans and discuss the main difference between this paper and Chen, Ren, and Zha (2017). In Table 16, we show three funding sources of entrusted loans: wealth management products by commercial banks, assets under management by funds and brokers.[32] Those are entrusted loans funded by financial institutions rather industrial firms. It can be seen from Table 16, in the peak year of 2014, about 30 percent of the outstanding entrusted loans are funded by financial institutions. Chen, Ren, and Zha (2017) mainly focus on this part of entrusted loans, and they use it an example to illustrate banks' risk taking behaviors.

Table 16: **Decompose the funding sources of entrusted loans**

	2012	2013	2014	2015	2016
Entrusted Loans	5.9	8.2	9.3	10.9	13.2
Banks-WMP	0.16	0.30	0.36	0.34	0.64
Funds-AUM	0.0	0.21	0.75	1.35	1.08
Brokers-AUM	0.0	0.93	1.64	1.49	1.75
Percent	3%	18%	30%	29%	26%

Data Source: AMAC, CBWMRS, PBOC

Entrusted loans prior to 2012 were rarely funded by financial institutions. First, before 2013, funds and brokers were only allowed to invest in tradable (market) securities. In October of 2012, the CSRC issued new regulations that allow the asset management plans to invest in non-trade financial assets such as entrusted loans. Second, in 2012 the total amount of wealth management products was 7.1 trillion. If we assume that the ratio of wealth management products invested in entrusted loans was the same as that of 2013, it can be calculated that in 2012 only about 3% of entrusted loans were funded by financial institutions.

[32]The data sources are Asset Management Association of China (AMAC), and China Banking Wealth Management Registration System (CBWMRS).

Moreover, entrusted lending had less to do with banks' risk-taking behavior prior to 2012. Chen, Ren, and Zha (2017) use banks' holding of ARI (account receivable investment) as a proxy of banks' risk-taking behavior of purchasing the beneficiary rights of entrusted loans and bringing them onto banks' balance sheet. In Table 17, we show that banks' new ARI holdings were almost zero before 2013. That is, banks were not much involved in taking the risk of entrusted loans before 2013.

Table 17: **Banks' ARI Holdings**

	2011	2012	2013	2014	2015	2016
New Entrusted Loans	1.30	1.28	2.55	2.17	1.59	2.18
New ARI Holdings	-0.05	0.01	1.36	2.22	3.42	0.87

Data Source: Wind, PBOC

In this paper, instead of studying banks' risk-taking behaviors as in Chen, Ren, and Zha (2017), we focus on the entrusted lending prior to 2012 and study the real effects of entrusted lending. That is, we focus on the entrusted lending between industrial firms.