Financial Repression and Interest Rate Liberalization in China

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Abstract

China has been experiencing financial repression for a long time. The main feature of this repression is a regulated interest rate system. This results in private firms’ low likelihood of getting money from the official banking system, and at the same time seeded the emergence of the shadow banks, which introduces uncontrollable risks into the Chinese economy. Also, other policy goals, such as monetary policy efficiency, cross-border capital mobility and a free-floating exchange rate, have to be sacrificed to maintain the dictated interest rates. We use an overlapping generations model to study the macroeconomic consequences of financial repression in an economy, as well as the effects of a potential interest rate liberalization reform of the Chinese financial system. We find that if the state-owned firm continues to have priority getting credit from the official banks, an interest rate liberalization may not deliver a convergence of the two interest rate systems and a shrinkage of the shadow banking industry.

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1 Introduction

The financial system in China has been significantly repressed over the past decades. The first non-state-owned commercial bank was launched in 1996, almost 20 years after the country’s announcement of the economic reform from a central planner’s economy to a market one. Although nowadays private banks are allowed to share the banking market, the government controls almost all the big banks in the economy. At the same time, it controls stringently the interest rates at which all banks involve depositing and lending activities.

The central bank in China, which is under complete control of the government, sets the benchmark deposit and lending interest rates by dictation. The rates that banks use in actual depositing and lending activities are only allowed to float within a small range around the benchmark rates. Benchmark rates are set well below the market interest rates, and are not always above the official inflation rate. Given that the official numbers in China is likely to underestimate the true inflation level (Moosa, 1997; Nakamura et al., 2014), the economy actually has a chronic zero real interest rate, if not negative.

It is believed that the government uses low interest rates to reduce the state-owned firms’ financing cost or to meet some output goal (e.g., Ferri and Liu, 2010; Dollar and Jones, 2013). And in order to manage the interest rates at levels significantly lower than the market ones, the government has adopted a variety of controls on capital inflow and outflow, exchange rates, and many others. Also, the government fixes the gap between deposit and lending rates to lock the profits of the banks it owns.

A direct consequence of this tight regulation is that it becomes very difficult for firms to borrow money from banks (e.g., Song et al., 2011). The regulated benchmark interest rates, serving as price ceilings, create shortage of deposits from households. Banks understand that they cannot affect deposits supplied and loans demanded because they cannot adjust interest rates, and that they can lock their profits for each dollar they lend out thanks to the fixed rates gap. Therefore, these banks work hard to lend out as much as they could, and do their best to guarantee that the debtors repay their loans on time. As a result, banks issue loans in a very conservative way, and collateral is usually mandate if a firm wants to borrow from the banks.

Another consequence of this financial repression is the emergence of the underground banking system. They take multiple forms, and some conventional financial institutions are involved in. These shadow banks in China collect deposit from wealthy households and cash-rich firms, and lend to firms who are in need of cash. It is not a secret in China that the nominal lending interest rate in this underground market is more than 20%. It is reported that the lending interest rate in some area of China could be as high as 100%.

This underground banking sector is not negligible. There was an estimate in China in 2005 that the trading volume of this underground banking industry is more than 800 billion Chinese yuan. And people believe that the trading volume nowadays should be counted in terms of at least trillions.

The coexistence of these two banking systems provides arbitrage opportunities: some firms, especially the state-owned companies, borrow money from the banks and invest into the underground banks to get interest gap.

Policy makers in China are aware of the great distortions introduced by interest rate control and have started to reform the interest rate regime. Recently, the central bank
removed the lower bound of lending rates for all banks, and also removed the upper bound of lending rates for some special financial institutions which mainly serve the undeveloped rural areas and are relatively small in size. Although not touching the hard core of the problem, it is a sign that the top designers of China are considering interest rate liberalization seriously.

Also, the launch of Shanghai Free Trade Zone sheds some light on China’s interest rate reform. This free trade zone is considered as a test bed for bold financial reforms in China. The government have promised to experiment on interest rate liberalization and a convertible yuan there, although the times and details are to be announced.

Recently, signals from the Congressional Press Conference in China reveal that the head of central bank is supportive of interest rates liberalization and is positive that the reform will be seen in a year or two.

Given all these happening in China, it is natural to ask what is the implication of financial repression in China what is the effects of the potential interest rate liberalization.

2 Financial Repression in China

2.1 Some Background

Financial repression of contemporary China dates back to the very start of the People’s Republic. Soon after its establishment in 1949, the government changed the economy into a centrally planned one. The government put its hands into almost every aspect of the country’s economic life: The government controlled the ownership of natural resources and production inputs. It regulated the price system; there was no markets in the real sense. Resources were allocated by central planners through executive orders instead of the invisible hands of free market. There were no private firms. All firms were either state owned or collectively owned. Input prices such as wage rates and interest rates were set by dictation. Private parties were not allowed to hold foreign currencies.

This economic mode lasted until the late 1970’s, driving the country almost to the edge of a crash. Then the country launched its economic reform in 1978. Starting from the agricultural sector, the government gradually gave more and more freedom to the producers: production inputs were still owned either by the government or collectively, however, economic entities began to have the right to distribute and use at least part of their production revenues. This reform provided incentives for workers and entrepreneurs to increase productivity because now they were working for themselves. This saved the economy from the brink of a bankruptcy.

In the 1980’s, the government began to acknowledg that privately owned components in the economy were not in conflict with the political foundations the People’s Republic relied on. Soon, the economy saw a surge of its private components. Without people’s appreciation of its significance at that time, these components powered the take-off of the Chinese economy.

At the same time, the government opened up the commodity markets and the input markets. The credit market grew significantly during that period.

In 1984, the economy began its price system reform. The reformers invented the so-called “dual-track system”. Products within the government’s production plan were sold at “the
official price”, while extra products were allowed to be sold at “the market prices”. Although the government tried to control the “market prices” to be within some range of the official prices at the beginning of the reform, this reform gradually established the core mechanisms of the market economy system, as oppose to the central planner’s system that dominated the economy for almost 30 years. This reform lasted until 1994 when the two tracks almost merged together.

After that, the government launched more reforms to further perfect the markets. A lot of the reforms are dealing with state-owned firms, deregulation and so on.

However, comparing with the reforms in the commodity markets and input markets, the financial system reform seems to be well lagged behind. Although the private firms were allowed in the early 1980’s, the first non-state-owned financial institution, namely the Chinese Minsheng Bank, was not launched until 1996.

2.2 Financial Repression in China

Even after years of reforms in almost all aspect of the economy, the government still controls tightly the financial system. The central bank dictates the interest rate directly, and all banking activities are highly regulated or supervised. Credit amount is controlled. The government controls capital flow across borders, and intervene the exchange market constantly. There has not been any major reform in terms of hardcore problems in the financial system.

The People Bank of China, which is the central bank of China, set the benchmark interests for deposit and lending activities. The actual rates set by individual banks could only float within a very small range around the benchmark rate. For example, the deposit rate that any bank could offer cannot exceed 110% of the benchmark rate.

![Figure 1: Interest Rates and Inflation In China](image)

Figure 1 shows the benchmark nominal deposit and lending interest rates as well as the official inflation rate in China. It could be noted easily that the benchmark deposit rate and lending rate are quite stable after 2000, while the inflation during the same period is
much more volatile. There is correlation between the interest rates and inflation, but the responses of interest rates to changes in inflation are quite small. This contradicts with the usual practice of a Taylor rule that central banks use. According to that rule, the central bank fights inflation by aggressively raising the interest rates.

The second noticeable feature regarding the interest rates in China is that the gap between the benchmark deposit rate and the benchmark lending rate is almost fixed after 2000. This contradicts with the implications from a financial market where interest rate is determined by the market: in that case, we expect to see an enlarged interest rates gap if there is a shortage of credit, and a shrunked interest rates gap if there is a surplus of credit. A possible interpretation of this unchanged gap is that the government controlled the interest rates to lock the profit of its state-owned official bank system.

The third pattern revealed in Figure 1 is that the inflation is not always below the nominal interest rates, especially for the deposit rates. This makes the economy in a situation where it is experiencing chronic zero or even negative real interest rates. Given that the official inflation rate is likely to underestimate the true inflation in China, this zero or negative interest rate problem is likely to be more severe actually.

It is hard to believe that in a country with an average annual economic growth rate of about 8%, the net real return to capital is almost 0. Bai et al. (2006) calculated that the return is significantly greater than 0. It is commonly believed that the real interest rate calculated from the benchmark rate cannot reveal the true market return to investment. The government must be suppressing the interest rates intentionally.

This is what we mean by “financial repression” in China. The government set the interest rates well below the market rates to lower the financing cost of its state-owned sectors. By regulations and executive interventions, the government guarantees that there are enough funds going to the state-owned sector rather than going to places where it admits higher return.

Financial repression results in great distortions in the economy. First, it introduces great distortions in terms of resource allocation. Since the official interest rates are capped, people do not save enough in the official banking system. To guarantee that the state-owned firms get the money they want from the official banking system, the government uses executive orders and explicitly backs the repayment ability of its state-owned firms. This creates an unfair competition environment, in which low productivity firms could survive, and resources do not go to places where they have the highest return. Private firms are not able to compete with the state-owned firms because of higher financing cost, which increases the monopoly power of the state-owned firms in the economy.

The second problem it creates is the shortage of credits for private firms. The limited credit from the official banking system, due to an interest rate ceiling, is allocated to the state-owned sectors with priority. Even without executive intervention, these banks would prefer to extend their loans to the state-owned firms. This is because under tight regulation, the banks become extremely conservative when they issue loans. Comparing to the private firms, the state-owned firms have larger assets and capital as collateral, are backed by the government, have larger scales, and are likely to be profitable due to their monopoly power. The banks definitely prefer the state-owned firms than private firms. This also contributes to the distortion that the sector with the highest productivity cannot produce to its best scale.
Another issue is the emergence of the shadow banking system. The shadow banking system in China is a mixture of debt guarantee firms, trust companies, insurance firms, leasing companies, pawnbrokers, and other informal lenders. Some of shadow banking businesses are conducted in legal financial institutions, but the businesses themselves are not completely legal, or under supervision, by the government’s law. Some of them are just underground transactions banned by the government. These shadow banks collect funds from the official banking system and from rich households looking for higher return on their accumulated wealth. The shadow banks provides higher return to their investors, but with high risks.

However, since these shadow banks are more vulnerable to economic shocks, and are not under supervision of the government, they introduces higher risk into the economy. Nowadays, more and more legal financial institutions are involved in shadow banking activities, resulting in a great increase in the risk of contagion greatly increased. Given the fragility of the Chinese financial system due to regulation, a crisis in the shadow banking system may develop into a crash of the financial system.

Another issue that come along is the arbitrage behaviors between these two banking systems. Since the state-owned firms and the conventional financial institutions have access to cheap credit, some of them borrow from the banking system and invest into the shadow banking system. This adds another channel through which risk in the shadow banking system could transmit into the official banking system.

Fourth, financial repression greatly limits the instrument the central bank could use to tune the economy. Since the interest rates are regulated and do not reveal the true rate of return in the economy, interest rate cannot be a policy instrument at all. The stability of Chinese actually official interest rates proves this point. Instead, the Chinese central bank mainly uses the deposit reserve ratio as its policy instrument. However, this is a less favorable instrument in a free economy because it is very costly for banks to adjust their reserve ratio. Also, quantity controls does not always guarantee determinacy (Woodford, 2003).

The last but not least, the government has to intervene its open economy activities (e.g., Prasad, 2011). To maintain the interest rate at a lower level than the international rate, the government has to control capital inflow and outflow, and also intervene the exchange rate market constantly. This again creates distortions in the economy in terms of its international trade and finance activities.

The Chinese government have tried a few financial reforms, but their depth and breadth are far from satisfactory, and their effectiveness was quite limited. For example, the government launched an exchange rate reform in 1985, using the same “dual track” logic as in the price system reform. Although the two tracks merged in 1994, until nowadays there is still nobody believes that the Chinese currencies’ exchange rate is at the level where it should be.

2.3 Modeling Financial Repression in China

To study financial repression in China, we use a model which features a dual banking system. Figure 2 gives an system map of the model. We have an official banking system whose interest rate is dictated by the central bank, and a shadow banking system whose interest rate is determined by market forces. Also, there are two type of firms: the state-owned firms borrow
only from the official banking system, and their borrowing requests are always satisfied. The private firms can borrow from both banking system, but their borrowing abilities from the official banks are limited. Potentially there could be default in the shadow banking system, which is where the risk comes from. Also, the state-owned firms may take advantage of the arbitrage opportunity to borrow from the official banks at a lower interest rate and invest into the shadow banks to get higher return.

3 A Simple Model: Complete Financial Segregation

We first present a simple model where the financial market is segregated: the state-owned firm and private firms borrow from different sources. Figure 3 gives the relationship between different sectors in this economy.

The model is an overlapping generation model. Each agent live for two periods, young and old. They supply labor when they are young, and earn wages as part of their income. Each agent consumes the final good in both periods, denoted by $c^y_t(i)$ and $c^o_t(i)$ respectively. Agents do not value leisure. In each period, a continuum of measure $\mu$ ex ante homogeneous agents is born. The agents are indexed by $i$.

Each agent maximizes his or her lifetime utility $u(c^y_t(i)) + \beta E_t u(c^o_t(i))$. All agents have the same utility function. We suppose that the instantaneous utility is of constant relative risk aversion:

$$u(c) = \frac{c^{1-\gamma} - 1}{1 - \gamma}$$

where $\gamma$ is the relative risk aversion coefficient.

There are two types of firms: one state-owned firm and a continuum of measure $\mu^p$.
private firms. The state-owned firm uses capital-intensive technology, hires labor $n_s^t$ at wage rate $w_t$, and borrow only from the official banks as their capital $k^n_s$. The technology of the state-owned firm is

$$Y_s^t = A_s^t(k_s^t)^{\alpha_{s1}}(n_s^t)^{\alpha_{s2}}(\chi_s^t)^{\alpha_{s3}}$$  \hspace{1cm} (2)

where $A_s^t$ and $\chi_s^t$ are terms indicating technology level and $\alpha_{s1} + \alpha_{s2} + \alpha_{s3} = 1$. Notice that it is redundant to have $A_s^t$ and $\chi_s^t$ as separated technology terms. We make this distinction to match the technology form in the private sector. At the end of each period, the state-owned firm has to pay back the principle as well as the interests to the official banks. That is, the state-owned firm never defaults.

In our setting, the state-owned firm may earn some positive profits. We assume that these profits go to the government and are thrown into the ocean.

The private firms are ex ante homogeneous, indexed by $j$, and share the same labor-intensive technology. All private firms are one-period firms. In the next period, a measure $\mu^p$ of new private firms are born. They hire labor at the same wage rate $w_t$ as faced by the state-owned firm, but get capital only from the shadow banks. Their technology is

$$Y_p^t(j) = A_p^t(k_p^t(j))^{\alpha_{p1}}(n_p^t(j))^{\alpha_{p2}}(\chi_p^t(j))^{\alpha_{p3}}$$  \hspace{1cm} (3)

where $\alpha_{p1} + \alpha_{p2} + \alpha_{p3} = 1$ and $A_p^t$ and $\chi_p^t$ are technology terms. Private firms receive idiosyncratic technology shock $\chi_p^t(j)$. At the end of period, a private firm may choose to repay its loan from the shadow banks or to default its loan. We assume that capital depreciates completely so that we can guarantee that our private firms are one-period firms for simplicity.

The two banking sectors, namely “official banks” and “shadow banks”, are assume to only play the role of cleaning houses. The are just markets to guarantee that assets supplies equal assets demands. There is no profit maximization behaviors in the two banking sectors.
3.1 The Aggregation Sector

The state-owned firm and the private firms produce different intermediate goods $Y^s_t$ and $Y^p_t$ respectively. The aggregation sector uses these two intermediate goods to produce the final consumption good using technology as in Dixit and Stiglitz (1977)

$$Y_t = \left( \varphi (Y^s_t)^{\frac{\sigma-1}{\sigma}} + (1 - \varphi)(Y^p_t)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{1}{\sigma-1}},$$  \hspace{1cm} (4)

where $\varphi$ is the share parameter, $\sigma$ is the elasticity of substitution, and

$$Y^p_t = \int Y^p_t(j) dj.$$  

We assume that the aggregation sector takes the prices of the two intermediate goods, $P^s_t$ and $P^p_t$, as given. The aggregation sector chooses $Y^s_t$ and $Y^p_t$ to maximize its production of the final good (4) subject to

$$P^s_t Y^s_t + P^p_t Y^p_t \leq C,$$  \hspace{1cm} (5)

where $C$ is a constant number, interpreted as the total cost of production. Optimality conditions imply that the ratio of marginal products of the two inputs should be equal to the ratio of their prices. That is

$$\frac{\varphi^{\frac{\sigma-1}{\sigma}} (Y^s_t)^{-\frac{1}{\sigma}}}{(1 - \varphi)^{\frac{\sigma-1}{\sigma}} (Y^p_t)^{-\frac{1}{\sigma}}} = \frac{P^s_t}{P^p_t},$$

or equivalently,

$$\frac{Y^s_t}{Y^p_t} = \left( \frac{\varphi}{1 - \varphi} \frac{P^p_t}{P^s_t} \right)^{\frac{1}{\sigma}}.$$  \hspace{1cm} (6)

Suppose that the aggregation sector is perfectly competitive. Let the final good as the numeraire, then zero profit condition implies that

$$P^s_t Y^s_t + P^p_t Y^p_t = Y_t.$$  \hspace{1cm} (7)

Substituting (4) into (7) and use the optimal condition (6), we obtain the price relationship

$$\left( \varphi^\sigma (P^s_t)^{1-\sigma} + (1 - \varphi)(P^p_t)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} = 1.$$  \hspace{1cm} (8)

3.2 The Agents

Figure 4 gives the time line of the agents problem.

Each agent lives for two periods, young and old. In their young period, they supply labor, and get wages as return. We follow Liu and Wang (2014) to assume that at any time $t$, the young cohort in that period mutually owns the continuum of private firms, and share the profits from those private firms. Therefore, at the end of an agent’s young period, he or she gets wage and profit as income, and make decisions on consumption and investment.

The agents have two investment options. They could either invest into the official banks, or into the shadow banks. Recall that the official banks only lend money to the state-owned
firm, and the state-owned firm does not default. Then the agents can always get back their investments in the official banks. So deposits in the official banks are viewed as risk-free assets.

On the other hand, the shadow banks only lend money to the private firms, and a private firm may or may not default depending on the firm-specific technology shock it receives. And we assume that each agent’s investment into the shadow bank goes to a particular firm. Notice that the shadow banking sector here is not a pool; the risk from investing into a particular firm is not pooled. Instead, the shadow banking sector is more of an intermediate that matches an agent who has extra money with a firm who is in need of money. Under this setting, an agent’s investment into the shadow banks is a risky asset since a particular firm may choose to default.

When agents are old, they do not work, and receive investment returns at the end of the old period, and use these returns to finance their consumption. The gross rate of return on an agent’s investment into the official banks, \( s_{RF}^t \), is \( R_{s}^t \), and the gross rate of return on an agent’s investment into the shadow banks, \( s_{R}^t \), is \( R_{p}^t \), if the investment is not defaulted. If defaulted, the gross return rate is 0. Let \( \xi_t(i) \) be a random variable defined by

\[
\xi_t(i) = \begin{cases} 
0, & \text{if agent } i \text{'s risky investment is defaulted,} \\
1, & \text{if agent } i \text{'s risky investment is repaid.} 
\end{cases}
\]

We assume that agents know the distribution of this random variable and take the distribution as given. I.e., agents know the default probability. Also we assume that agents take prices \( w_t, R_{s}^t \) and \( R_{p}^t \) as given. In the end we impose two borrowing constraints: agents are not allowed to borrow. Agent’s problem is then

\[
\begin{align*}
\max_{c_y^t, c_o^t, s_{RF}^t, s_{R}^t} & \quad u(c_y^t) + \beta \mathbb{E}_{t} u(c_o^t) \\
\text{s.t.} & \quad c_y^t + s_{RF}^t + s_{R}^t = I_t, \\
& \quad c_o^t = R_{s}^t s_{RF}^t + \xi_{t+1} R_{p}^t s_{R}^t, \\
& \quad s_{RF}^t, s_{R}^t \geq 0
\end{align*}
\]

where \( I_t \) is the agent’s income in his or her young period. We suppress the consumer’s index \( i \).
3.3 The State-Owned Firm

The state-owned firm chooses \( k_t^s \) and \( n_t^s \) to at the beginning of each period and then uses these inputs to produce the capital intensive products. At the end of the period, the firm sells its products, pay the workers and also repays its bank loan. We assume that the state-owned firm takes the prices \( P_t^s, w_t \) and \( R_t^s \) as given. Also, the firm takes the technology levels as given. The state-owned firm’s problem is then

\[
\max_{k_t^s, n_t^s} P_t^s Y_t^s - R_t^s k_t^s - w_t n_t^s
\]

(14)

where \( Y_t \) is given by (2).

Given that \( \alpha_1^s + \alpha_2^s + \alpha_3^s = 1 \), the optimal conditions imply that the income share of each output should equal to its corresponding \( \alpha^s \). That is

\[
\frac{R_t^s k_t^s}{w_t n_t^s} = \frac{\alpha_1^s}{\alpha_2^s}.
\]

(15)

Combining (15) with the first order conditions, one can solve for the optimal choices of capital and labor:

\[
k_t^s = \left( \frac{R_t^s}{\alpha_1^s P_t^s A_t^s \left( \frac{\alpha_2^s R_t^s}{\alpha_1^s w_t} \right)^{\alpha_2^s} \left( \chi_t^s \right)^{\alpha_3^s}} \right)^{-\frac{1}{\alpha_3^s}},
\]

(16)

\[
n_t^s = \frac{\alpha_3^s R_t^s}{\alpha_1^s w_t} \left( \frac{R_t^s}{\alpha_1^s P_t^s A_t^s \left( \frac{\alpha_2^s R_t^s}{\alpha_1^s w_t} \right)^{\alpha_2^s} \left( \chi_t^s \right)^{\alpha_3^s}} \right)^{-\frac{1}{\alpha_3^s}}.
\]

(17)

3.4 Private Firms

There is a continuum of measure 1 private firms and they subject to idiosyncratic technology shock, denoted by \( \chi_t^p(j) \). Following Carlstrom and Fuerst (1997) we assume that the shocks are independently identically distributed across time and firms. Figure 5 shows the time line of private firms.

![Figure 5: Timeline of Private Firms](image)

At the beginning of a period, a private firm borrows money from the shadow banks and also hires labor in the labor market. Suppose that the firm knows the prices \( P_t^p, w_t \) and
and takes them as given, but it does not know its technology level when it makes its capital and labor decisions. However, it knows the distribution $\mathbb{P}$ of the technology shock. Let the support of $\mathbb{P}$ be $\mathcal{X}$. The technology shock realizes in the process of production. After production, a private firm sells its products, pays the workers, and then makes a decision on whether or not to default on its loans from the shadow banks.

If a firm chooses to repay, its profit is whatever that is left after paying the workers and the lenders:

$$\pi_t^R = P_t^p Y_t^p - w_t n_t^p - R_t^p k_t^p.$$  (18)

We suppress the index $j$ of firms for concision. If a firm chooses to default, then it does not need to pay the lenders, both the principal and the interest:

$$\pi_t^D = P_t^p Y_t^p - w_t n_t^p.$$  (19)

However, if a firm defaults, it suffers from a profit loss, which is a fraction $\lambda$ of its profit after paying the workers. Then the default set is given by

$$D_t(P_t^p, R_t^p, w_t) = \{ \chi_t^p \in \mathcal{X} \mid (1 - \lambda)\pi_t^D > \pi_t^R \}.$$  (20)

Notice that potentially, $D_t$ may depend on the prices $P_t^p, w_t$ and $R_t^p$.

A private firm’s problem chooses its capital input, $k_t^p$, labor input, $n_t^p$ and default schedule $D_t$ to maximized its expected profits:

$$\max_{k_t^p, n_t^p, D_t} \int_{\chi_t^p \in D_t} \left[ P_t^p A_t^p (k_t^p)^{\alpha_1^p} (n_t^p)^{\alpha_2^p} (\chi_t^p)^{\alpha_3^p} - w_t n_t^p \right] (1 - \lambda) d\mathbb{P}(\chi_t^p)$$

$$\quad + \int_{\chi_t^p \not \in D_t} \left[ P_t^p A_t^p (k_t^p)^{\alpha_1^p} (n_t^p)^{\alpha_2^p} (\chi_t^p)^{\alpha_3^p} - w_t n_t^p - R_t^p k_t^p \right] d\mathbb{P}(\chi_t^p).$$  (21)

Given the default schedule, one can solve for the optimal choice of $k_t^p$ and $n_t^p$:

$$k_t^p = \left( \frac{R_t^p}{P_t^p \frac{R_t^p}{w_t} C_1} \right)^{-\frac{1}{\alpha_3^p}} C_2,$$  (22)

$$n_t^p = \frac{R_t^p}{w_t} C_1 \left( \frac{R_t^p}{P_t^p \frac{R_t^p}{w_t} C_1} \right)^{-\frac{1}{\alpha_3^p}} C_2,$$  (23)

where

$$C_1 = \frac{\alpha_2^p}{\alpha_1^p} \cdot \frac{1}{\int_{\chi_t^p \in D_t} d\mathbb{P} - \int_{\chi_t^p \not \in D_t} (1 - \lambda) d\mathbb{P} + \int_{\chi_t^p \not \in D_t} d\mathbb{P}},$$  (24)
\[ C_2 = \frac{1}{\alpha_t^p A_t^p} \cdot \frac{\int_{x_t^p \in D_t} \chi_t^p \, \mathrm{d}\mathbb{P}}{\int_{x_t^p \in E_t} (1 - \lambda)(\chi_t^p)^{\alpha_t^p} \, \mathrm{d}\mathbb{P} + \int_{x_t^p \notin D_t} (\chi_t^p)^{\alpha_t^p} \, \mathrm{d}\mathbb{P}}. \] (25)

If we substitute (18) and (19) into (20), we obtain the private firm’s optimal default rule: the firm defaults if and only if

\[ \chi_t^p < \left( \frac{R_t^k + w_t E_t^p}{P_t^k A_t^p (k_t^p)^{\alpha_t^p} (n_t^p)^{\alpha_2^p}} \right)^{\frac{1}{\alpha_3^p}}. \] (26)

Substituting (22) and (23) into (26), we get that a firm defaults if and only if

\[ \chi_t^p < \left( \frac{1 + C_1}{A_t^p C_2} \right)^{\frac{1}{\alpha_3^p}}. \] (27)

Notice that \( C_1 \) and \( C_2 \) depend on \( D_t \). In optimum, the \( D_t \) used to calculate \( C_1 \) and \( C_2 \) should be consistent with the default rule (27). Let \( D_t^* \) be such a default schedule.

**Proposition 1.** If \( D_t^* \) exists, and if \( \chi \in D_t^* \), then \( \chi' \in D_t^* \) for all \( \chi' < \chi \).

*Proof.* This is a direct consequence of (27).

**Proposition 2.** If \( \mathcal{X} \) is compact, and \( \mathbb{P} \) is absolutely continuous on \( \mathcal{X} \), then there exist a default schedule \( D_t^* \) consistent with (27).

*Proof.* For notational concision, we drop all time subscripts. Notice that in (24) and (25), \( C_1 \) and \( C_2 \) are correspondences of \( D_t \). To be explicit, we write them as \( C_1(D_t) \) and \( C_2(D_t) \).

For any \( \chi \in \mathcal{X} \), let the set \( \tilde{D}_\chi = (-\infty, \chi) \cap \mathcal{X} \). Let \( f : \mathcal{X} \to \mathcal{X} \) be a function on \( \mathcal{X} \) defined by

\[ f(\chi) = \left[ \frac{1}{\chi} + C_1 \left( \frac{\tilde{D}_\chi}{A_t^p C_2 (\tilde{D}_\chi)} \right) \right]^{\frac{1}{\alpha_3^p}}. \] (28)

Since \( \mathbb{P} \) is absolutely continuous, \( C_1(\tilde{D}_\chi) \) and \( C_2(\tilde{D}_\chi) \) are continuous in \( \chi \), and therefore \( f(\chi) \) is continuous in \( \chi \).

Let \( E = \{ \chi \in \mathcal{X} | \chi \leq f(\chi) \} \). If \( E = \emptyset \), then let \( D^* = \emptyset \). That is, a firm never defaults. It is easy to see such a default rule satisfy (27).

If \( E \neq \emptyset \), by continuity of \( f(\chi) \), we can write \( E = E_1 \cup E_2 \cup \cdots \cup E_n \) where \( \{E_i\} \) is a sequence of disjoint closed sets. Take any \( E_i \), and let \( E_i^* = E_i \setminus \{ \chi \in \mathcal{X} | f(\chi) = \chi \} \).

Let \( \bar{\chi} = \max \mathcal{X} \). If \( \bar{\chi} \in E_i \), then \( D^* = \mathcal{X} \) is an optimal defaulting rule satisfying (27). This is easy to see because if \( \bar{\chi} < f(\bar{\chi}) \), then \( \chi < f(\chi) \) for all \( \chi \in \mathcal{X} \).

Otherwise, let \( \chi_i^* = \sup E_i^* \). Then \( \tilde{D}_{\chi_i^*} \) is an optimal default rule that satisfies (27). This is because that if \( \bar{\chi} \notin E_i \), and all \( E_i^* \) are disjoint, by continuity of \( f \) it must be that \( f(\chi_i^*) = \chi_i^* \). Then \( \chi < f(\chi_i^*) \) if and only if \( \chi \in \tilde{D}_{\chi_i^*} \), by definition of \( \tilde{D}_{\chi_i^*} \).
As we can see in the proof of Proposition 2, there may be multiple optimal default rules, depending on the shape of $f$. We are not able to prove any uniqueness results.

**Proposition 3.** If $\mathcal{X}$ is compact, the probability density function of $\mathbb{P}$ is strictly positive, and

$$
\left( \frac{\alpha^P}{\lambda} + \alpha^2 \right) \mathbb{E} \left[ (\chi^P)^{\alpha^2} \right] > \chi
$$

where $\chi = \min \mathcal{X}$, then default probability is non-zero.

*Proof.* Let $D^*$ be an optimal default set. It is easy to check that if condition (29) holds, $f(\chi) > \chi$. By continuity of $f$, there exists $\varepsilon > 0$ such that $\mathcal{A} = [\chi, \chi + \varepsilon] \subset D^*$. The default probability should be greater than

$$
\int_{\mathcal{A}} d\mathbb{P} = \int_{\chi}^{\chi + \varepsilon} d\mathbb{P},
$$

which is strictly positive if $d\mathbb{P} > 0$. \(\square\)

**Proposition 4.** If $D^*$ exists, $D^*$ is independent of the prices. That is, $D^*$ is independent of $P^p, w$ and $R^p$.

*Proof.* Notice that there is no price terms in (24), (25) and (27), and these three equations are necessary and sufficient conditions for the optimal default rule $D^*$. Therefore, $D^*$ is independent of prices. \(\square\)

### 3.5 Equilibrium

An equilibrium of the economy under financial repression sequences of prices $\{P^s_t\}, \{P^p_t\}, \{R^s_t\}, \{R^p_t\}, \{w_t\}$, sequences of quantities $\{c^s_t(i)\}, \{c^p_t(i)\}, \{s^RF_t(i)\}, \{s^R_t(i)\}, \{I_t(i)\}, \{k^s_t\}, \{n^s_t\}, \{k^p_j\}, \{n^p_j\}, \{\pi_t(j)\}$, sequences of default schedules $\{D_t(j)\}$, a sequence of employment set $\{H_t\}$, and a sequence of default probability $\{\kappa_t\}$ such that

1. $\{R^s_t\}$ is dictated as an exogenous process.

2. Given prices, income $\{I_t\}$ and the default probability $\{\kappa_t\}$, the quantities $\{c^s_t(i)\}, \{c^p_t(i)\}, \{s^RF_t(i)\}, \{s^R_t(i)\}$ solves the agent’s problem.

3. Given prices, the quantities $\{k^s_t\}, \{n^s_t\}$ solves the state-owned firm’s problem.

4. Given prices and the default schedule $\{D_t\}$, the quantities $\{k^p_t(j)\}, \{n^p_t(j)\}, \{\pi_t(j)\}$ solves the private firm’s problem.

5. Asset markets clear:

$$
\int s^RF_t(i)di = k^s_t, \quad (30)
$$

$$
\int s^R_t(i)di = \int k^p_t(j)dj. \quad (31)
$$
6. In labor market
\[ \int_H d\bar{\epsilon} = n_t^s + \int n_t^p(j) d\bar{\epsilon}. \]  
(32)

7. Income is given by
\[ I_t(i) = \begin{cases} 
  w + \int \pi_t(j) d\bar{\epsilon}, & i \in E, \\
  \int \pi_t(j) d\bar{\epsilon}, & i \notin E.
\end{cases} \]  
(33)

8. Default schedule is consistent with the optimal condition (27).

9. Default probability is consistent with the default schedule:
\[ \kappa_t = \int_{D_t} d\mathbb{P}. \]  
(34)

10. Optimal condition (6) for the aggregation sector holds.

We assume that there is no inter-generational dependence among agents. Also, since all firms are one-period firms, there is no dynamics going on in the production sector. Therefore, once there is no aggregate uncertainty, by law of large number, the economy admits an equilibrium in which all aggregate variables and prices are static.

It should be pointed out that in this equilibrium, the labor market is not cleared. This is because the price in the risk-free asset market, i.e., the risk-free interest rate, is dictated rather than market-determined. In the case of complete financial segregation, there is no extra links between the markets in the model that could serve as an extra degree of freedom. As a consequence, there has to be at least one market that cannot be cleared. Given that in the real world, labor market is likely to have the least mobility, we sacrifice the labor market to guarantee that the other markets are cleared.

### 3.6 Some Numerical Results

Table 1 shows the parameters values used in the numerical exercise. Since we are using a two-period overlapping generation model, we treat each period as 30 years and set the subjective discount factor so that the annual subjective discount factor is 0.99. Also, we set the relative risk aversion coefficient in the utility function to be 2. These are common values used in the literature.

The output elasticities of inputs for the two kinds of firms are set to mimic the fact that the state-owned firms in China are relatively more capital intensive and private firms are relatively more labor intensive. The technology levels and shock processes are set so that private firms do default, but the overall default probability is not too high. Unfortunately there is no data available to estimate the default probability in Chinese economy. Default has never occurred in the shadow banking activities in which the large legal financial institutions are involved. However, there has been default incidences in the illegal shadow banks. Under our parameter settings, the default probability turns out to be 0.41%.

Figure 6 gives the comparative statics with respect to changes in the official interest rate in this model with financial segregation. We interpret the increase of official interest rate
as the government gradually increasing the upper bound of the interest rate in the official banking system. If we follow the logic of the “dual track” reforms in other areas of the economy in the past, we would hope that as the government gradually increases the official interest rate, the gap between the official interest rate and the shadow bank rate shrinks, and when the two rates are close, the two tracks are to be merged.

The numerical results agree with the above conjecture. As the official interest rate goes up, the shadow banks rate goes up, but with smaller magnitude. This implies that lifting the upper bound of the official bank rate helps the convergence of the two rates.

As the interest rates go up, the firms’ uses of capital and labor both decrease and the wage rate goes up. The price the government pays for a policy that helps the close up of the two tracks is a falling employment, and a falling output.

On the other hand, the economy sees an relative expansion of its state-owned sector to its private sector. Both the capital and labor usage ratio of state-owned firms to private firms increase resulting in a relative increase in the output of state-owned firms produced intermediate good. Prices of the products from the state-owned sector becomes cheaper.

While average profit of private firms decreases monotonically as the official interest rate goes up, profit of the state-owned firm is hump-shape. This supports our earlier claim that at least part of the reason that the government chooses a particular level of official interest rate is that the government tries to maintain a high level of profits from the firm it owns. The government does not lower the state-owned firm’s financial cost arbitrarily close to 0 because in that case, risk-free savings from the agents, which finances the state-owned firm’s production, will be extremely low, which hamper the profitability of the state-owned firm.

As interest rates goes up, the overall saving rate decreases. This seems to be counter-intuitive at first glance since it implies that people save less when returns of savings increase.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>subjective discount factor</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>relative risk aversion coefficient</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>share parameter of input in aggregation technology</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>elasticity of substitution in aggregation technology</td>
</tr>
<tr>
<td>$\mu$</td>
<td>measure of agents</td>
</tr>
<tr>
<td>$\mu^p$</td>
<td>measure of private firms</td>
</tr>
<tr>
<td>$A_s$</td>
<td>technology level (S)</td>
</tr>
<tr>
<td>$\alpha_s^1$</td>
<td>output elasticity of capital (S)</td>
</tr>
<tr>
<td>$\alpha_s^2$</td>
<td>output elasticity of labor (S)</td>
</tr>
<tr>
<td>$\alpha_s^3$</td>
<td>output elasticity of technology shock (S)</td>
</tr>
<tr>
<td>$\chi_s$</td>
<td>technology shock process (S)</td>
</tr>
<tr>
<td>$A_p$</td>
<td>technology level (P)</td>
</tr>
<tr>
<td>$\alpha_p^1$</td>
<td>output elasticity of capital (P)</td>
</tr>
<tr>
<td>$\alpha_p^2$</td>
<td>output elasticity of labor (P)</td>
</tr>
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<td>$\alpha_p^3$</td>
<td>output elasticity of technology shock (P)</td>
</tr>
<tr>
<td>$\chi_p$</td>
<td>technology shock process (P)</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>fraction of income loss if default</td>
</tr>
</tbody>
</table>

Table 1: Parameter Values
However, this decrease is a consequence of the general equilibrium: income of agents decreases when the interest rates increase. Under constant relative risk aversion utility, given prices, consumption profile is concave, implying a decreasing saving rate when income decreases. And our result shows that this effect dominates the effect of increases in the interest rates.

## 4 An Augmented Model

In this section we present a model in which the financial market is not completely segregated, but still the private firms are discriminated against the state-owned firm.

Figure 7 gives the relationships between different sectors in our augmented model. In this model, the state-owned firm again borrows only from the official banks. The private firms may borrow both from the official banks and from the shadow banks. However, the official banks extend credit to private firms only after they have satisfied the need from the state-owned firm. Therefore, it could be the case that some of the private firms who apply for credit from the official banks can not get money from the official banks in the end. The private firms take this possibility into consideration when they make their decisions.

In this model, the problem of agents and the state-owned firm are the same as those in
the simple model. The private firms’ problem is different because now they have two sources to finance their capital investment.

4.1 Private Firms

Figure 8 gives the time line of the private firm’s problem. At the beginning of a period, a private firm submits a loan plan \( k_t^B(i) \) to an official bank. Before it gets any response from the official banks, it has to determine how much to borrow from the shadow banks and how many workers to hire on the labor market. Its loan application to shadow banks, denoted by \( k_t^{SB}(i) \), will always be honored in equilibrium since the interest rate there is determined by demand and supply and there is no friction in that market. However since interest rate in the official banking sector is regulated, credit shortage may appear and some of the private firms may not be able to get money they want from the official banks. Let the probability of not being able to get money from the official banks be \( \eta \), and suppose private firms take this probability as given.

Before a private firm starts to produce, it gets the result whether its loan application to the official bank is approved. Then the firm goes to the production process, during which the idiosyncratic technology shock realizes.

In the end of the period, the firm sells its products, pays the workers, repays the principle and interest of their official bank loans if applicable, and choose whether or not to default on its loans from the shadow banks. The default set \( D_t^1 \) of the private firms that manages to borrow from the official banks may be different from the default set \( D_t^0 \) of the private firms whose loan application are not approved.

The default arrangement is as before: if a firm defaults, it loses a fraction \( \lambda \) of its profit.
Suppose that the private firms take prices as given. Then their problem is

\[
\max_{k_t^B, k_t^{SB}, n_t, D_t^0, D_t^1} \eta \left[ \int_{\chi_t^P \in D_t^1} \left( P_t^p A_t^p \left( k_t^B + k_t^{SB} \right)^{\alpha_1^P} (n_t^p)^{\alpha_2^P} (\chi_t^P)^{\alpha_3^P} - R_t^p k_t^B - w_t n_t^p \right) (1 - \lambda) d\mathbb{P}(\chi_t^P) \right. \\
+ \left. \int_{\chi_t^P \notin D_t^1} \left( P_t^p A_t^p \left( k_t^B + k_t^{SB} \right)^{\alpha_1^P} (n_t^p)^{\alpha_2^P} (\chi_t^P)^{\alpha_3^P} - R_t^p k_t^B - w_t n_t^p - R_t^p k_t^{SB} \right) d\mathbb{P}(\chi_t^P) \right] \\
+ (1 - \eta) \left[ \int_{\chi_t^P \in D_t^0} \left( P_t^p A_t^p \left( k_t^{SB} \right)^{\alpha_1^P} (n_t^p)^{\alpha_2^P} (\chi_t^P)^{\alpha_3^P} - w_t n_t^p \right) (1 - \lambda) d\mathbb{P}(\chi_t^P) \right. \\
+ \left. \int_{\chi_t^P \notin D_t^0} \left( P_t^p A_t^p \left( k_t^{SB} \right)^{\alpha_1^P} (n_t^p)^{\alpha_2^P} (\chi_t^P)^{\alpha_3^P} - w_t n_t^p - R_t^p k_t^{SB} \right) d\mathbb{P}(\chi_t^P) \right].
\]

(35)

The default rules are given by: if a firm is not able to get money from the official banks, it defaults if and only if

\[
\chi_t^P < \left( \frac{R_t^p k_t^{SB} + w_t n_t^p}{P_t^p A_t^p \left( k_t^{SB} \right)^{\alpha_1^P} (n_t^p)^{\alpha_2^P}} \right)^{\frac{1}{\alpha_3^P}}; \tag{36}
\]

if a firm is able to get money from the official banks, it defaults if and only if

\[
\chi_t^P < \left( \frac{R_t^p k_t^{SB} + w_t n_t^p + R_t^p k_t^B}{P_t^p A_t^p \left( k_t^B + k_t^{SB} \right)^{\alpha_1^P} (n_t^p)^{\alpha_2^P}} \right)^{\frac{1}{\alpha_3^P}}. \tag{37}
\]

In general, (36) and (37) will generate different default sets. Since we do not have explicit expressions for optimal \( k_t^B, k_t^{SB} \) and \( n_t^p \), we do not have expressions as (27) for the default rule. Also, we are not able to prove existence and uniqueness of optimal default rule, and the optimal default rule, if exits, is not independent of the prices any more.
4.2 Equilibrium

Comparing with the complete financial regression model, there is an extra connection between the private firms and the official banks, which serves as an extra degree of freedom and clears the extra market. So this augmented model admits an equilibrium in which all markets could clear:

An equilibrium of the economy under financial repression sequences of prices \{P_s^t\}, \{P_p^t\}, \{R_s^t\}, \{R_p^t\}, \{w_t\}, sequences of quantities \{c_s^y(i)\}, \{c_p^0(i)\}, \{s_t^{R_F}(i)\}, \{s_t^{R_R}(i)\}, \{I_t(i)\}, \{k_s^t\}, \{n_s^t\}, \{k_p^B(j)\}, \{k_p^{SB}(j)\}, \{n_p^t(j)\}, \{\pi_t(j)\}, sequences of default schedules \{D_p^0(j)\}, \{D_p^1(j)\}, a sequence of default probabilities \{\kappa_t\} and a sequence of official bank loan approval rates \{\eta_t\} such that

1. \{R_s^t\} is dictated as an exogenous process.

2. Given prices, income \{I_t\} and the default probability \{\kappa_t\}, the quantities \{c_s^y(i)\}, \{c_p^0(i)\}, \{s_t^{R_F}(i)\}, \{s_t^{R_R}(i)\} solves the agent’s problem.

3. Given prices, the quantities \{k_s^t\}, \{n_s^t\} solves the state-owned firm’s problem.

4. Given prices, the official bank loan approval rate \{\eta_t\}, and the default schedule \{D_t\}, the quantities \{k_p^B(j)\}, \{k_p^{SB}(j)\}, \{n_p^t(j)\}, \{\pi_t(j)\} solves the private firm’s problem.

5. Asset markets clear:
   \[\int s_t^{RF}(i)di = k_s^t + \eta_t \int k_t^B(j)dj, \quad (38)\]
   \[\int s_t^R(i)di = \int k_t^{SB}(j)dj. \quad (39)\]

6. Labor market clears:
   \[n_s^t + \int n_p^t(j)dj = \mu. \quad (40)\]

7. Income is given by
   \[I_t(i) = w + \frac{1}{\mu} \int \pi_t(j)dj \quad (41)\]

8. Default schedules are consistent with optimal conditions (36) and (37).

9. Default probability is consistent with the default schedule:
   \[\kappa_t = (1 - \eta_t) \int_{D_p^0} d\mathbb{P} + \eta_t \int_{D_p^1} d\mathbb{P}. \quad (42)\]

10. Optimal condition (6) for the aggregation sector holds.
4.3 Some Numerical Results

Using the same parameter values as in the complete financial segregation model, we obtain the comparative statics of our augmented model with respect to official interest rate changes as in Figure 9.

Under our parameter settings, the default probability for private firms who get money from the official banks is the same as the default probability for the private firms who cannot get money from the official bank. Both the default probabilities are 0.41%

The key difference of this exercise from the one discussed in the previous section is that the interest rate ratio gets larger as the official bank rate goes up. This is because the labor market puts restrictions on how the two interest rates interacts. To see this, we take logs on both side of equations (16) and (17), we get

\[
\ln k^s = -\frac{\alpha_1^s + \alpha_3^s}{\alpha_3^s} \ln R^s - \frac{\alpha_2^s}{\alpha_3^s} \ln w + F_1,
\]

\[
\ln n^s = - \ln R^s - \frac{\alpha_2^s + \alpha_3^s}{\alpha_3^s} \ln w + F_2,
\]

where \(F_1\) and \(F_2\) are terms independent of \(R^s\) and \(w\). It could be seen that \(\alpha_1^s\), \(\alpha_2^s\) and \(\alpha_3^s\) measures how choices of inputs responses to price changes. In the private sector, there are
also relations like (43) and (44). Although the introduction of default makes the expression much more complicated, the signs and basic pattern remains.

When the official interest rate goes up, labor demand from the state-owned firm goes down, which drives the wage rate down. This in turn increases the private firms’ demand of capital. Since private firms are labor intensive and thus has large $\alpha_p^2$, the responsiveness of capital demand to wage changes is big, which lead to a big increase in shadow bank interest rate, given that the official banks do not help the private firms much, which lead to larger interest rate gap between the official rate and the shadow rate. This increased gap implies that the usual dual track reform strategy may not work in our financial repression situation.

Also, an increased risky to risk-free asset ratio shows that the economy would see an expansion of its shadow banking sector, which is not what policy makers in China want since this sector introduces extra risks into the economy and these risks are not under their supervision or control.

Another main difference is that in this augmented model, as the government increases the official interest rate, the relative size of the state-owned sector shrinks comparing to the private firms. This is because as interest rate increases faster in the shadow banking system, more resources go to the private firms instead of the state-owned firm. However, once again this is at the price of hampered profitability of both kinds of firms as well as a depressed economy.

5 Conclusion

In this paper we did two exercises using two models that incorporate financial repression. The two models give different results in terms of policy implications of an interest rate liberalization in the Chinese economy. If our augmented model do captures the main features of a financially repressed Chinese economy, then an interest rate liberalization may not deliver desired results (that is, a convergence of the two interest rate systems, and a shrinkage of the shadow banking sector) if the current economic structure is to be preserved. Actually, the result of a reform like this is exactly the opposite of what the reformers want.

We propose that a structural reform of removing the state owned firm’s priority in the economy should be a prerequisite of an effective interest rate liberalization. In our augmented model, due to the priority the state-owned has in terms of financing its operations from the official banks, the private firms are left with little from the official banks. Interest rate changes in the official banks then affect/benefit the private firms very little, which makes the official interest rate more of a benchmark rate rather than a driving force of resource reallocation. If, on the other hand, the state-owned firm and the private firms are on a plain field, an increase in the official interest rate may serve as a release of the price ceiling, increases the supply of capital from the official banks, thus decreases the private firms’ demand of capital in the shadow banking system, which would decrease the shadow bank rate as well as the size of the shadow banking industry.
References


