

Shadow Banking: China's Dual-Track Interest Rate Liberalization*

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Abstract

Shadow banking in China is mainly conducted by banks to evade the excessive credit control, which constitutes a dual-track approach to liberalize the country's rigid interest rate policy. The market track of shadow banking can lead to efficiency gain by allowing credit resale to fund the more productive yet credit-deprived private enterprises (PEs). *Pareto* improvement can be achieved as the banks and state owned enterprises (SOEs) participate in shadow banking and share the efficiency gain. Full interest rate liberalization may not lead to additional efficiency gain, as it magnifies the credit mis-allocation in favor of the less productive SOEs.

JEL Classification: G21, G23, G28, P21, P31, P34.

Keywords: Shadow banking, dual-track reform, interest rate liberalization, *Pareto* improvement, credit resale.

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Abstract

Shadow banking in China is mainly conducted by banks to evade the excessive credit control, which constitutes a dual-track approach to liberalize the country's rigid interest rate policy. The market track of shadow banking can lead to efficiency gain by allowing credit resale to fund the more productive yet credit-deprived private enterprises (PEs). *Pareto* improvement can be achieved as the banks and state owned enterprises (SOEs) participate in shadow banking and share the efficiency gain. Full interest rate liberalization may not lead to additional efficiency gain, as it magnifies the credit mis-allocation in favor of the less productive SOEs.

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1 Introduction

Interest rate policy in China has been exercised through price control over bank deposit rate and quota control over bank loan volume, as banks dominate the country's financial system. This policy remains one of the root causes for economic imbalance and structural distortions in China, but has never been fundamentally reformed.¹ The main objection comes from banks and state-owned enterprises (SOEs), because they fear to become reform losers if deprived of the privileges under the credit control regime. Moreover, the regulators also worry that the traditional banking system is ill-equipped to compete and survive in an interest rate sensitive market environment. Therefore, formulating a practical reform strategy to liberalize the interest rate policy presents a monumental challenge for Chinese decision makers, especially to achieve a broad consensus.

Shadow banking in China has experienced spectacular growth since 2007-2009 global financial crisis.² Two features distinguish China's shadow banking from its Western counterparts: (1) it is dominated by banks; and (2) it has tacit endorsement from the government. Banks take a leading role in shadow banking, in order to evade regulatory controls over interest rate and loan volume. They issue off-balance-sheet wealth management products (WMPs) to depositors and make trust loans to borrowers. Banks also serve as intermediary for large corporations, mainly SOEs, to issue entrust loans to mostly private enterprises (PEs). About two-thirds of the business flow in shadow banking are

¹We provide an overview of the interest rate policy in China in Section 2.1.2. The economic imbalance and distortions include over-investment, policy-driven business cycle, high and volatile inflation, capital mis-allocation to the state-owned sector, and lack of financing to the private sector. The financial and fiscal decentralizations have led to a transition from a credit plan regime to a credit control regime in China (Brandt and Zhu, 2000). Also credit control has been loosening gradually over time. However, the controls over deposit interest rate and bank loan volume effectively remain today, via formal and informal guidance from the central bank and other regulatory agencies.

²The People's Bank of China (PBC) defines China's shadow banking sector as credit intermediation involving entities and activities outside the regular banking sector, which provides liquidity and credit transformation, and can potentially be a source of systemic risk or regulatory arbitrage. The shadow banking practice in China involves quite different yet much simpler financial products compared the Western shadow banking. According to Adrian and Ashcraft (2012) and Adrian, Covitz and Liang (2013), the typical shadow banking products in the U.S. include asset-backed commercial papers, tri-party repurchase agreements, money market funds, asset-backed securities (ABSs) through securitization, and dealer-intermediated finance.

effectively “bank loans in disguise” (Elliott, Kroeber and Qiao, 2015).

Shadow banking in China essentially constitutes a dual-track reform design to liberalize the country’s interest rate policy. The notion of dual-track reform mechanism in this context begins with a preexisting control credit track, where deposit rate and loan volume are depressed below equilibrium. Then, a market track of shadow banking is introduced to allow agents to have additional credit demand or supply satisfied at the market interest rates. One advantage of the dual-track mechanism is that it does not require dismantling or restructuring the existing system and institutions, and thus, reduces the likelihood of economic instability. In this paper, we develop a simple market equilibrium model to examine China’s shadow banking from the perspective of economic reform mechanism.

The dual-track approach to interest rate liberalization can lead to efficiency gain through a joint effect of more efficient credit allocation and less capital idolization. The former is unique to the Chinese economy, while the latter is common to shadow banking in general. Under the control track of bank credit, interest rate repression leads to excessive credit demand. Given banks’ dominance in the financial system, loan quota is imposed to avoid credit flooding, resulting in capital idolization and relative short-supply of credit. Banks ration the cheap credit in favor of less productive SOEs, partly because SOEs have implicit government guarantee (Brandt and Zhu, 2001; Song, Storesletten and Zilibotti, 2011), while more productive PEs are insufficiently funded by bank credit. After the rise of shadow banking, capital idolization moderates as households switch from deposits to WMPs, reducing the amount of social financing subject to stringent lending constraint and high reserve requirement ratio (RRR). Output increases as shadow banking credit, including credit resale by SOEs, flows to more productive yet under-funded PEs.

Pareto improvement can be achieved under the dual-track mechanism. PEs and households benefit unconditionally from the interest rate liberalization, as PEs obtain the option to borrow additional credit while households obtain the option to invest in WMP for higher return. Banks and SOEs are potential reform losers, if banks’s interest margin shrinks due to competition while SOEs lose access to low cost credit. However, dual-track

mechanism allows banks and SOEs to participate in the market track of shadow banking and therefore to share efficiency gain from the PEs' high productivity. The gains shared by banks and SOEs can fully compensate their reform losses, under reasonable conditions. Thus, dual-track liberalization can have the least opposition from banks and SOEs, which still dominate the Chinese economy and financial system.

We show that, compared with the current dual-track liberalization, full interest rate liberalization that removes binding deposit rate ceiling and loan quota may not necessarily lead to additional efficiency gain. As the controls being removed, more capital flows back to the banking sector. This magnifies the credit mis-allocation problem by banks in favor of the less efficient SOEs, which adversely affects the aggregate output. Capital idolization also increases as more deposit is subject to the reserve requirement. This finding highlights the importance of joint reforming both banks and SOEs.

Numerical simulations from the extended baseline model—more resembling the reality in Chinese financial system—confirm the analytical results mentioned above. Moreover, the efficiency gain from dual-track interest rate liberalization increases with the degrees of controls on deposit rate and loan volume. The effect of shadow banking on output gain depends critically on bond market (direct financing) efficiency—less efficient bond market implies more efficiency gain from dual-track interest rate liberalization.

Lin (1992) and Lau, Qian and Roland (2000) study dual-track reforms in the agricultural and industrial sectors in China.³ Our finding shares the same insight—when facing multiple distortions, pragmatic dual-track reform (second best) may outperform full marketization reform (first best) in achieving *Pareto* improvement. However, the dual-track reforms in real sectors rely on forced execution of the plan track to guarantee *Pareto* improvement (Lau, Qian and Roland, 2000), while in financial sector it is achieved by credit transfer or resale from SOEs to PEs through shadow banking. Intermediaries play trivial roles in real

³China has carried out a series of economic reforms since 1979. These reforms largely followed a dual-track approach, which involves introducing a market track in addition to a preexisting plan track to liberalize the market. See Sicular (1988), Byrd (1991), Lin (1992), Lin and Zhou (1993), Lau, Qian and Roland (2000), Sun and Tong (2003), and Liao, Liu and Wang (2014) for discussions on China's dual-track reforms in the agricultural and industrial sectors, and on state-owned enterprise ownership structure.

sector reforms but are critical in financial sector reforms (Brandt and Zhu, 2000). Our work is related to Gennaioli, Shleifer and Vishny (2012, 2013) in that shadow banking improves welfare but exposes financial system to greater risks. Our focus is on how shadow banking functions as an integral part of transitioning credit system to liberalize China's rigid interest rate policy in a pragmatic manner.

Recently, Funke, Mihaylovski and Zhu (2015) study the interactions among nonstandard monetary policy, the traditional banking sector, and the shadow bank sector in China with a dynamic stochastic general equilibrium (DSGE) model. Hachem and Song (2016) relate asymmetric competition in the bank sector to the rise of shadow banking in China. Our paper models shadow banking as a reform mechanism, with implications relevant for financial liberalization in other transitioning economies. We also provide a useful framework to analyze shadow banking as an integral part of a country's credit system.

The rest of the paper is organized as follows: Section 2 reviews China's interest rate policy, bank sector, and the rise of shadow banking. Section 3 introduces the baseline model. Section 4 analyzes the theoretical results. Section 5 presents the extended baseline model and numerical simulations. Section 6 concludes.

2 Institutional Background

This section gives an overview of China's interest rate policy, banking sector, and shadow banking. It provides an important context for understanding the role of shadow banking in the process of interest rate liberalization in China under the dual-track framework.

2.1 China's Interest Rate Policy

Interest rates have been rigidly controlled in China since the era of planned economy. The *price-based* and *quantity-based* controls are exercised through bank regulations because banks dominate China's credit system. *Price-based* control involves maximum deposit rate and minimum loan rate that were imposed to create a wealth transfer from savers to

borrowers (Lardy, 2008), and to ensure banks to have healthy profit margins.⁴ Repressing interest rates below the equilibrium leads to excessive demand for credit, over-investment, and high inflation. To maintain price and economic stability, *quantity-based* control is exercised by limiting bank loan volume, which is largely equivalent to controlling overall money supply. Banks were not allowed to lend funds more than 75% of their deposit volumes prior to October 2015. The People’s Bank of China (PBC) requires banks to hold substantial deposit reserve at time-varying but high levels.⁵ Banks receive formal and informal guidance from the PBC and other government officials, e.g., to limit or boost lending to certain sectors whose growth the government intends to influence.

2.1.1 Formation of China’s Interest Rate Policy

Interest rate repression was formed to facilitate China’s early economic growth strategy, which prioritized the development of heavy industries in the 1950’s (Lin, 1990; Lin and Zhou, 1993).⁶ Heavy industries are capital-intensive, while capital was by then the scarcest production resource. China artificially kept interest rates below the equilibrium to reduce the price of capital. In addition, exchange rates were set artificially high to enable heavy industries to import at low cost at the expense of primary product exportation. Wage and material prices were also repressed to allow heavy industries to generate high profit margins. Enterprises were nationalized to ensure that profits were retained in heavy industries. Price repression inevitably leads to resource shortage. To solve the problem, a highly centralized planning economy was established to secure resource allocation in favor of heavy industries.

⁴Official minimum loan rate and maximum deposit rate were removed in 2013 and 2015, respectively. However, bank deposit and lending rates are still effectively controlled through substantial window guidance today.

⁵As of February 2015, the required reserve ratios (RRRs) for large depository institutions, small and medium banks, and rural credit cooperatives and small financial institutions are 19.5%, 17.5%, and 16.0%, respectively.

⁶There were several reasons to prioritize the development of heavy industries: (1) China needed to quickly establish a nation-wide defense system given its geopolitical environment in the 1950’s; (2) impoverished agricultural economy could not provide necessary market conditions for the debut of economic development; (3) heavy industries have the advantage of consuming their own outputs to self-sustain growth at the initial stage of development. Same strategy was also adopted by the former Soviet Union, India, and Eastern European and Latin American countries in their early economic development.

China established a complete heavy industry system and achieved high-speed economic growth during 1949-1956. However, the strategy of prioritizing the development of heavy industries was costly and unsustainable. Surplus transferred from other industries and households was gradually exhausted, i.e., the agriculture and consumer sectors experienced almost no growth during the same period of time. Most households remained impoverished in the face of low wealth accumulation. On the other hand, excessive output of heavy industries could not be afforded for consumption by other underdeveloped industries and financially constrained households. Economic growth stagnated over the period of 1956-1979, and then, reforms became inevitable in China.

China has gradually transitioned from planned economy to market economy since 1979. State-controlled procurement system of agricultural and industrial products was demolished (Lin, 1992; Lau, Qian and Roland, 2000). Prices of labor and almost all goods are market-based today. PEs have emerged and grown rapidly since the 1980's. Some SOEs have been partially privatized and publicly listed since the 1990's (Sun and Tong, 2003). The split-share structure reform granted legitimate trading right to state-owned shares in the secondary markets, paving way for further privatization (Liao, Liu and Wang, 2014). However, interest rates have remained repressed and been under tight control (Brandt and Zhu, 2000), until very recently. We discuss below the problems caused by interest rate repression, followed by the reasons for lack of reform.

2.1.2 Problems Caused by Interest Rate Repression

Interest rate repression is one of the root causes of the structural imbalance and distortions of the Chinese economy. Interest rates below the equilibrium naturally induce incentive to invest excessively. Cheap credit flows into capital-intensive industries, e.g., steel and coal mining, and inefficient state-owned sector, resulting in over capacity and pollution. Interest rate repression leads to the co-movements of investment and consumption demands in the same direction, resulting in excessively volatile aggregate demand.

Interest rate repression presents a major challenge for the monetary policy by fueling

policy-driven economic cycles in China. A boom typically starts with simultaneous increases in investment and consumption as the government loosens investment restrictions in certain sectors. Bank credit is expanded to meet rapidly rising demand. After experiencing rapid growth for a couple of years, the economy becomes over-heated due to credit over-supply. Inflation rises as demand for resources and services exceeds their supply. [Brandt and Zhu \(2000\)](#) show that growth rate and inflation move in tandem in China.

To tame inflation, monetary and administrative policies are tightened to prevent the economy from overheating, which may threaten economic and social stability. PBC orders banks to suddenly reduce credit supply, and the government reimposes limits on the price increases of agricultural products. Both investment and consumption drop dramatically, risking an economic hard-landing. The government cannot balance its budget if the economic growth falls below a threshold for a prolonged period of time. This fiscal pressure leads to softening of administrative restrictions on investment in some sectors and easing of the monetary tightening. A new round of policy-driven economic cycle begins.

Despite these well-known problems, the interest rate policy has never been fundamentally reformed.⁷ Lack of reform comes mainly from the policy makers, who fear that premature financial sector reform may bring economic and social instability before the economic micro-foundation is ready. Banks and SOEs worry to lose their privileged positions and oppose financial reform. Banks are used to extract high profit margins from the repressed deposit rates and ill-equipped with modern risk management tools and skills. SOEs enjoy ample cheap credit and have never operated in an interest-sensitive market environment. Without a fully-functioning bond market, monetary policy is more effectively transmitted through interest rate controls, rather than through financial markets ([Zhou, 2009](#)). Therefore, interest rate liberalization in China requires a gradual approach to overcome resistance from the vested interests and to coordinate with other financial market reforms.

⁷See, e.g., [Brandt and Zhu \(1995, 2000\)](#) and [Lardy \(1998\)](#) on financial reforms in China.

2.2 Banking Sector in China

Banks dominate China's financial system with an unrivaled customer base including SOEs. Under the controlled credit system, almost all lending was carried out through banks. There were few legal alternatives to bank deposit for households savings, because of the underdeveloped bond and equity markets and closed capital accounts. Bonds are also largely held by banks. Banks benefit from an official guarantee on their deposits.⁸

The government effectively controls all large banks through majority shareholding. Executives at the biggest banks are appointed by the government. Banks receive formal instructions and informal guidances from the central bank and other regulators. Although the official loan floor rate and deposit ceiling rate were removed in 2013 and 2015, respectively, bank deposit rate is still effectively controlled by the government, and bank loan quota remains official and binding. Therefore, the bank credit system in China is a controlled system, although not a strict planning system (Brandt and Zhu, 2000).

Banks can make discretionary loan decisions, but choose to ration credit in favor of SOEs that are backed by implicit government guarantee. Some SOEs also enjoy monopoly positions and have very low credit risks. Banks' internal reward system also encourages lending to SOEs, e.g., making bad loans to SOEs is unlikely to be punished severely, due to implicit government guarantee. As a result, banks are less inclined to lend to PEs, especially small- and medium-sized enterprises (SMEs) that have high credit risk and lack quality collaterals. It appears to be a global issue that PEs and SMEs are insufficiently funded, but the situation is much more severe in China because of banks' conscious decision to allocate credit in favor of SOEs.

⁸China announced in May 2015 to establish bank deposit insurance, which provides official guarantee of bank deposit up to 500 thousand yuan per account.

2.3 Shadow Banking in China

Shadow banking in China experienced explosive growth after the 2007-2009 global financial crisis.⁹ Banks conduct shadow banking activities to evade binding regulatory controls. In particular, banks raise capital through WMPs to bypass deposit rate ceiling and high reserve requirement, and subsequently make trust loans to bypass regular loan quota. Banks also serve as intermediaries to make entrust loans on behalf of large corporations. Banks assume the core positions in shadow banking transactions, taking the majority of risks and profits. Non-bank institutions are involved to help bypass regulatory restrictions and reduce costs.¹⁰

The “bank-initiated” shadow banking practice must be understood in the context of banks’ dominance in the credit system. Banks have a sheer advantage over other financial institutions in accessing individual and institutional savings. Historically, only state-owned banks were allowed to take deposits. Banks inherit such a huge customer base even though they went public since 2004. Before a formal deposit insurance was announced in 2015, bank deposit had implicit government guarantee. The scope of the guarantee, however, was vague, leading to the perception that the government will bail out the entire bank in the event of insolvency. Banks take advantage of this perception to raise WMPs at low cost, which is not possible for other shadow banking products issued by non-bank financial institutions.

Why did shadow banking only take off in the recent years, while the regulatory regime has been in place since the 1980’s? During recent years, increasingly binding credit controls

⁹Table 1 shows that the volume of entrust loans (trust loans) increased from 270 (83) billion yuan in 2006 to 2,547 (1,840) billion yuan in 2013, constituting from 6.3% (14.7%) to 1.9% (10.6%) of aggregate financing to the real economy in 2006 (2013), respectively. In contrast, the sizes of corporate debt and equity were 1,811 and 222 billion yuan in 2013, respectively. The ratio of domestic loans to aggregate financing to the real economy fell continuously from 91.9% in 2002 to 51.3% in 2013, implying that business flew away from banks towards shadow banks over time.

¹⁰The non-bank shadow banking sector is of much smaller scale than the “bank-initiated” shadow banking sector. Non-bank shadow banking institutions include micro-finance companies that are licensed to lend in small amounts, pawn shops, third-party wealth management entities, and guarantee agencies. Very few asset management programs of mutual funds and securities companies involve in shadow banking transactions. Secularization only began to take off in 2013.

pushed business away from banks towards shadow banks. About one hundred small and regional banks were established in China by the end of 2001. Bank capital is primarily sourced from deposits. But deposit rate ceiling puts small banks in an inferior position to solicit customer deposits. This propelled small banks to engage in shadow banking business, and the high profit margins force large banks to follow suit (Hachem and Song, 2016). The PBC tripled deposit reserve requirement ratio (RRR) from 7% in 2004 to 21% in 2011. Banks had a growing incentive to engage in shadow banking transactions to bypass the ultra-high RRR.

The global financial crisis played a remarkable role in stimulating the shadow banking growth in China. The government launched a 4-trillion-yuan stimulus package mostly in bank credit to arrest likely economic hard-landing in 2008. Once the economic growth recovered, monetary policy was tightened dramatically to crack down run-away inflation in 2010. Loans to many government sponsored long-term projects and their follow-up programs could not be rolled over when banks were withdrawing credit. Fearing that a sudden stop of credit will trigger widespread defaults and cause significant increase in nonperforming loans, banks stepped up with shadow banking operation to offset the diminishing bank credit, with implicit and explicit government endorsement.

3 Model Setup

This section introduces the baseline model of the dual-track credit system. It can be easily modified to resemble China's credit systems both before the rise of shadow banking and after the full interest rate liberalization in the future.

3.1 Baseline Model

The baseline model describes a dual-track credit system involving four representative agents: bank, household, state-owned enterprise (SOE), and private enterprise (PE). As shown in Figure 1, under the control credit track, the bank receives deposit from the household and makes loan to the firms. Under the market credit track of shadow banking,

the bank raises capital from the household through wealth management product (WMP) and makes trust loan to the firms at market rate. Deposit is subject to interest rate ceiling and capital reserve requirement, while WMP is not. Bank loan is limited by quota, while trust loan is not.

Previous research on dual-track reform (see, e.g., [Lau, Qian and Roland \(2000\)](#)) does not consider the role of intermediary in facilitating transactions. In our context, banks as financial intermediary play an active role in the financial system reform. Our model explicitly considers the intermediary's objective function together with those of credit supplier (the household) and borrowers (firms).

3.1.1 Key Assumptions

For the baseline model of dual-track credit system, we make the following assumptions:

Assumption 1: The PE has higher productivity than the SOE, which is consistent with ample empirical evidence (see, e.g., [Brandt and Zhu, 2000](#); [Song, Storesletten and Zilibotti, 2011](#); [Liao, Liu and Wang, 2014](#)).

Assumption 2: Bank credit is entirely rationed to the SOE, and the PE has no access to bank loan. [Brandt and Zhu \(2000\)](#) show that before the financial decentralization, bank credit was only allocated to the state-owned sector during the central planning era. After China loosened its practice from credit plan to credit control, banks began to have limited discretion to allocate a small portion of credit to the non-state sector. Without loss of generality, we still assume that, in the baseline model, only the SOE has access to bank loan. This assumption greatly simplifies the model and allows for analytical solutions. We relax this assumption in the extended version of the model for numerical analysis. The simulation results indicate that the assumption does not qualitatively affect our conclusions.

Assumption 3: We assume that under the market track of shadow banking, the SOE and PE can resell credit to each other. One important feature of dual-track financial liberalization is to allow for credit transfer among borrowers. This assumption is consistent

with the practice of entrust loans in China. Banks act as intermediary to make entrust loans on behalf of large corporations, mostly SOEs (Allen et al., 2015). Tables 1 shows that entrust loans constitute a large proportion of shadow bank credit in China. To make our model analytically tractable, we combine entrust loan and trust loan together—the SOE actually makes entrust loan to the PE, when the SOE’s holding of trust loan is negative.

3.1.2 Bank

On the liabilities side of its balance sheet, the bank raises capital from the household through both deposit and WMP. On the assets side, the bank makes loan and trust loan to the firms. The bank maximizes the following objective function under budget constraint:

$$\begin{aligned} \Pi^{BK} = \max_{L, TL, D, WMP} \{ & r_l L + r_r \alpha D + r_{tl} TL - r_d D - r_{wmp} WMP - C^{BK} \}, \quad (1) \\ \text{s.t. } & L + TL \leq (1 - \alpha)D + WMP, \end{aligned}$$

where L , D , TL , and WMP denote the amount of bank loan, deposit, trust loan, and WMP, respectively; r_l , r_r , r_{tl} , r_d , and r_{wmp} denote the interest rates of loan, deposit reserve, trust loan, deposit, and WMP, respectively; α denotes reserve requirement ratio (RRR); throughout the paper, the superscript “ BK ” denote bank; C^{BK} represents bank operation cost:

$$C^{BK} = \frac{1}{2}(\delta_l^{BK} L^2 + \delta_{tl}^{BK} TL^2 + \delta_{wmp}^{BK} WMP^2),$$

where δ_l^{BK} , δ_{tl}^{BK} , and δ_{wmp}^{BK} denote the coefficients of marginal operation costs in the loan, deposit, trust loan, and WMP markets, respectively.¹¹ Deposit interest rate, r_d , equals the repressed ceiling, \bar{r}_d , which is artificially set by the central bank:

$$r_d = \bar{r}_d < r_d^*, \quad (2)$$

¹¹We do not explicitly model bank operation cost of deposit for a technical reason. The bank’s objective function aims to solve for the equilibrium interest rates and the amount of deposit, loan, trust loan, and WMP. The cost function only needs to consider three products, because the budget constraint in Equation (1) already serves as a condition for the optimization solution. In other words, modeling the cost of the fourth product will lead to over-identification problem. We omit modeling the deposit cost, given the higher relevance of bank loan, trust loan, and WMP costs. One can also think of the costs of loan, trust loan and WMP as the relative costs to the deposit cost—a normalized benchmark.

where r_d^* denotes equilibrium deposit rate in an otherwise control-free credit system.

For simplicity, we use high RRR as a proxy for control on loan volume. This simplification ensures analytical solutions in the baseline model. As an illustration, the sharp rise of RRR from 7% in 2004 to 21% in 2011 will correspond to around 15% reduction of loan volume in the absence of shadow banking. Loan volume control and RRR are substitutes in the PBC's toolbox, as can be seen from the relationship $L = (1 - \alpha)D$. In the generalized version of the model (in Section 5), we impose explicit control on loan volume quota, producing numerical simulation results consistent with the model's theoretical implications.

3.1.3 Firms

We denote state-owned enterprise with the superscript of “*SOE*” and private enterprise with “*PE*”, respectively. Both firms have production functions that are linear in capital input. The firms have no capital endowment, and entirely rely on external financing. Their objective functions are written as

$$\Pi^F = \max_{L^F, TL^F} \{ \varphi^F(L^F + TL^F) - r_l L^F - r_u^F TL^F - C^F \}, \quad (3)$$

where the superscript $F \in \{SOE, PE\}$; φ^F denotes marginal productivity. According to Assumption 1, $\varphi^{PE} > \varphi^{SOE}$. The firm's operation cost is expressed as $C^F = \frac{1}{2}(\delta_l^F(L^F)^2 + \delta_{tl}^F(TL^F)^2)$, where δ_l^F and δ_{tl}^F denote the coefficients of firms' marginal operation costs of loan and trust loan, respectively. A firm simultaneously determines its demand for loan and trust loan, taking into account its productivity and bank credit accessibility. Following Assumption 2, we set $\delta_l^{PE} = +\infty$, which means all bank credit is rationed to the SOE under credit control.

3.1.4 Household

The household invests her wealth, W , in deposit and WMP to maximize total return. Throughout the paper, the superscript “*HH*” denotes household. The objective function

of the household is expressed as

$$\Pi^{HH} = \max_{D, WMP} \{ \bar{r}_d D + r_{wmp} WMP - C^{HH} \} \quad (4)$$

$$s.t. \quad D + WMP \leq W,$$

where $C^{HH} = \frac{1}{2}(\delta_{wmp}^{HH} WMP^2)$; δ_{wmp}^{HH} denotes the household's coefficient of marginal cost of engaging in the shadow bank sector. Her marginal deposit operation cost is set to be zero, for the same technical consideration as stated in Footnote 11. The household simultaneously determines the amount of investment in deposit and WMP.

3.1.5 Equilibrium

The financial markets are cleared when aggregate credit demand meets aggregate credit supply. Under credit controls on deposit rate and bank loan volume, the market clearing conditions are expressed as

$$\begin{cases} r_d = \bar{r}_d; \\ L^{BK}|_{Supply} = L^{SOE}|_{Demand}; \\ TL^{BK}|_{Supply} = TL^{SOE}|_{Demand} + TL^{PE}|_{Demand}; \\ WMP^{BK}|_{Supply} = WMP^{HH}|_{Demand}. \end{cases} \quad (5)$$

From top to bottom, the equations are the market clearing conditions for the deposit, bank loan, trust loan, and WMP sectors, respectively. We solve the four equations to pin down the equilibrium r_l , r_d , r_{tl} , and r_{wmp} . We then solve for the agents' monetary gains using their objective functions.

3.2 Credit System in Other Transition Stages

To study the dual-track interest rate liberalization in a historical context, we also need to model China's credit system prior to the rise of shadow banking and after full interest rate liberalization. The baseline model can be easily modified to resemble China's credit systems at those times. The following illustrates how such modifications can be made.

3.2.1 Before the Rise of Shadow Banking

To model the credit system before the rise of shadow banking, we shut off the market track by setting the shadow banking costs infinitely large, that is, $\delta_{tl}^F = +\infty$, $\delta_{tl}^{BK} = +\infty$, $\delta_{wmp}^{BK} = +\infty$, and $\delta_{wmp}^{HH} = +\infty$. Given the quadratic operation cost functions in the agents' objective functions, the agents' usage of shadow banking products quickly converges to zero when these marginal cost coefficients approaches infinity. Then bank credit constitutes the sole source of capital, which is rationed to the SOE only.

3.2.2 After Full Interest Rate Liberalization

China has set full interest rate liberalization as an ultimate goal of financial reform. In our context, full liberalization removes the controls on deposit rate and bank loan volume, while shadow banking remains to exist. Credit price and quantity in both the bank and shadow bank sectors are market-determined. Technically, we remove \bar{r}_d , allowing r_d to be determined by demand and supply in equilibrium. Note that "single-track" liberalization, which directly removes deposit rate ceiling and loan quota in the absence of shadow banking, is a special case of full interest rate liberalization.

4 Theoretical Analysis

This section analyzes the effects of dual-track interest rate liberalization on aggregate output, agents' monetary payoffs, and economic efficiency. We further study the implications of full interest rate liberalization on additional output and efficiency gain.

4.1 Efficiency Gain

We first examine whether dual-track liberalization leads to gains in output and efficiency. The bank's budget constraint is $L_i + TL_i^{BK} = (1 - \alpha)D_i + WMP_i$, the household's budget constraint is $D_i + WMP_i = W$, where the subscript $i = 0$ for the controlled credit system prior to the dual-track reform and $i = 1$ for the dual-track credit system. Total credit

inputed into production is $K_i = L_i + TL_i^{BK} = W - \alpha D_i$. Given that $TL_0^{BK} = 0$, $TL_1^{BK} > 0$, $WMP_0 = 0$, and $WMP_1 > 0$, and the household's budget constraint, we have $D_1 < D_0$ and $K_1 > K_0$. Total credit inputed into production increases as the household shifts away from deposit to WMP, which reduces the amount of capital reserve.

The proportion of trust loan in total credit put into production, $s_i^A \in [0, 1]$, is endogenously determined in equilibrium. The proportion of bank loan is $1 - s_i^A$. Overall productivity is the weighted average productivities of the SOE and PE: $A_i = s_i^A \varphi^{PE} + (1 - s_i^A) \varphi^{SOE}$, where $s_1^A > s_0^A = 0$. Given that $\varphi^{PE} > \varphi^{SOE}$, we have $A_1 > A_0$. Under the controlled credit system, the bank rations all credit to the SOE. After partial liberalization, overall productivity increases as some credit is allocated to the more productive PE under the market track of shadow banking.

Output can be expressed as the weighted average of the SOE and PE productivities *times* the amount of capital input into production:

$$Y_i = A_i K_i = \underbrace{[s_i^A \varphi^{PE} + (1 - s_i^A) \varphi^{SOE}]}_{\text{Average Productivity}} \cdot \underbrace{[W - \alpha D_i]}_{\text{Capital}} \quad (6)$$

It is easy to show that $Y_1 > Y_0$, when $K_1 > K_0$ and $A_1 > A_0$. Output increases through two channels combined together: (1) *Productivity channel*: The market track of shadow banking helps to correct the bank's credit mis-allocation problem that originally prevents the PE from accessing to credit. Aggregate productivity increases since the more productive PE sector is getting financed. (2) *Capital idolization channel*: One important purpose of shadow banking is to evade high deposit reserve requirement or other excessive capital requirements. Funds flow from deposit to WMP with the rise of shadow banking, which effectively reduces capital idolization.

We have the following lemmas leading up to the result on aggregate efficiency gain:

Lemma 1. *Given that $f(x)$ is well-defined and continuous on \mathbb{X} , where \mathbb{X} is compact and bounded, $f(x)$ is bounded.*

According to Lemma 1, if agents—household, bank, and firms—have binding budget constraints, changes in their operation costs are bounded, that is, change in agent J 's

operation cost from stage i to k , $C_{i-k}^J < M_{i-k}^J$, where $J \in \{HH, BK, SOE, PE\}$ and M_{i-k}^J denotes agent-specific and situation-dependent upper bound.

Lemma 2. *Given a continuous, twice-differentiable, and increasing function $f(x)$, if a function y is bounded, that is, $y \leq \bar{y}$, there exists an \bar{x} , s.t. $\forall x > \bar{x}, f(x) > \bar{y}$.*

According to Lemma 2, given that the change in output $\Delta Y_{1-0} = Y_1 - Y_0$ is increasing in φ^{PE} —the PE’s efficiency parameter and that the change in operation cost $\Delta C_{1-0} = C_1 - C_0$ under the dual-track reform is bounded, there exists a lower bound $\bar{\varphi}^{PE}$ such that $Y_1 - C_1 > Y_0 - C_0$ for any $\varphi^{PE} > \bar{\varphi}^{PE}$. Intuitively, if the PE’s productivity is sufficiently high, the rise of shadow banking can lead to *Kaldor-Hicks* improvement to efficiency, which means increase in aggregate output outweighs increase in aggregate cost. Hence, we summarize the above discussion in the following proposition:

Proposition 1. *Dual-track interest rate liberalization leads to output gain through more efficient credit allocation and less capital idolization. In particular, shadow banking provides financing to productive and under-funded private sector. Capital idolization due to bank loan volume control diminishes. Kaldor-Hicks improvement to efficiency is achieved when increase in aggregate output exceeds bounded increase in aggregate cost.*

4.2 Pareto Improvement

Kaldor-Hicks improvement is a necessary but insufficient condition for *Pareto* improvement. Whether the dual-track mechanism leads to *Pareto* improvement depends on the distribution of efficiency gain among agents. The distribution rule is determined by the equilibrium interest rates in all market sectors. If the interest rate in one sector increases, there is a transfer from credit demander to credit supplier. This section demonstrates the existence of *Pareto* improvement and the conditions for it under the dual-track interest rate liberalization. The idea is that the *Kaldor-Hicks* efficiency gain can be distributed properly to all agents through financial markets, which creates no losers in the reform.

We present the following lemmas in preparation for the proof of the existence of *Pareto* improvement under the dual-track reform mechanism:

Lemma 3. *The endogenously-determined trust loan rate relates to the productivities of the SOE and PE in following ways:*

- (i) *If $r_{tl} > \varphi^{SOE}$ and credit transfer is allowed under the market track, the SOE's optimal strategy is to resale credit to the PE in the form of entrust loan.*
- (ii) *Given that $\varphi^{PE} > \varphi^{SOE}$, there exists a scenario, where $\varphi^{PE} > r_{tl} > \varphi^{SOE}$;*
- (iii) *Rate and size of trust loan, r_{tl} and TL , increase as φ^{PE} increases.*

See Appendix [A.2](#) for proof of Lemma 3.

The household and PE are unconditionally better off in dual-track interest rate liberalization. In particular, WMP presents a “take-it-or-leave-it” option to the household. Consider an extreme case in which WMP rate is below deposit rate, the household can ignore WMP and continues to invest in deposit only. Since WMP allows the bank to gain additional profit by evading loan quota and reserve requirement, the bank is willing to pay higher WMP rate than deposit rate. Investment in WMP leads to higher return for the household. As long as the gain of switching from deposit to WMP exceeds the switching cost, which is almost zero in reality, the household benefits from the dual-track liberalization.

The PE is also presented with a “take-it-or-leave-it” option of trust loan under the market track. It can avoid being worse off by declining to participate in the shadow banking market. Hence, trust loan rate cannot be higher than the PE's marginal productivity. Using Lemma 4 below, one can show that the PE is better off as long as its production gain exceeds its operation cost associated with trust loan.

Lemma 4. *Given a function $f(x) = ax - bx^2$ with $a > 0$, $\forall x_0 \in (0, \frac{a}{2b})$, $\exists f(x_0) > 0$.*

To analyze whether the SOE and bank benefit from dual-track liberalization, first let us consider a hypothetical single-track interest rate reform. The single-track reform

leads to an increase in deposit rate as the rate ceiling is removed. The bank's financing cost increases, leading to a decrease in profit. The SOE's profit margin also falls as bank loan rate increases with deposit rate. This result suggests that SOEs and banks are potential losers in interest rate reform. It also explains why interest rate reform has faced tremendous *ex ante* opposition from these powerful institutions.

How to compensate the potential losses of SOEs and banks plays a critical role in the success of interest rate reform. The dual-track mechanism provides a solution to allow SOEs and banks to participate in shadow banking and share efficiency gain. In particular, SOEs resale credit to PEs to make a profit, banks issue WMP and make trust loan to make a profit.

Proposition 1 implies that the efficiency gain is positively related to the PE productivity. Equilibrium interest rates determine efficiency gain distribution among agents along the credit supply chain. Since the total reform cost is limited in our model setup, there exists a lower bound of PE productivity to generate sufficient efficiency gain such that the SOE and bank are compensated adequately. Another way of stating the result is: there exists a set of equilibrium interest rates to make no agents worse off in the reform. We have the following proposition:

Proposition 2. *Dual-track interest rate liberalization leads to Pareto improvement if PEs are sufficiently productive. Households and PEs unconditionally benefit from interest rate reform. SOEs and banks can avoid being worse off if their monetary gain in sharing the market track of shadow banking exceeds their reform loss under the credit control track.*

See Appendix A.3 for proof. Numerical analysis in Section 5 shows that with reasonable PE productivity and realistic economic parameters, the dual-track interest rate liberalization leads to *Pareto* improvement intra-temporally and inter-temporally. Liberalized productivity leads to sufficient increase in aggregate output, benefiting all agents along the credit supply chain. A reform strategy with intra-temporal *Pareto* improvement is admittedly free of *ex post* regression. Regardless of whether the policy maker is long

reigning or not, and whether the agents are patient or not, the dual-track mechanism has a known advantage in achieving creditable expectation of “reform without losers”.

The dual-track reforms in Chinese agricultural and industrial sectors rely on forced execution of the plan track to guarantee *Pareto* improvement (Lau, Qian and Roland, 2000), which is not feasible in financial sector reform. Financial reform involves powerful intermediary that is under the control of the government but also has some degree of discretion (Brandt and Zhu, 2000). *Pareto* improvement is achieved through an allocation mechanism determined by equilibrium credit prices, which are jointly established by market forces and credit controls. *Pareto* improvement does not require forced execution of the control track. On the other hand, it does depend on whether there is sufficient productivity gain to compensate reform losses of SOEs and banks.

4.3 Full Interest Rate Liberalization

China has set full interest rate liberalization as one of its ultimate goals of financial reforms. This section aims to shed light on the implications of dual-track reform on future full interest rate liberalization, which interacts with in-depth reforms in the banking sector and SOEs. Dual-track mechanism introduces a new market track without restructuring the control track. Full interest rate liberalization proceeds to remove the deposit rate ceiling in our model, liberalizing the control track while keeping shadow banking in place.

Similar to the development of Proposition 1, the total output during dual-track or full liberalization is in the same form of Equation 6 (reproduced here):

$$Y_i = A_i K_i = \underbrace{[s_i^A \varphi^{PE} + (1 - s_i^A) \varphi^{SOE}]}_{\text{Average Productivity}} \cdot \underbrace{[W - \alpha D_i]}_{\text{Capital}}$$

where $i = 1$ denotes dual-track liberalization; $i = 2$ denotes full liberalization.

Equation A-2 in Appendix shows that trust loan rate r_{tl} increases as deposit rate r_d increases, leading to greater credit resale from the SOE to the PE, i.e., $TL_2^{SOE} > TL_1^{SOE}$. Hence, the share of trust loan in total credit $s_2^A > s_1^A$. Given that $\varphi^{SOE} < \varphi^{PE}$, the weighted-average productivity, represented by the first term on the RHS of Equation 6,

increases. Full liberalization increases the repressed deposit rate to its equilibrium level, i.e., $r_{d_2} > r_{d_1} = \bar{r}_d$. Based on the market clearing condition for the deposit market in Equation 5, we have $D_2 > D_1$. Credit injected into production, represented by the second term on the RHS of Equation 6, diminishes after full liberalization, i.e., $W - \alpha D_2 < W - \alpha D_1$. The positive effect of rising productivity and the negative effect of falling credit supply on aggregate output offset each other. As a result, full interest rate liberalization may not necessarily lead to output gain or efficiency gain. We have

Corollary 1. *Full interest rate liberalization may not necessarily achieve additional efficiency gain in the presence of high reserve requirement and bank credit mis-allocation in favor of SOEs. More capital flows back to the banking sector after full liberalization, leading to greater capital idolization and diminishing PE financing.*

As the interest rate controls being removed, some funds flow back to the bank sector. Capital idolization increases as more deposit is subject to reserve requirement. The removal of interest rate distortion effectively magnifies bank credit mis-allocation in favor of less efficient SOEs, which adversely impacts aggregate output. Therefore, full interest rate liberalization may not necessarily achieve its intended goal to gain additional efficiency, when there exist multiple distortions in the credit system.

5 Numerical Simulation

Our baseline model imposes simplifying assumptions to ensure analytical solutions. This section extends the baseline model, removing some technical restrictions, to better resemble the China's financial system in reality. Numerical analysis not only verifies the robustness of the analytical results, but also provides additional insights through comparative statics.

5.1 Extended Baseline Model

The baseline model omits the bond market and central bank and substitutes loan quota control with reserve requirement ratio. These simplifications allow for analytical tractability

and easy interpretation at the expense of model flexibility and richness. As shown in Panel B of Figure 1, the extended baseline model considers the bond market, where the household and bank invest in bonds issued by the SOE.¹² The central bank plays an exogenous role in collecting deposit reserve and providing temporary liquidity through central bank fund (CBF). Degrees of interest rate repression and loan volume constraint are explicitly modeled. The extended baseline model can be easily modified to resemble China’s credit systems at the other reform stages.

5.2 Calibration

Table 2 classifies model parameters for the household, firm, bank, and central bank. RRR is set to be 15%; reserve rate and CBF rate are 1.5% and 2%, respectively. Following Bai, Hsieh and Qian (2006) and Song, Storesletten and Zilibotti (2011), we set returns on capital for the SOE and the PE as 10% and 20%, respectively. Parameter values, if unobservable, are set to generate interest rates and asset features consistent with corresponding empirical stylized facts, e.g., the ranking of interest rates follows $r_{tl} > r_l > r_b > r_{wmp} > r_d$. As reported in Table 3, the baseline model yields trust loan rate of 13.7%, bank loan rate of 9.4%, bond rate of 5.8%, WMP rate of 5.1%, and deposit rate of 3.2%. The implied interest rates closely resemble their observed counterparts, suggesting that our selections of parameter values are reasonable.

The key parameters in the extended baseline model include the coefficients of marginal operation costs, whose values cannot be accurately pinned down. We focus on measuring the relative values (or rankings) of different costs. To the bank, the marginal cost of deposit ($\delta_d^{BK} = 0.01$) should be lower than the marginal cost of loan ($\delta_l^{BK} = 0.02$), because it is more costly to manage loans. It is even more costly to engage in shadow banking as the market is less transparent. We set the marginal cost of WMP two times of the deposit cost ($\delta_{wmp}^{BK} = 0.02$). The marginal cost of trust loan ($\delta_{tl}^{BK} = 0.15$) is much higher than the

¹²We assume that the PE has no access to the bond market. This assumption is consistent to the fact that only large and listed firms can publicly issue corporate bonds in China, and that few private firms can issue bonds through private placement.

marginal cost of bank loan.¹³

For the SOE, the marginal cost of bond is higher than that of bank loan ($\delta_b^{SOE} = 0.08$ versus $\delta_l^{SOE} = 0.02$); trust loan ($\delta_{tl}^{SOE} = 0.05$) is more costly than bank loan, but less costly than bond. In the shadow bank sector, we assume that the SOE and the PE are equally competitive, i.e., $\delta_{tl}^{SOE} = \delta_{tl}^{PE} = 0.05$.

For simplicity and without loss of generality, we assume that investing in deposit is cost-free for the household. Investing in bond is costly with $\delta_b^{HH} = 0.15$, but purchasing WMP is less costly than bond with $\delta_{wmp}^{HH} = 0.05$. The ratio of CBF to aggregate output was roughly 4% in China in 2013. Hence, we set the household's endowed wealth $W = 2.4$, and $CBF = 0.1$. We set the degree of loan volume control, k_1 , and the degree of deposit rate repression, k_2 , to be 90% and 80% of their market equilibrium levels, respectively. Robustness check indicates that our conclusions are not sensitive to the values of k_1 and k_2 in reasonable ranges.¹⁴

5.3 Analysis

This section presents the numerical results to verify that our theoretical findings are robust in a more realistic setting. It provides additional insights on how dual-track interest rate liberalization affects the efficiency gain and profit sharing.

¹³The selection of marginal cost values is less strict and by no means perfect. These selected values nevertheless reflect considerations for market accessibility, transparency, liquidity, expected default loss, and other frictions. Ranking of these cost values is in general consistent with the intuition and empirical observations. We do not introduce the bank's operation cost for bond holding because it is relatively costless for the bank to hold bond (issued by the SOE in our model) and also to ensure equal numbers of unknowns and equations. Untabulated sensitivity analysis shows that our findings are robust for a reasonable but broad range of cost values.

¹⁴We set deposit rate ceiling and loan quota in percentage to their control-free equilibrium levels for the following considerations: First, the market-determined equilibrium deposit interest rate and loan quota are perhaps the most meaningful benchmarks to measure the degree of restriction; second, the percentage measures of policy distortion are direct and easy to interpret; third, they are consistent with the fact that these restriction are periodically adjusted for economic development needs; furthermore, alternative fixed controls on deposit rate ceiling and loan quota tend to be more restrictive and magnify the effects of shadow banking in our favor, hence not changing our conclusions, only enhancing them.

5.3.1 Interest Rates and Financial Products

Interest rates generally increase after the dual-track liberalization. Deposit rate repression has an anchoring effect on all other rates, given banks' dominance in the controlled credit system. Introducing shadow banking sector tends to weaken such a repressing-anchoring effect. Table 3 reports that deposit rate, r_d , increases from 2.1% to 3.2%, which is comparable to the observed deposit rate of 3.0% in China. Even if the degree of deposit rate repression remains unchanged, deposit rate still increases significantly, because of the spillover effect from the shadow banking sector. The equilibrium WMP rate is 5.1%, which is significantly higher than deposit rate. The bank loan rate, r_l , increases from 9.0% to 9.4% after the reform, somewhat higher than the observed (official) bank loan rate of 7.2%. The model implied bond rate since dual-track liberalization is 5.8%, very close to the observed bond rate of 6.0% in China.

A substantial portion of credit flows into the shadow bank sector. The model-implied amount of bank loan is 1.18, which is comparable to the ratio of bank loan to gross domestic production (GDP) of 1.20 in China in 2013. The model-implied amounts of bond and deposit are 0.52 and 1.84, respectively. In comparison, the observed ratios of bond and deposit to GDP in China are 0.56 and 1.76, respectively, in 2013. The implied deposit reserve decreases from 0.34 to 0.28 after the shadow banking emerges, implying less capital idling. The close resemblance between model-implied interest rates and financial quantities to their observed counterparts suggests that our model calibration is reasonable.

5.3.2 Efficiency Gain

Dual-track liberalization creates efficiency gains through credit transfer from the SOE to PE. Table 3 reports that the SOE's holding of trust loan is negative -0.74, suggesting that less efficient SOE acts as a credit supplier under the market credit track of shadow banking. The more efficient PE is willing to finance at higher interest rates, whose credit demand pushes trust loan rate above the SOE's productivity. The SOE in turn optimally acts as

capital supplier. This result echoes the finding of [Song, Storesletten and Zilibotti \(2011\)](#) that such a *de facto* privatization process has fueled China’s economic growth in the past decades. As shown in [Table 3](#), the total credit injected in production—loan, trust loan, and bond—is 2.16 and 2.22, respectively, before and after the dual-track reform. Therefore, shadow banking helps to increase capital input into the production, and consequently, to increase the aggregate output.

5.3.3 Pareto Improvement

We measure the welfare gain from dual-track liberalization as the difference between the aggregate monetary payoffs of all agents before and after the rising of shadow banking. [Table 4](#) shows that the aggregate efficiency increases by 41.8% (from 18.92×10^{-2} to 26.82×10^{-2}) with the rise of shadow banking. Dual-track liberalization reduces the size of deposit reserve by attracting households to invest into WMP. More capital enters into the production of efficient private sector, leading to an increase in aggregate output.

As detailed in [Table 4](#), the household’s payoff increases by 55.4% (from 5.27×10^{-2} to 8.19×10^{-2}), as the household diversifies investment from deposit into WMP. The bank’s payoff increases by 19.4% (from 6.23×10^{-2} to 7.44×10^{-2}). Off-balance sheet capital raised through WMP is not subject to reserve requirement, and trust loan investment is not subject to bank loan quota. The payoffs of the SOE and the PE increase by 8.6% and 70.5% (from 2.34×10^{-2} and 5.08×10^{-2} to 2.54×10^{-2} and 8.66×10^{-2} , respectively), with the rise of shadow banking. Shadow banking transactions enable banks and SOEs to benefit from the production increase of PE and, in return, to support the dual-track interest rate reform. The numerical results confirm the implication of [Proposition 2](#) that, if implemented properly, dual-track interest rate liberalization can lead to *Pareto* improvement, that is, creating no losers in the reform.

5.3.4 Comparative Statics

We investigate how the efficiency gain of dual-track interest rate liberalization is related to the degree of deposit rate repression, the degree of bank loan restriction, and bond market inefficiency. Panels A and B in Figure 2 show that the efficiency gain is positively correlated to the degree of bank loan volume constraint ($1 - k_1$) and the degree of deposit rate repression ($1 - k_2$ when k_2 in the range of $[0.9 - 1.0]$). The more distorted the bank financing channel, the greater value can dual track liberalization contribute.¹⁵ Panel C in Figure 2 shows that shadow banking-induced gain is positive related to the inefficiency of the bond market. The Chinese bond market grew rapidly in recent years but still suffers from low efficiency. Bond issuance process is lengthy, costly, and subject to high qualification standards. PEs, especially SMEs, virtually have no access to the bond market. Hence, shadow banking leads to greater efficiency gain when bond market has more frictions.

5.3.5 Full Interest Rate Liberalization

China will eventually embrace full interest rate liberalization. However, as our theoretical analysis points out, moving from dual-track to full liberalization may or may not bring additional welfare gain. Table 4 shows that aggregate payoff slightly increases after full interest rate liberalization, specifically, by 0.3% (from 26.82×10^{-2} to 26.90×10^{-2}). Notably the bank's payoff actually decreases by 22.5% (from 7.44×10^{-2} to 5.77×10^{-2}), while the household's payoff increases by 22.8% from (8.19×10^{-2} to 10.06×10^{-2}). The removal of interest rate repression shifts more financing from WMP to deposit, which magnifies the credit mis-allocation as banks ration credit to less efficient SOEs.

Panel A of Figure 3 shows that aggregate gain is positively correlated to the ratio of SOE loan financing cost to PE loan financing cost. The evidence suggests that additional

¹⁵For the range of deposit rate repression $k_2 \in (0, 0.9)$, because the bond market becomes relatively more efficient comparing to bank financing channel, more social financing are competed away from the loan market to the bond market, even before the rise of shadow banking. Therefore, the efficiency gain from dual-track liberalization becomes less strong if the existing deposit rate repression is more severe.

output gain can be achieved when the implicit government guarantee is removed and banks no longer ration credit in favor of SOEs. While, Panel B of Figure 3 depicts that aggregate gain increases with SOE productivity increasing. Overall, whether additional gain can be achieved by fully liberalizing the interest rates critically depends on the implementation of bank and SOE sector reforms, in particular, improving SOE operational efficiency and reducing bank credit rationing.

Full interest rate liberalization does not crowd out shadow banking, which still serves as an effective channel for banks to evade high reserve requirement. From the capital utilization efficiency perspective, shadow banking is advantageous over commercial banking in reducing capital idling. On one hand, shadow banking provides firms with a valuable alternative credit channel in the face of underdeveloped bond market. On the other side, high transaction cost and opaqueness of the shadow bank sector undermines its importance in a fully liberalized financial system.

5.4 Further Discussion

Gennaioli, Shleifer and Vishny (2012, 2013) argue that shadow banking exposes the financial sector to greater systemic risk. In our simple framework, various risk considerations are reflected in the transaction costs for each agents holding various financial assets and ultimately reflected in various equilibrium interest rates. It is important to examine the potential systemic risk from shadow banking introduced by dual-track liberalization, however, the task may be out of the scope of this paper. We leave it to future research.

There exists a mis-perception that recently shadow banking fuels irrational and excessive investments in China. The over-investment problem is in fact driven by the cheap credit supply mainly to the SOEs due to the interest rate repression policy. Even in the absence of shadow banking, easy credit finds its way through other channels, such as bank loan and government planning, into the real economy. Hence, the problems are created by the preexisting distortions within China's credit system rather than by shadow banking *per se*. The market track of shadow banking has credit prices and quantities determined by supply

and demand, which moderates, rather than, exacerbates the over-investment problem.

6 Conclusion

Shadow banking provides a pragmatic dual-track liberalization solution to China's controlled interest rate policy, which underlies phenomenal structural imbalance and distortion in the Chinese economy. In contrast to the developed economies, shadow banking in China mainly helps banks to evade the excessive regulatory controls on deposit rate and credit volume, with tacit government endorsement. In this sense, shadow banking in China essentially constitutes a covert effort of interest rate liberalization.

Using a market equilibrium model, we show 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 mis-allocation 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. Therefore, dual-track interest rate liberalization can face the least opposition *ex ante*.

China will embrace full interest rate liberalization in its on-going financial reforms. Evidence shows that full interest rate liberalization may not lead to additional efficiency gain, since it magnifies the adverse effect of bank credit mis-allocation in favor of less efficient SOEs. Capital idolization also increases when high reserve requirement ratio continues to exist. Market-oriented monetary policy and regulatory framework need to be established under a fully liberalized credit system. The market track of shadow banking nevertheless prepares the central bank as well as other agents for such a complex transition.

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Appendix

A.1 Market Clearing Conditions

A.1.1 Baseline Model

The baseline model captures the most simplified environment with no direct financing approach (i.e., bond market or equity market) from the household to the firm, and no money injection from the central bank to the commercial bank. There are four agents in the baseline model, i.e., the household, the bank, the SOE, and the PE. The SOE and the PE constitute the heterogeneous firm sector.

(1) To better demonstrate the market clearing conditions before and after the rise of shadow banking, as well as before and after full interest rate liberalization, we consider the credit system with shadow banking after full liberalization as a benchmark. There are four markets, i.e., loan market, deposit market, trust loan market, and wealth management product market. Traditional banking business is free from additional financial regulation.¹⁶ Market clearing conditions are given by

$$\begin{cases} D_2^{HH} = D_2^{BK}; \\ L_2^{BK} = L_2^{SOE}; \\ WMP_2^{HH} = WMP_2^{BK}; \\ TL_2^{BK} = TL_2^{SOE} + TL_2^{PE}. \end{cases}$$

subject to binding balance sheets of the household and the bank, respectively:

$$\begin{cases} WMP_2^{HH} + D_2^{HH} = W; \\ L_2^{BK} + TL_2^{BK} = (1 - \alpha)D_2^{BK} + WMP_2^{BK}. \end{cases}$$

First-order conditions (FOCs) of each agent can be easily solved by Lagrangian equations, hence we omit them for the sake of simplicity. By substituting these FOCs into the equation system above, we have

$$\begin{cases} W - \frac{r_{wmp} - r_d}{\delta_{wmp}^{BK}} = \frac{r_l - \frac{r_d - \alpha r_r}{1 - \alpha}}{\delta_l^{BK}} + \frac{r_{tl} - \frac{r_d - \alpha r_r}{1 - \alpha}}{\delta_{tl}^{BK}} - \frac{r_d - \alpha r_r - r_{wmp}}{1 - \alpha} \frac{1}{\delta_{wmp}^{BK}}; \\ \frac{r_l - \frac{r_d - \alpha r_r}{1 - \alpha}}{\delta_l^{BK}} = \frac{\varphi^{SOE} - r_l}{\delta_l^{SOE}}; \\ \frac{r_d - \alpha r_r - r_{wmp}}{\delta_{wmp}^{BK}} = \frac{r_{wmp} - r_d}{\delta_{wmp}^{HH}}; \\ \frac{r_{tl} - \frac{r_d - \alpha r_r}{1 - \alpha}}{\delta_{tl}^{BK}} = \frac{\varphi^{SOE} - r_{tl}}{\delta_{tl}^{SOE}} + \frac{\varphi^{PE} - r_{tl}}{\delta_{tl}^{PE}}. \end{cases}$$

where four equations jointly solve the four unknown variables, i.e., r_d , r_l , r_{wmp} , and r_{tl} .

¹⁶“Additional financial regulation” here indicates the deposit interest rate ceiling. For the sake of simplicity, we omit the setting of loan quota, because the high deposit reserve requirement ratio functions as a substitution of loan quota in the baseline model, as proved in Section ??.

(2) While, the credit system with shadow banking before full liberalization (the “dual-track liberalization” credit system) is slightly different with the above equation system. That is, there exist a interest rate ceiling that distorts the deposit market. Given an artificially lower deposit rate (\bar{r}_d), the equilibrium deposit size will be lowered down, which affects the other markets through asset reallocation approach. Market clearing conditions are given by

$$\begin{cases} r_{d_1} = \bar{r}_d; \\ L_1^{BK} = L_1^{SOE}; \\ WMP_1^{HH} = WMP_1^{BK}; \\ TL_1^{BK} = TL_1^{SOE} + TL_1^{PE}. \end{cases}$$

subject to binding balance sheets of the household and the bank, respectively:

$$\begin{cases} WMP_1^{HH} + D_1^{HH} = W; \\ L_1^{BK} + TL_1^{BK} = (1 - \alpha)D_1^{BK} + WMP_1^{BK}. \end{cases}$$

Similarly, we have

$$\begin{cases} r_d = \bar{r}_d; \\ \frac{r_l - \frac{\bar{r}_d - \alpha r_r}{1 - \alpha}}{\delta_l^{BK}} = \frac{\varphi^{SOE} - r_l}{\delta_l^{SOE}}; \\ \frac{\frac{\bar{r}_d - \alpha r_r}{1 - \alpha} - r_{wmp}}{\delta_{wmp}^{BK}} = \frac{r_{wmp} - \bar{r}_d}{\delta_{wmp}^{HH}}; \\ \frac{r_{tl} - \frac{\bar{r}_d - \alpha r_r}{1 - \alpha}}{\delta_{tl}^{BK}} = \frac{\varphi^{SOE} - r_{tl}}{\delta_{tl}^{SOE}} + \frac{\varphi^{PE} - r_{tl}}{\delta_{tl}^{PE}}. \end{cases}$$

where four equations jointly solve the four unknown variables, i.e., r_d , r_l , r_{wmp} , and r_{tl} .

(3) The credit system in the absence of shadow banking only contains two markets, i.e., deposit market and loan market. Agents have almost no freedom in asset allocation. Specifically, the household has to allocate all their wealth endowment to deposit, the bank’s optimization problem is reduced to a rigid balance sheet, and only the SOE can get access to the bank loan. Market clearing conditions are given by

$$\begin{cases} r_{d_0} = \bar{r}_d; \\ L_0^{BK} = L_0^{SOE}. \end{cases}$$

subject to binding balance sheets of the household and the bank, respectively:

$$\begin{cases} D_0^{HH} = W; \\ L_0^{BK} = (1 - \alpha)D_0^{BK}. \end{cases}$$

It is worth noting that the propositions in Section 4 do not require the equilibria in all credit systems to be fully solved. Instead, we only need to know the direction of capital re-allocation of each agent across stages, and the change in equilibrium interest rates, as

demonstrated in Section 4. Moreover, the setting of convex operation cost function is simple, reasonable and intuitive, which leads to inner solutions that feature agents' optimal allocation among different financial assets when facing structural shocks.¹⁷

A.1.2 Extended Baseline Model

In Section 5, we conduct numerical simulation based on an extended baseline model with bond market, central bank, as well as explicit loan quota. The corresponding model framework is presented in Panel B of Figure 1. Besides new market (bond market), new agent (the central bank), and new type of financial repression (explicit bank loan quota), new features of the extended baseline model further include the following: (i) The household can obtain access to corporate bond market as a direct financing approach; (ii) The SOE and the PE compete not only in trust loan market, but also in bank loan market, although with different marginal costs; (iii) For the bank, the purchase of bond is regarded as the benchmark marginal cost parameter because fixed income trade is more flexible and costless compared to deposit, and also for the technical reason as stated in Footnote 11.

(1) Following a similar manner, we derive the market clearing conditions for the credit system with shadow banking after full interest rate liberalization:

$$\begin{cases} D_2^{HH} = D_2^{BK}; \\ L_2^{BK} = L_2^{SOE} + L_2^{PE}; \\ B_2^{HH} + B_2^{BK} = B_2^{SOE}; \\ WMP_2^{HH} = WMP_2^{BK}; \\ TL_2^{BK} = TL_2^{SOE} + TL_2^{PE}. \end{cases}$$

By substituting the FOCs of each agent into the equation system above, we have

$$\begin{cases} W - \frac{r_b - r_d}{\delta_b^{HH}} - \frac{r_{wmp} - r_d}{\delta_{wmp}^{HH}} = \frac{\alpha r_r + (1 - \alpha)r_b - r_d}{\delta_b^{BK}}; \\ \frac{r_l - r_b}{\delta_l^{BK}} = \frac{\varphi^{SOE} - r_l}{\delta_l^{SOE}} + \frac{\varphi^{PE} - r_l}{\delta_l^{PE}}; \\ CBF + (1 - \alpha) \left[\frac{\alpha r_r + (1 - \alpha)r_b - r_d}{\delta_b^{BK}} \right] + \frac{r_b - r_{wmp}}{\delta_{wmp}^{BK}} - \frac{r_l - r_b}{\delta_l^{BK}} - \frac{r_{tl} - r_b}{\delta_{tl}^{BK}} + \frac{r_b - r_d}{\delta_b^{HH}} = \frac{\varphi^{SOE} - r_b}{\delta_b^{SOE}}; \\ \frac{r_{tl} - r_b}{\delta_{tl}^{BK}} = \frac{\varphi^{SOE} - r_{tl}}{\delta_{tl}^{SOE}} + \frac{\varphi^{PE} - r_{tl}}{\delta_{tl}^{PE}}; \\ \frac{r_b - r_{wmp}}{\delta_{wmp}^{BK}} = \frac{r_{wmp} - r_d}{\delta_{wmp}^{HH}}. \end{cases}$$

where CBF denotes the size of central bank fund which is exogenously given. The five equations above jointly solve the following five unknown variables, i.e., r_d , r_l , r_b , r_{wmp} , and r_{tl} .

(2) The credit system before full liberalization (“dual-track interest rate liberalization credit system”) still have two types of explicit financial repressions, i.e., deposit interest

¹⁷Structural shocks here indicate the permanent changes in credit system, including the rise of shadow banking, and the removal of financial repressions.

rate ceiling and bank loan quota. Hence, market clearing conditions are given by

$$\begin{cases} r_{d_1} = \bar{r}_d; \\ \bar{L} = L_1^{SOE} + L_1^{PE}; \\ B_1^{HH} + B_1^{BK} = B_1^{SOE}; \\ WMP_1^{HH} = WMP_1^{BK}; \\ TL_1^{BK} = TL_1^{SOE} + TL_1^{PE}. \end{cases}$$

where $\bar{L} = k_1 \cdot L^*$, L^* is the equilibrium loan size under an otherwise control-free economy; similarly, $\bar{r}_d = k_2 \cdot r_d^*$, r_d^* is the equilibrium deposit rate under an otherwise control-free economy. $k_1 \in [0, 1]$ and $k_2 \in [0, 1]$ capture the degree of bank loan volume control, and deposit rate repression, respectively. The lower k_1 and k_2 , the tighter the controls will be.

By substituting the FOCs of each agent, we have

$$\begin{cases} r_d = \bar{r}_d; \\ \frac{r_l - r_b}{\delta_{BK}^{BK}} = \frac{\varphi^{SOE} - r_l}{\delta_{il}^{SOE}} + \frac{\varphi^{PE} - r_l}{\delta_{il}^{PE}}; \\ CBF + (1 - \alpha) \left(W - \frac{r_b - r_d}{\delta_b^{HH}} - \frac{r_{wmp} - r_d}{\delta_{wmp}^{BK}} \right) + \frac{r_b - r_{wmp}}{\delta_{wmp}^{BK}} - \bar{L} - \frac{r_{tl} - r_b}{\delta_{tl}^{BK}} + \frac{r_b - r_d}{\delta_b^{HH}} = \frac{\varphi^{SOE} - r_b}{\delta_b^{SOE}}; \\ \frac{r_{tl} - r_b}{\delta_{tl}^{BK}} = \frac{\varphi^{SOE} - r_{tl}}{\delta_{tl}^{SOE}} + \frac{\varphi^{PE} - r_{tl}}{\delta_{tl}^{PE}}; \\ \frac{r_b - r_{wmp}}{\delta_{wmp}^{BK}} = \frac{r_{wmp} - r_d}{\delta_{wmp}^{HH}}. \end{cases}$$

(3) Market clearing conditions in the absence of shadow banking are very similar to those in the baseline model. Hence we omit them here for the sake of simplicity.

A.2 Proof for Lemma 3

The proof for Lemma 3 is straightforward.

Proof. (i) Obviously. If $r_{tl} > \varphi^{SOE}$, the interior optimal strategy for SOE to hold TL is $TL = \frac{\varphi^{SOE} - r_{tl}}{\delta_{il}^{SOE}} < 0$. On the other hand, suppose SOE does not resell credit in the trust loan market given $r_{tl} > \varphi^{SOE}$, a marginal resale, ΔTL , could lead to SOE's efficiency gain,

$$\begin{aligned} \Delta \Pi^{SOE} &= \Delta TL * (r_{tl} - \varphi^{SOE}) - \frac{1}{2} \delta_{il}^{SOE} \Delta TL^2 \\ &= \Delta TL \left(r_{tl} - \varphi^{SOE} - \frac{1}{2} \delta_{il}^{SOE} \Delta TL \right), \end{aligned}$$

$\forall \Delta TL \in (0, \frac{2(r_{tl} - \varphi^{SOE})}{\delta_{il}^{SOE}})$, we have $\Delta \Pi^{SOE} > 0$. That is, $TL \leq 0$ is not an optimal strategy for SOE given $r_{tl} > \varphi^{SOE}$.

(ii) Suppose not, we will have $r_{tl} > \varphi_{PE} > \varphi_{SOE}$, which implies $TL^{SOE} < 0$, $TL^{PE} < 0$. together with $TL^{BK} > 0$, we will obtain $TL^{BK} - TL^{SOE} - TL^{PE} > 0$, which happens

to be a contradiction to the market clearing condition of trust loan market, $TL^{BK} = TL^{SOE} + TL^{PE}$.

(iii) As stated in Equation 5, the market clearing condition for trust loan market is

$$\frac{r_{tl} - r_r - \frac{r_d - r_r}{1-\alpha}}{\delta_{tl}^{BK}} = \frac{\varphi^{SOE} - r_{tl}}{\delta_{tl}^{SOE}} + \frac{\varphi^{PE} - r_{tl}}{\delta_{tl}^{PE}} \quad (\text{A-1})$$

$$\Rightarrow r_{tl} = m_1 \varphi^{SOE} + m_2 \varphi^{PE} + (1 - m_1 - m_2) \frac{\bar{r}_d - \alpha r_r}{1 - \alpha}, \quad (\text{A-2})$$

where $m_1, m_2, 1 - m_1 - m_2 \in [0, 1]$ are constant.¹⁸ Hence, r_{tl} is increasing in φ^{PE} . Equilibrium TL will be pinned down correspondingly, i.e.,

$$\begin{aligned} TL = \frac{\varphi^{PE} - r_{tl}}{\delta_{tl}^{PE}} &= \frac{\varphi^{PE} - (m_1 \varphi^{SOE} + m_2 \varphi^{PE} + (1 - m_1 - m_2) \frac{\bar{r}_d - \alpha r_r}{1 - \alpha})}{\delta_{tl}^{PE}} \\ &= \frac{(1 - m_2) \varphi^{PE} - m_1 \varphi^{SOE} - (1 - m_1 - m_2) \frac{\bar{r}_d - \alpha r_r}{1 - \alpha}}{\delta_{tl}^{PE}}. \end{aligned}$$

Thus, TL is increasing in φ^{PE} . □

A.3 Proof for Proposition 2

We prove that the rise of shadow banking could conditionally make all the four representative agents (The household, the SOE, the PE, and the bank) better off, one by one.

Proof. (i) **The household:** The market clearing condition of the WMP market is given by

$$\frac{\frac{r_d - r_r}{1-\alpha} - (r_{wmp} - r_r)}{\delta_{wmp}^{BK}} = \frac{r_{wmp} - r_d}{\delta_{wmp}^{HH}} \quad (\text{A-3})$$

$$\Rightarrow r_{wmp} = \frac{\delta_{wmp}^{BK} + \frac{\delta_{wmp}^{HH}}{1-\alpha}}{\delta_{wmp}^{HH} + \delta_{wmp}^{BK}} r_d > r_d, \forall \alpha \in (0, 1). \quad (\text{A-4})$$

Thus, from the perspective of household's WMP demand, we have

$$WMP_1 = \frac{\alpha}{(1 - \alpha)(\delta_{wmp}^{BK} + \delta_{wmp}^{HH})} > 0. \quad (\text{A-5})$$

¹⁸To be specific, we have

$$\begin{aligned} m_1 &= \frac{\delta_{tl}^{BK} \delta_{tl}^{PE}}{\delta_{tl}^{SOE} \delta_{tl}^{PE} + \delta_{tl}^{BK} \delta_{tl}^{SOE} + \delta_{tl}^{BK} \delta_{tl}^{PE}}; \\ m_2 &= \frac{\delta_{tl}^{BK} \delta_{tl}^{SOE}}{\delta_{tl}^{SOE} \delta_{tl}^{PE} + \delta_{tl}^{BK} \delta_{tl}^{SOE} + \delta_{tl}^{BK} \delta_{tl}^{PE}}; \\ 1 - m_1 - m_2 &= \frac{\delta_{tl}^{SOE} \delta_{tl}^{PE}}{\delta_{tl}^{SOE} \delta_{tl}^{PE} + \delta_{tl}^{BK} \delta_{tl}^{SOE} + \delta_{tl}^{BK} \delta_{tl}^{PE}}. \end{aligned}$$

The household's aggregate gains before and after the rise of shadow banking are given by

$$\Pi_i^{HH} = [s_i^{HH}r_{wmp} + (1 - s_i^{HH})\bar{r}_d]W - C_i^{HH} \quad (\text{A-6})$$

where s_i^{HH} is the share of WMP in household's investment portfolio, and $1 - s_i^{HH}$ is that of deposit in household's investment portfolio before and after the rise of shadow banking. Based on Equation A-4, we have

$$s_i^{HH} = \begin{cases} \frac{\alpha}{(1-\alpha)(\delta_{wmp}^{BK} + \delta_{wmp}^{HH})W}, & \text{if } i=0; \\ 0, & \text{if } i=1. \end{cases}$$

and

$$C_1^{HH} - C_0^{HH} = \frac{1}{2}WMP_1^2 = \frac{1}{2} \frac{\alpha^2 \delta_{wmp}^{HH}}{(1-\alpha)^2(\delta_{wmp}^{BK} + \delta_{wmp}^{HH})^2} \quad (\text{A-7})$$

Recalling $r_{wmp_1} > r_{d_1} = r_{d_0} = \bar{r}_d$, we can easily prove $\Pi_1^{HH} > \Pi_0^{HH}$ based on Equation A-6. The household's gain from shadow banking is calculated as

$$\begin{aligned} \Delta \Pi_{1-0}^{HH} &= s_i^{HH}(r_{wmp_1} - \bar{r}_d) - (C_1^{HH} - C_0^{HH}) \\ &= \frac{1}{2} \frac{\alpha^2 \delta_{wmp}^{HH}}{(1-\alpha)^2(\delta_{wmp}^{BK} + \delta_{wmp}^{HH})^2} > 0. \end{aligned}$$

Therefore, the household unconditionally gets better off after the rise of shadow banking.

(ii) The SOE: Allowing credit resale between the SOE and the PE, the SOE's aggregate gains before and after the rise of shadow banking are given by

$$\begin{aligned} \Pi_i^{SOE} &= r_{tl_i}|TL_i^{SOE}| + \varphi^{SOE}(L_i^{SOE} - |TL_i^{SOE}|) - r_{l_i}L_i^{SOE} - C_i^{SOE} \\ &= (r_{tl_i} - \varphi^{SOE})|TL_i^{SOE}| + (\varphi^{SOE} - r_{l_i})L_i^{SOE} - C_i^{SOE}, \end{aligned}$$

where $|TL_1^{SOE}| > 0$, $TL_0^{SOE} = 0$, $L_0^{SOE} > L_1^{SOE} > 0$, $r_{l_1} = r_{l_0} > 0$.¹⁹ Since the bank's budget constraint is binding before and after the reform, i.e.,

$$TL_i^{BK} + L_i = (1 - \alpha)D_i + WMP_i = W - \alpha D_i.$$

¹⁹According to Equation 5, the loan market clearing condition is given by

$$\begin{aligned} \frac{r_{l_i} - r_r - \frac{\bar{r}_d - r_r}{1-\alpha}}{\delta_l^{BK}} &= \frac{\phi^{SOE} - r_l}{\delta_l^{SOE}} \\ \Rightarrow r_l &= \frac{\delta_l^{BK}}{\delta_l^{BK} + \delta_l^{SOE}} \varphi^{SOE} + \frac{\delta_l^{SOE}}{\delta_l^{BK} + \delta_l^{SOE}} \left(\frac{\bar{r}_d - \alpha r_r}{1-\alpha} \right). \end{aligned}$$

Hence, r_l is a fixed interest rate before and after the rise of shadow banking.

Let us consider the change in the SOE's capital operation cost,

$$\begin{aligned}
\Delta C_{1-0}^{SOE} &= C_1^{SOE} - C_0^{SOE} \\
&= \frac{1}{2}(\delta_{tl}^{SOE}|TL_1^{SOE}|^2 + \delta_l^{SOE}L_1^{SOE^2} - \delta_l^{SOE}L_0^{SOE^2}) \\
&= \frac{1}{2}\left[\delta_{tl}^{SOE}|TL_1^{SOE}|^2 - \delta_l^{SOE}\left(L_0^{SOE^2} - L_1^{SOE^2}\right)\right] \\
&< \frac{1}{2}\delta_{tl}^{SOE}|TL_1^{SOE}|^2.
\end{aligned}$$

The SOE's gain from the rise of shadow banking is:

$$\begin{aligned}
\Delta \Pi_{1-0}^{SOE} &= (r_{tl_1} - \varphi^{SOE})|TL_1^{SOE}| + \varphi^{SOE}(L_1 - L_0) + r_{l_0}L_0 - r_{l_1}L_1 - \Delta C_{1-0}^{SOE} \\
&= (r_{tl_1} - \varphi^{SOE})|TL_1^{SOE}| + (r_{l_0} - \varphi^{SOE})L_0 - (r_{l_1} - \varphi^{SOE})L_1 - \Delta C_{1-0}^{SOE} \\
&> (r_{tl_1} - \varphi^{SOE})|TL_1^{SOE}| + (r_{l_0} - \varphi^{SOE})L_0 - (r_{l_1} - \varphi^{SOE})L_0 - \Delta C_{1-0}^{SOE} \\
&= (r_{tl_1} - \varphi^{SOE})|TL_1^{SOE}| - (r_{l_1} - r_{l_0})L_0 - \Delta C_{1-0}^{SOE} \\
&= (r_{tl_1} - \varphi^{SOE})|TL_1^{SOE}| - \Delta C_{1-0}^{SOE} \\
&> (r_{tl_1} - \varphi^{SOE})|TL_1^{SOE}| - \frac{1}{2}\delta_{tl}^{SOE}|TL_1^{SOE}|^2 \\
&= \frac{(r_{tl_1} - \varphi^{SOE})^2}{2\delta_{tl}^{SOE}} > 0.
\end{aligned}$$

Hence, $\Pi_0^{SOE} > \Pi_1^{SOE}, \forall r_{tl} > \varphi^{SOE}$. That is, if ϕ^{SOE} is sufficiently large to yield $r_{tl} > \varphi^{SOE}$,²⁰ the SOE will benefit from the rise of shadow banking.

(iii) **The PE:** The PE's gain from the rise of shadow banking is given by

$$\begin{aligned}
\Delta \Pi_{0-1}^{PE} &= \Pi_0^{PE} - \Pi_1^{PE} = \Pi_0^{PE} \\
&= (\varphi^{PE} - r_{tl_0})TL_0^{PE} - \frac{1}{2}\delta_{tl}^{PE}TL_0^{PE^2} \\
&= \frac{1}{2}\delta_{tl}^{PE}TL_0^{PE^2} > 0
\end{aligned}$$

Thus, the PE unconditionally gets better off from the rise of shadow banking.

(iv) **The bank:** The bank's objective function is given by

$$\Pi_i^{BK} = r_{l_i}L_i + r_r\alpha D_i + r_{tl_i}TL_i - r_{di}D_i - r_{wmp_i}WMP_i - C_i^{BK}.$$

²⁰Based on Equation A-2, the sufficient and necessary condition for $r_{tl} > \varphi^{SOE}$ is

$$\varphi^{PE} > \frac{1 - m_1}{m_2}\varphi^{SOE} + \frac{1 - m_1 - m_2}{m_2}\frac{\bar{r}_d - \alpha r_r}{1 - \alpha}.$$

Correspondingly, the bank's gain from shadow banking is

$$\begin{aligned}
\Delta\Pi_{1-0}^{BK} &= r_{l_1}L_1 + (r_r\alpha - \bar{r}_d)D_1 + r_{tl_1}TL_1^{BK} - r_{wmp_1}WMP_1 \\
&\quad - [r_{l_0}L_0 + (r_r\alpha - \bar{r}_d)D_0] - \Delta C_{1-0}^{BK} \\
&= \underbrace{[r_{l_1}L_1 - r_{l_0}L_0 + r_{tl_1}TL_1^{BK}]}_{\text{Change in Revenue}} - \underbrace{[r_{wmp_1}WMP_1 + (\bar{r}_d - r_r\alpha)(D_1 - D_0)]}_{\text{Change in Financing Cost}} \\
&\quad - \underbrace{(C_1^{BK} - C_0^{BK})}_{\text{Change in Operation Cost}}.
\end{aligned}$$

Lamma 3 indicates that r_{tl} and TL are increasing in φ^{PE} . As we proved previously, (1) $r_{l_0} = r_{l_1}$; (2) $\Delta C_{1-0}^{BK} = C_1^{BK} - C_0^{BK}$ is bounded; (3) $\Delta\Pi_{1-0}^{BK}$ is increasing in φ^{PE} . Thus, based on Lemmas 1 and 2, there exists a constant $\bar{\varphi}^{PEBK}$ that yields $\Pi_1^{BK} > \Pi_0^{BK}$ for any $\varphi^{PE} > \bar{\varphi}^{PEBK}$. The bank will gain from the rise of shadow banking given a sufficiently large φ^{PE} .

Therefore, the household and the PE unconditionally get better off. While, the SOE and the bank could get better off conditional on a sufficiently large φ^{PE} . In other words, shadow banking could lead to *Pareto* improvement given a sufficiently large φ^{PE} . \square

Table 1: **Composition of Aggregate Financing in China**

This table reports aggregate financing to the real economy (in billion RMBs) in China between 2002 and 2013. *AFRE* denotes the aggregate volume of financing to the real economy in a year; *RMBL* denotes RMB-denominated loan; *FL* denotes foreign currency-denominated loan (RMB equivalent); *EL* denotes entrust loan; *TL* denotes trust loan; *UBA* denotes undiscounted banker's acceptance; *CB* denotes net issuance of corporate bond; *EQ* denotes net equity issuance of non-financial firms on domestic markets. Percentages to *AFRE* are reported in parentheses. Sources of data: People's Bank of China (PBC), National Development and Reform Commission (NDRC), China Securities Regulatory Commission (CSRC), China Insurance Regulatory Commission (CIRC), China Government Securities Depository Trust & Clearing Co. Ltd. (CDC), and National Association of Financial Market Institutional Investors (NAFMII).

Year	<i>AFRE</i>	<i>RMBL</i>	<i>FL</i>	<i>ETL</i>	<i>TL</i>	<i>UBA</i>	<i>CB</i>	<i>EQ</i>
2002	2011	1848	73	18		-70	37	63
		(91.9%)	(3.6%)	(0.9%)		(-3.5%)	(1.8%)	(3.1%)
2003	3411	2765	229	60		201	50	56
		(81.1%)	(6.7%)	(1.8%)		(5.9%)	(1.5%)	(1.6%)
2004	2863	2267	138	312		-29	47	67
		(79.2%)	(4.8%)	(10.9%)		(-1.0%)	(1.6%)	(2.4%)
2005	3001	2354	142	196		2	201	34
		(78.5%)	(4.7%)	(6.5%)		(0.1%)	(6.7%)	(1.1%)
2006	4270	3152	146	270	83	150	231	154
		(73.8%)	(3.4%)	(6.3%)	(1.9%)	(3.5%)	(5.4%)	(3.6%)
2007	5966	3632	386	337	170	670	228	433
		(60.9%)	(6.5%)	(5.7%)	(2.9%)	(11.2%)	(3.8%)	(7.3%)
2008	6980	4904	195	426	314	106	552	332
		(70.3%)	(2.8%)	(6.1%)	(4.5%)	(1.5%)	(7.9%)	(4.8%)
2009	13910	9594	927	678	436	461	1237	335
		(69.0%)	(6.7%)	(4.9%)	(3.1%)	(3.3%)	(8.9%)	(2.4%)
2010	14019	7945	486	875	387	2335	1106	579
		(56.7%)	(3.5%)	(6.2%)	(2.8%)	(16.7%)	(7.9%)	(4.1%)
2011	12829	7472	571	1296	203	1027	1366	438
		(58.2%)	(4.5%)	(10.1%)	(1.6%)	(8.0%)	(10.6%)	(3.4%)
2012	15763	8204	916	1284	1285	1050	2255	251
		(52.0%)	(5.8%)	(8.1%)	(8.1%)	(6.7%)	(14.3%)	(1.6%)
2013	17317	8892	585	2547	1840	776	1811	222
		(51.3%)	(3.4%)	(14.7%)	(10.6%)	(4.5%)	(10.5%)	(1.3%)

Table 2: **Variable Definitions and Benchmark Values**

This table reports the benchmark parameter values in the numerical simulations. The observed parameters have their mostly recently observed values or values reported in previous literature. In particular, the values of r_r , r_p , α and the ratio of CBF to W are based on the data released by the National Bureau of Statistics of China. The values of unobservable parameters must be intuitive and enable the model to generate interests rates and asset composition that are consistent with observed features and patterns. Some variables— φ_b^{HH} , δ_b^{SOE} , r_p , CBF , k_1 , and k_2 —appear only in the extended baseline model for numerical analysis.

Variable	Definition	Value
<i>Household</i>		
φ_b^{HH}	Coefficient of Marginal Cost of Bond	0.15
δ_{wmp}^{HH}	Coefficient of Marginal cost of WMP	0.05
W	Wealth Endowment	2.4
<i>Firm</i>		
φ^{SOE}	Coefficient of Marginal Productivity of SOE	10%
φ^{PE}	Coefficient of Marginal Productivity of PE	20%
δ_l^{SOE}	Coefficient of Marginal Cost of Bank Loan of SOE	0.02
δ_l^{PE}	Coefficient of Marginal Cost of Bank Loan of PE	0.12
δ_b^{SOE}	Coefficient of Marginal Cost of Bond of SOE	0.08
δ_{tl}^{SOE}	Coefficient of Marginal Cost of Trust/Entrust Loan of SOE	0.05
δ_{tl}^{PE}	Coefficient of Marginal Cost of Trust Loan of PE	0.05
<i>Bank</i>		
δ_l^{BK}	Coefficient of Marginal Cost of Loan	0.02
δ_d^{BK}	Coefficient of Marginal Cost of Deposit	0.01
δ_{wmp}^{BK}	Coefficient of Marginal Cost of WMP	0.02
δ_{tl}^{BK}	Coefficient of Marginal Cost of Trust Loan	0.15
<i>Central Bank</i>		
α	Reserve Requirement Ratio	15%
r_r	Deposit Reserve Rate	1.5%
r_p	Central Bank Fund Rate	2%
CBF	Central Bank Fund (CBF)	0.1
k_1	Degree of Bank Loan Volume Constraint	90%
k_2	Degree of Deposit Rate Constraint	80%

Table 3: **Interest Rates and Financial Assets**

This table reports the equilibrium interest rates and financial asset sizes at different stages of the interest rate liberalization process. The three stages are before interest rate liberalization (past), dual-track reform with shadow banking (present), and full interest rate liberalization (future), respectively. The variables r_l , r_{tl} , r_b , r_d , and r_{wmp} denote the interest rates of loan, trust loan, bond, deposit, and WMP, respectively. The variables, L , TL , B , D , and WMP denote the sizes of loan, trust loan, bond, deposit, and WMP, respectively. Short dash, “-”, indicates that the corresponding asset does not exist in the model, or is unobserved.

Variable	Before Reform	Dual-Track Reform	Full Liberalization	Observed
<i>Interest Rates</i>				
r_{tl}	-	13.7%	13.8%	$\geq 12.0\%$
r_l	9.0%	9.4%	9.2%	7.2%
r_b	4.2%	5.8%	6.6%	6.0%
r_{wmp}	-	5.1%	5.8%	5.0%
r_d	2.1%	3.2%	4.0%	3.0%
<i>Financial Products</i>				
L	1.44	1.18	1.31	1.20
L^{SOE}	0.52	0.30	0.41	-
L^{PE}	0.92	0.88	0.88	-
TL	-	0.52	0.48	-
TL^{SOE}	-	-0.74	-0.76	-
TL^{PE}	-	1.26	1.24	-
B	0.72	0.52	0.43	0.56
D	2.26	1.84	1.85	1.76
WMP	-	0.38	0.37	-

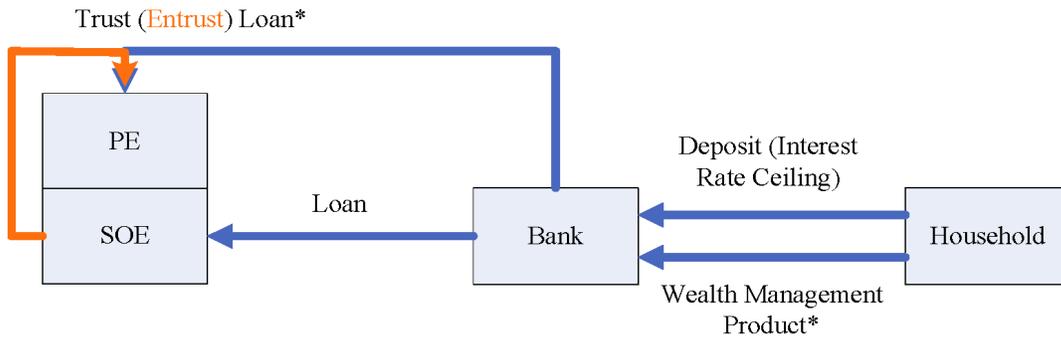
Table 4: **Agent Gains under Different Credit System Settings**

This table presents gains of the agents at different reform stage under different reform mechanisms. Columns (2)-(5) are for the stages of before interest rate liberalization, dual-track liberalization with shadow banking; full interest rate liberalization; and single-track one step liberalization, respectively. Aggregate gain is the summation of household gain, firm gain, and bank gain, and expressed under the scale of 10^{-2} .

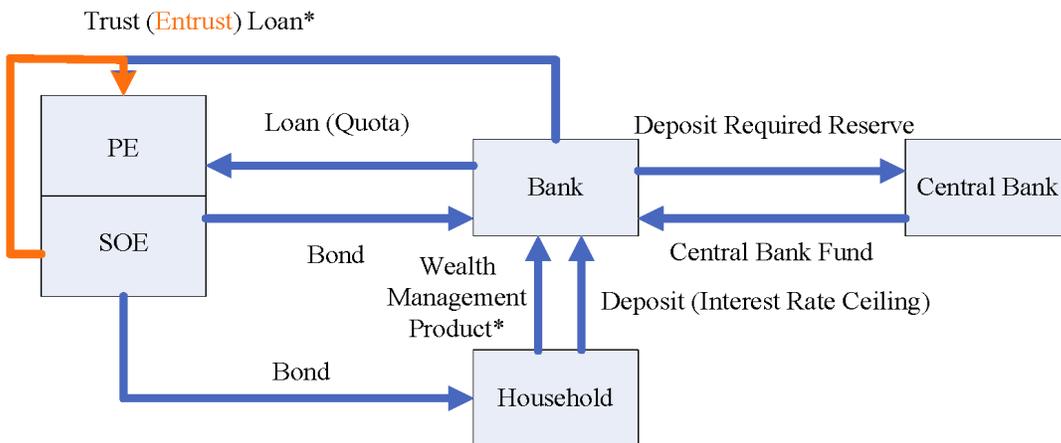
	Before Reform	Dual-Track Reform	Full Liberalization
Firm	7.42	11.19	11.35
-SOE	2.34	2.54	2.35
-PE	5.08	8.66	8.73
Bank	6.23	7.44	5.77
Household	5.27	8.19	10.06
Aggregate	18.92	26.82	26.90

Figure 1: Credit System in the Baseline Model

This figure illustrates the credit system in the baseline model in Panel A, and the extended (full version) baseline model in Panel B, respectively. We (1) remove bond market and central bank; and (2) combine bank loan volume constraint with high RRR in the baseline model to simplify model setup and to generate analytical solutions and implications in a clean manner. The arrows represent the directions of asset flows, which are in the opposite direction of capital flows. The figure resembles the credit system before dual-track liberalization if shadow banking activities marked with asterisks (*) are removed. It resembles full interest rate liberalization if the financial restrictions highlighted in the parentheses are removed, while the shadow banking activities are kept. Removing both the shadow banking activities and the financial restrictions leads to a credit system under single-track one stop liberalization.



(A) Baseline Model



(B) Extended Baseline Model

Figure 2: **Efficiency Gain from the Rise of Shadow Banking**

This figure reports the relations between efficiency gain from dual-track liberalization with shadow banking and key credit system characteristics, including the degree of bank loan volume constraint (k_1), the degree of deposit rate repression (k_2), and bond market inefficiency (δ_b^{SOE}). Efficiency gain is measured as the difference between the aggregate gains in the presence and absence of shadow banking.

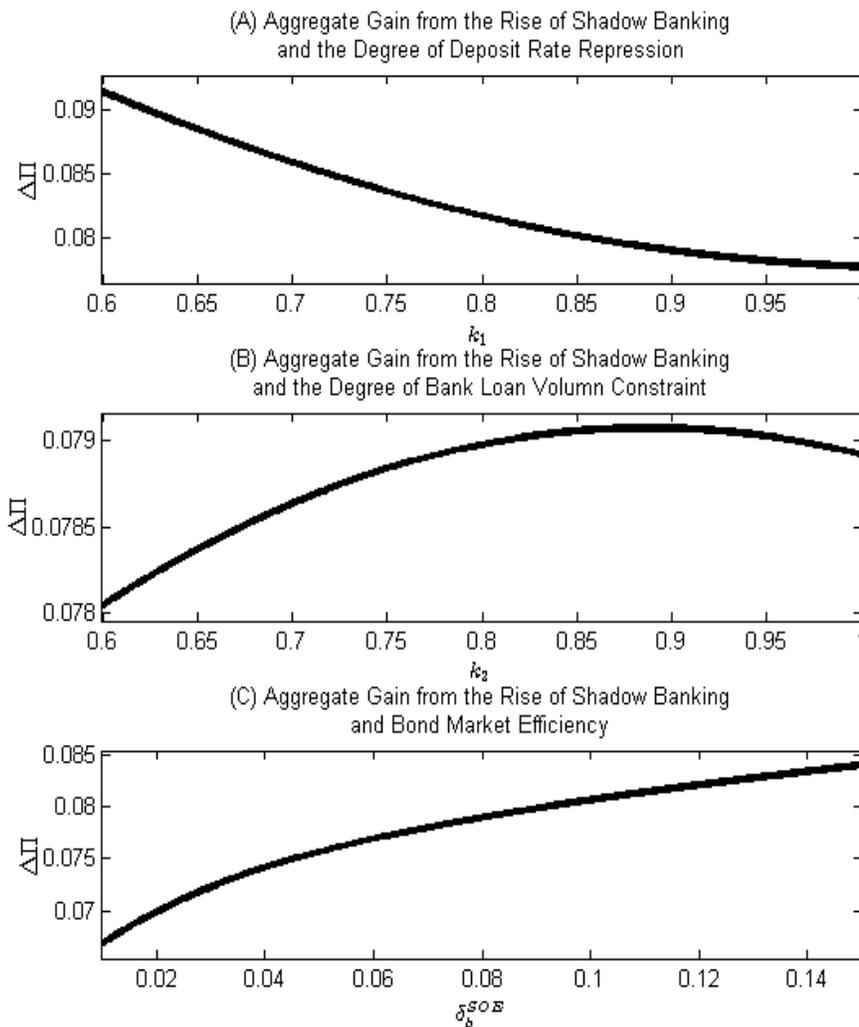


Figure 3: **Full Interest Rate Liberalization**

This figure reports the relations between efficiency gain from dual-track liberalization with shadow banking and key firm characteristics, including the ratio of SOE loan financing cost to PE loan financing cost ($\delta_i^{SOE}/\delta_i^{PE}$) and the ratio of the SOE's productivity to the PE's ($\varphi^{SOE}/\varphi^{PE}$). Efficiency gain is measured as the difference between the aggregate gains before and after full interest rate liberalization in the presence of shadow banking.

