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Financial Distortions in China: A General Equilibrium Approach

by Diego Anzoategui, Mali Chivakul, and Wojciech Maliszewski

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Asia and Pacific Department

Financial Distortions in China: A General Equilibrium Approach

Prepared by Diego Anzoategui, Mali Chivakul, and Wojciech Maliszewski¹

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Abstract

Widespread implicit guarantees and interest ceilings were major distortions in China's financial system, contributing to a misallocation of resources. We analyze the impact of removing such frictions in a general equilibrium setting. The results show that comprehensive reforms generate better outcomes than partial ones: removing the deposit rate ceiling alone increases output, but the efficiency of capital allocation does not improve. Removing implicit guarantees improves output through lower cost of capital for private companies and better resource allocation.

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1 Introduction

While a succession of market-oriented reforms has transformed China into the second largest economy in the world, financial sector reforms have been lagging behind. Interest rates used to be heavily controlled and had been liberalized only gradually. Even more entrenched is the system of implicit state guarantees covering financial institutions and corporates (particularly state-owned), giving an easier access to credit to entities perceived to be backed by the government.

Why have these distortions survived for that long, even as the rest of the economy has been undergoing a transition to a market-oriented system? They have been an integral part of the China's growth story. Low, administratively-controlled interest rates have worked in tandem with distortions artificially boosting saving rates. Both reduced the cost of capital to support what has long been the highest investment rate in the world. Widespread implicit state guarantees further supported credit flow and investment, particularly when export collapsed after the Global Financial Crisis. This mechanism supercharged China's growth liftoff.

The distortions, however, have had costs, which become heavier over time. Abundant and cheap credit has increasingly flown to finance low-return activities, with true risks mispriced given the strength of implicit guarantees. The economy has got locked in an equilibrium that is fundamentally unsustainable: slowing credit growth would sharply reduce activity and profits in several sectors of the economy, putting in question their debt-servicing capacity. A continued credit expansion prevents this from happening by supporting demand and covering losses. The adjustment can be delayed as long as losses can be covered by still high national savings, but ultimately this and other buffers will be exhausted as growth slows further due to an increasingly inefficient allocation of capital.

Is there a way out? The crux of the problem is the misallocation of capital, promoted by skewed incentives to invest in low-return projects. Removing the distortions—implicit guarantees and interest rate controls—is therefore key to allocate resources better, generate higher return, and make debt sustainable.

The Third Plenum reform blueprint, announced in 2013, includes important reforms to tackle the distortions, but progress in implementation has been mixed. In particular, the People's Bank of China (PBC) has just completed the process of liberalizing interest rates after lifting the deposit rate ceilings, but it is taking time for banks to fully adjust to the new environment, particularly as PBC is still reportedly providing “window guidance” out of legitimate concerns about the effect of greater competition on financial stability. “Leveling the playing field between SOEs and private-owned enterprises” (POEs)-another objective of reforms- is widely understood as the removal of implicit guarantees. Progress in this direction, however, has been even slower, although the authorities appear to test the ground by allowing some defaults in the corporate sector.

Intuitively, these reforms are good for the allocation of capital and for breaking the circle of over-reliance on credit. But a more formal model is needed to evaluate general equilibrium effects of proposed reforms and track specific channels. This paper attempts to address these questions by calibrating a standard heterogeneous agent model `a la Bewley-Aiyagari (aligned to Buera and Shin, 2013; and Quadrini, 2000) to Chinese data.

The model is then used to simulate the effects of lifting the deposit rate ceilings (which does not appear to be fully reflected in banks' behavior yet) and removing implicit guarantees (which has not yet started in earnest).

The main findings are as follows:

- Removing the deposit interest rate ceilings alone would not result in a more efficient allocation of credit. It would reduce lending rates, increase capital intensity in the economy, and therefore boost output. However, with implicit guarantees still in place, both less efficient SOEs and more efficient POEs would expand given the additional capital. As a result, total factor productivity (TFP) level would be reduced and output gains would come mainly from the increase in capital stock. Moreover, the impact on output could be even smaller if other factors, including other Third Plenum reforms, lead to an offsetting reduction in savings.
- It is the removal of implicit guarantees that leads to more efficient allocation of capital and higher GDP. It happens through the reduction of the role of less efficient SOEs in the economy.

This paper is related to a large literature employing heterogeneous agent models to assess the effects of misallocations. Nevertheless, to the best of our knowledge, there has only been two previous studies on the effects of financial reforms in China. Feyzioglu and others (2009) investigate the effects of deposit interest rate liberalization using a partial equilibrium model. Their findings differ from ours as they conclude that both deposit and lending interest rates will increase. The main reasons for the difference are: (i) our results are based on a general equilibrium model while Feyzioglu and others (2009) relies on partial equilibrium; and (ii) Feyzioglu and others (2009) assume monetary policy tightening to avoid the increase in the capital intensity in the economy. Song and others (2014) use a stylized model developed in Song and others (2011) to address effects of interest rate liberalization. They conclude, like us, that the real effects of the liberalization depend on how much savings would rise as a response to increases in real deposit interest rates. However, they do not assess the consequences of removing government implicit guarantees.

One caveat on our model is that it does not address the impact of stronger banking competition on financial sector stability. There is extensive literature on this topic which relates financial sector liberalization to fiercer competition and consequently stronger incentives for banks to take excessive risks. While the model does not address this concern, it does highlight the importance of removing the two distortions simultaneously, as liberalizing deposit rate alone would likely reinforce distortions from implicit guarantees.

The rest of the paper is as follows. Section 2 describes and provides evidence of the two distortions we are addressing in this paper. Section 3 describes the model and Section 4 defines the equilibrium. The calibration of the model is detailed in Section 5 and the main results are presented in Section 6. Section 7 concludes.

2 Financial Distortions in China

2.1 Interest Rate Ceilings

While China has fully liberalized its bank lending rates since end-2013, deposit rates have been freed only since October 2015. All deposits used to be subject to the rate ceiling before, unless specifically exempted. The ceilings used to range from 0.35 percent for demand deposits to 3.3 percent for 1-year time deposits, although they became less binding after 2012 when banks were allowed to offer rates up to 1.1 times higher (the ‘float’ above the ceilings was widened in several steps, but always in conjunction with commensurate reductions in the ceilings themselves).

Were the ceilings binding? Most likely yes. Average effective deposit rate has been between 1-2 percent and have remained within this range even after the full liberalization in October 2015, likely reflecting the PBC ‘window guidance’. This implies either negative or, more recently, very low real deposit rates (well below the real rate of GDP growth). Even when the deposit ceilings were still in place, a partial (and unofficial) liberalization had already started through the emergence of alternative saving products such as wealth management products (WMPs) and internet-based money market funds (MMFs). These products are more risky, but are offered or marketed by banks, creating a perception that the umbrella of implicit guarantees extends to them as well (defaults were rare and ended in a partial bail out). As the liberalization advanced, banks were also allowed to offer negotiated deposits and structured deposits exempted (fully or partly) from the ceilings.¹ These products -the closest substitute to deposits- offered rates in the range of 4 to 6 percent and are therefore several times higher than that of regular deposits. They were growing strongly, accounting for about 13 percent of total bank deposits by mid-2015. This phenomenon is not unique to China. In the U.S., Regulation Q imposed maximum interest rates on various types of bank deposits from 1933 to 1986 and prohibited banks from paying interest on demand deposits until 2011. The cap encouraged the emergence of other saving alternatives, especially the MMFs.

What is the nature of the distortions? Deposit interest ceilings are a form of financial repression, or a tax on household savings. This distortion is aggravated by the limited choice of alternative saving instruments: with the capital account remaining closed, households can put their savings in only a handful of assets, such as property, stock market, gold, and more recently WMPs. These asset classes are not only inherently more risky, but their limited size creates a fertile ground for bubbles. For the lack of better alternatives, bank deposits have continued to increase with the rise in savings, despite negative or low real yields.

Moreover, the deposit interest rate ceilings provide little incentive for banks to become more efficient. Indeed, even after the liberalization of bank lending rates, there is no clear evidence that the banking system as a whole has become more competitive and efficient.

¹Negotiated deposits included interbank placements and negotiable certificate of deposits in which the rate and maturity are negotiated. Structured deposits were a hybrid wealth management product combining a regular deposit (subject to the rate ceiling) and a derivative component (not subject to the rate ceiling) linked to the exchange rate, foreign interest rates, equities, or commodity prices.

Figure 1. Wealth Management Products

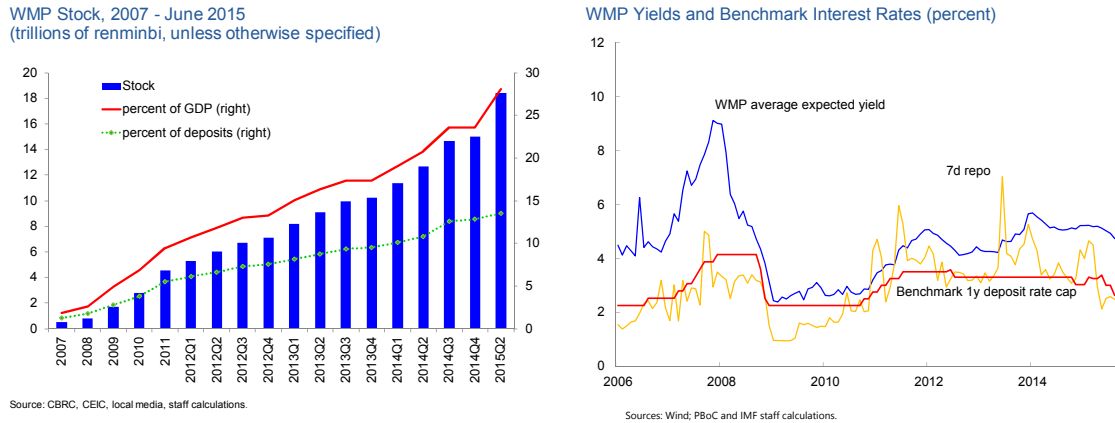
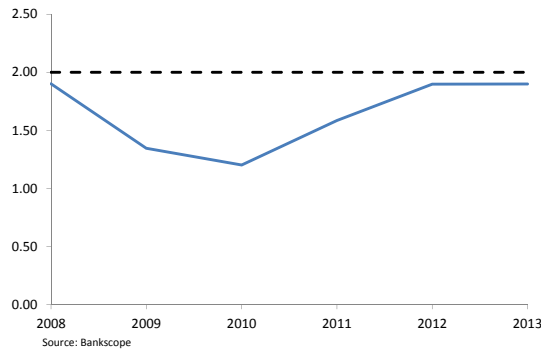


Figure 2. Average Deposit Interest Rate (%)



While the mid-sized joint stock banks have seen their net interest margin (NIM) falling recently, the big four state banks have maintained their comfortable NIM.

2.2 Implicit Guarantees

Implicit guarantees are widespread in China. A number of firms (the borrowers) enjoy privileged access to credit as creditors presume that they are implicitly supported by the government. State-owned enterprises (SOEs) are the main, but not exclusively the only, beneficiaries of these guarantees. With the overarching goal of maintaining social stability, all enterprises sufficiently important for the local economy -for employment in particular- are expected to benefit from such implicit support. Creditors, both financial institutions and bond holders, act rationally to grant credit to these enterprises, understanding that the government would foot the bill in the event of a default.

There is clear evidence that creditors have been bailed out in the event that their lending

Figure 3. Deposits and Household Savings

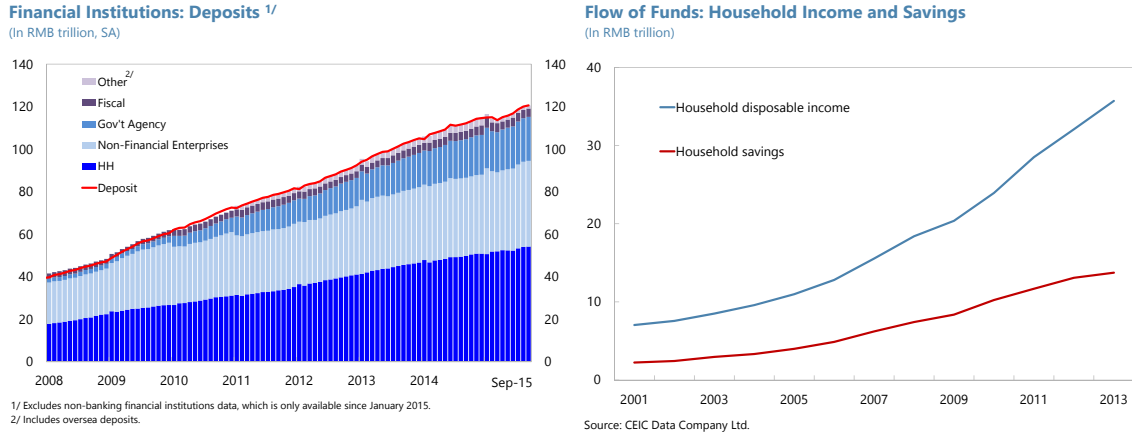
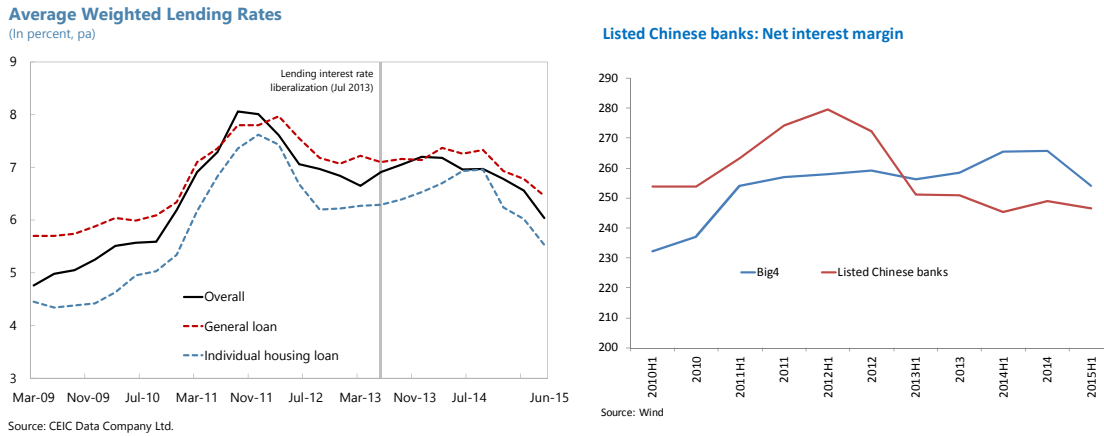


Figure 4: Lending Interest Rates and Net Interest Margins



to these implicitly guaranteed enterprises went sour. One important example is from bank bail-out in early 2000s. As nonperforming loans (NPLs) from directed lending to SOEs mounted by late 1990s, the Chinese government had to restructure the banks. Ma (2006) estimated that the cost of cleaning up the banks was more than 20 percent of GDP by mid 2000s. Another example is the fact that bond default in China is a rare event. Debtors usually receive support from their local government and bond underwriter to patch together payment to avoid default.²

Implicit guarantees distort lending decision. With the guarantees, there is incentive for creditors to lend more (and more cheaply) to those perceived to be guaranteed, regardless of the viability or profitability of the project. Indeed, there is evidence that SOEs have enjoyed better access to finance than their private counterpart. Based on our regression using

²See here for example: <http://www.bloomberg.com/news/2014-07-23/china-averts-second-corporate-default-as-huatong-pays-bonds-1-.html>.

the World Bank's 2012 Enterprise Survey, SOEs are more likely to have access to finance than their private counterparts, even after controlling for industry and individual firm characteristics. Table 1 shows marginal effects of the probability of being credit constrained from a probit regression. The dependent variable is a dummy variable taking the value 1 if the firm is constrained and 0 otherwise. The results indicate that, controlling for other characteristics, a POE is 12 percent more likely to be constrained. The marginal effect is significant taking into account that 23 percent of all firms in the survey were constrained.

Table 1. Probability of Being Constrained (marginal effects)

	Dependent Variable: Constrained=1			
	(1)	(2)	(3)	(4)
POE	0.123*** (0.0217)	0.117*** (0.0223)	0.119*** (0.0231)	0.109*** (0.0235)
Manufacturing Sector		0.0456*** (0.0171)	0.0667*** (0.0182)	0.0590*** (0.0182)
Retail		0.134*** (0.0414)	0.0844** (0.0419)	0.0760* (0.0432)
log(employees)			-0.0390*** (0.00700)	-0.0371*** (0.00715)
log(years of operation)			-0.0144 (0.0168)	-0.0323* (0.0175)
% of production exported			-0.120*** (0.0378)	-0.0656* (0.0392)
Growth of sales			-0.0657** (0.0305)	-0.0513* (0.0273)
Region dummies	No	No	No	Yes
Observations	2,734	2,734	2,514	2,437

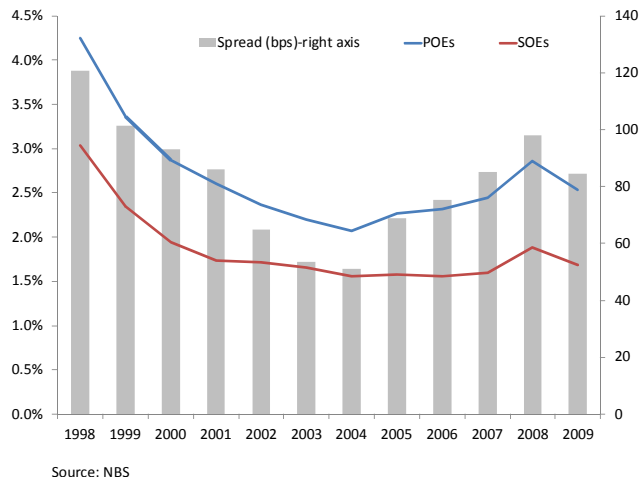
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

We label a firm as constrained if either: (i) the firm applied for a loan and was rejected, (ii) did not apply because interest rates, collateral requirements or size were not favorable, or (iii) did not apply because did not think it would be approved.

Moreover, SOEs seem to also enjoy lower borrowing cost than POEs. Based on firm-level data from the National Bureau of Statistics (NBS), Ferri and Liu (2010) document a spread of 200 bps between borrowing rates of SOEs and POEs in early to mid 2000s, controlling for firm characteristics. Based on more recent NBS firm-level data up to 2009, our panel estimates suggest that there remains statistically significant spread between SOEs and POEs effective borrowing rates. Figure 5 shows a higher ratio interest expenses to total liabilities for POEs than for SOEs. Even after controlling for individual characteristics of firms, this difference remains statistically significant.

The bank bailout example from early 2000s also connects implicit guarantees with deposit rate ceilings. Financial losses from the guarantee being called were ultimately born by the government, taxpayers as well as bank customers. The government, as the main shareholder of banks, suffers losses from its equity holding, while taxpayers pay for public funds used to inject into the banks. By receiving below-market rates on their deposits, bank depositors contribute to bank operating profits that would over time help rebuild bank balance sheets.

Figure 5. Interest Expenses/Total Liabilities, POEs vs SOEs



In other words, deposit rate ceilings act as a subsidy to banks to pay for the guarantees that have been called (or that could be called in the future). From this perspective, the two distortions considered in this paper coexisted to support each other. Implicit guarantees have to be paid for and deposit rate ceilings are one way to share the burden with the wider public.

3 The Model

We assume discrete time and that every period represents one year. The model has four types of agents: (i) private agents, (ii) SOEs, (iii) banks, and (iv) a government.

Private agents are either workers or entrepreneurs. Workers offer labor services whereas entrepreneurs own and receive profits from POEs. In turn, POEs hire labor and invest capital in a production process with a stochastic productivity level. We assume that POEs face collateral constraints when they demand credit from the banking sector.

SOEs are represented by a corporate sector that enjoys better access to credit (lower interest rates and no collateral constraints). Banks are state owned and monopolistically competitive. Finally, we assume a government with a balanced budget. This government collects income through consumption taxes, lump sum taxes and profits from the SOE and banking sector. Public resources are devoted to public consumption and subsidies.

3.1 Households: Workers and Entrepreneurs

We assume there is a continuum of private agents, who are heterogeneous in terms of the assets they hold (a) and their entrepreneurial ability (e). Assets and ability are the

two state variables of agent's problem. The former is endogenous as it is chosen by the agent subject to her budget constraint, whereas the latter is exogenous.³

Following Buera and Shin (2013), we assume that an agent can keep her entrepreneurial ability from previous period with probability $p_e \in (0, 1)$. If the agent is not able to keep her level of e , she draws a new ability level e' from a distribution $\mu(e')$, which is invariant in time.

Since this model has heterogeneous agents, at every time t there is a measure of agents with different assets and ability levels. We denote that (endogenous) measure by Γ_t .

Given the prices in the economy and a pair of states (a, e) , every period an agent has to make two decisions: (i) First, she has to choose between being a worker, or running a firm (a POE) that delivers a profit, and after that choice (ii) she decides the amount of consumption and savings. The problem described above can be represented recursively in the following way,

$$\begin{aligned} V_t(a_t, e_t) &= \max_{\{a_{t+1}, c_t\}} U(c_t) + \beta E \{V_{t+1}(a_{t+1}, e_{t+1})\} \\ &\text{st.} \\ a_{t+1} + (1 + \tau_c)c_t &= \max\{w_t, \pi_t^{int}(a_t, e_t), \pi_t^{ext}(a_t, e_t)\} + (1 + r_t^d)a_t - T_t \\ a_{t+1} &\geq 0 \end{aligned}$$

Where, V_t represents the value function of the household at time t , a_{t+1} represents the asset holdings the following period, and c_t stands for consumption. Moreover, τ_c represents the consumption tax, T_t are lump sum taxes collected by the government.

As detailed in the budget constraint of the problem, the agent has two sources of income: (i) deposits at the banking sector that pay a real interest rate r_t^d , and (ii) depending on her decision of being either a worker or an entrepreneur, labor income or profits from POEs.

Since agents offer labor inelastically, labor income is given by the real wage w_t .⁴ Profits from POEs are divided in two types depending on the source of funds that are invested in the firm. When a firm uses external resources, it gets $\pi_t^{ext}(a_t, e_t)$. On the other hand, when only internal funds are used (the firm does not go to the banking sector for credit) profits are $\pi_t^{int}(a_t, e_t)$.

The decision of being a worker or an entrepreneur is implicit in the max operator in the budget constraint. Hence, if $w_t > \max\{\pi_t^{int}(a_t, e_t), \pi_t^{ext}(a_t, e_t)\}$ then the agent will decide to be a worker and it will be an entrepreneur otherwise. Furthermore, if $\pi_t^{int}(a_t, e_t) > \max\{w_t, \pi_t^{ext}(a_t, e_t)\}$ the agent will be an entrepreneur using only internal funds and if $\pi_t^{ext}(a_t, e_t) > \max\{w_t, \pi_t^{int}(a_t, e_t)\}$ she will use external funds.

Firm's profit function when the entrepreneur decides to use only internal funds is given by,

³For simplicity, we assume that the only financial instrument that households can use to save are one year deposits. Hence, there is only one deposit interest rate (r_t^d) and, therefore, only one interest rate ceiling.

⁴We are normalizing average working hours to one.

$$\pi_t^{int}(a_t, e_t) = \max_{\{k_t^{int}, l_t^{int}\}} f(e_t, k_t^{int}, l_t^{int}) - (r_t^d + \delta)k_t^{int} - w_t l_t^{int}$$

st.

$$k_t^{int} \leq a_t$$

Here $f(\cdot)$ is the production function of the firm, δ is the depreciation rate, k_t^{int} is the capital invested in the firm, and l_t^{int} is the demand for labor.

If the entrepreneur decides to get bank credit then it would have to sign a contract with a financial institution. We assume that, in order to provide credit, banks require a collateral.⁵ For simplicity and following Dabla-Norris and others (2014), we assume that the collateral is interest bearing. Hence, the entrepreneur optimally deposits all the assets (a) in the bank and gets credit paying an interest rate $r_{t,poe}^l$, determined in equilibrium. The firm's problem in this case is represented by,

$$\pi_t^{ext}(a_t, e_t) = \max_{\{k_t^{ext}, l_t^{ext}\}} f(e_t, k_t^{ext}, l_t^{ext}) - (r_{t,poe}^l + \delta)k_t^{ext} - w l_t^{ext}$$

st.

$$a \leq k_t^{ext} \leq \lambda a_t$$

Where λ is a collateral constraint parameter, and k_t^{ext} and l_t^{ext} are the capital and labor demand of the firm.

3.2 SOEs

We assume that the SOE sector is represented by a constant returns to scale technology given by a typical Cobb Douglas function,

$$y_{t,soe} = A k_{t,soe}^\alpha l_{t,soe}^{1-\alpha}$$

This sector has access to cheap credit, they pay an interest rate $r_{t,soe}^l \leq r_{t,poe}^l$, and they do not have collateral restrictions. Therefore, the SOE problem is given by,

⁵This can be theoretically justified embedding a model with lack of commitment à la Townsend (1979). Empirically, we found that around 70 percent of firms with outstanding loans or credit lines in 2011 were asked to provide collateral.

$$\max_{\{k_{t,soe}, l_{t,soe}\}} Ak_{t,soe}^\alpha l_{t,soe}^{1-\alpha} - (r_{t,soe}^l + \delta)k_{t,soe} - w_t l_{t,soe}$$

Where $k_{t,soe}$ and $l_{t,soe}$ are SOEs capital and labor demand, respectively. A represents the total factor productivity in this sector and α is the capital-output elasticity. This problem yields the following first order conditions (FOCs),

$$\alpha \left(\frac{k_{t,soe}}{l_{t,soe}} \right)^{\alpha-1} = r_{t,soe}^l + \delta \quad (1)$$

$$(1 - \alpha) \left(\frac{k_{t,soe}}{l_{t,soe}} \right)^\alpha = w_t \quad (2)$$

3.3 Banks

There are a continuum (measure unity) of monopolistic competitive banks⁶. We assume that they are state owned and, therefore, they transfer their profits to the government⁷. Each bank j supplies a different type of loan at an interest rate $r_t(j)$. In turn, POEs and SOEs demand capital from banks and aggregate them using the following CES aggregators with parameter $\mu > 1$.

$$k_{t,i}^{ext} = \left[\int_0^1 k_{t,i}^{ext}(j)^{1/\mu} dj \right]^\mu$$

$$k_{t,soe} = \left[\int_0^1 k_{t,soe}(j)^{1/\mu} dj \right]^\mu$$

Where $k_{t,i}^{ext}(j)$ represents the demand for bank credit from POE i to bank j and $k_{t,soe}(j)$ is the demand from the SOE sector to bank j .

It is straightforward to show that the demand for credit that each bank faces is given by,

⁶We assume for simplicity that there is monopolistic competition in the loans market only.

⁷Note that practically all banks in China are public.

$$k_{t,i}^{ext}(j) = \left(\frac{r_{t,poe}(j)}{r_{t,poe}} \right)^{\frac{\mu}{1-\mu}} k_{t,i}^{ext} \quad (3)$$

$$k_{t,soe}(j) = \left(\frac{r_{t,soe}(j)}{r_{t,soe}} \right)^{\frac{\mu}{1-\mu}} k_{t,soe} \quad (4)$$

Where $r_{t,poe}(j)$ and $r_{t,soe}(j)$ are the interest rates charged by bank j to POEs and SOEs, respectively. Moreover, $r_{t,poe}$ and $r_{t,soe}$ denote the average interest rates paid by POEs and SOEs and are given by,

$$r_{t,poe} = \left[\int_0^1 r_{t,poe}(j)^{\frac{1}{1-\mu}} dj \right]^{1-\mu}$$

$$r_{t,soe} = \left[\int_0^1 r_{t,soe}(j)^{\frac{1}{1-\mu}} dj \right]^{1-\mu}$$

Banks' optimization problem consists of choosing lending interest rate given the demand schedule determined by equation (3) and (4). However, since we are assuming that there is a deposit interest rate ceiling, banks might face scarcity of deposits. Therefore, we need to add a resource constraint to reflect this possible lack of funding. This resource constraint for a given bank j is given by,

$$k_{t,soe}(j) + \int_{P_{t,ext}} k_{t,s}^{ext}(j) ds \leq D_{t,j} \quad (5)$$

Where $D_{t,j}$ denotes the deposits available to bank j at time t . Further, $P_{t,ext}$ denotes the measure of producers that demand external funds from banks. Hence, the problem a bank j faces when a POE with name i demands credit is the following,

$$\pi_{t,i}^b(j) = \max_{r_{t,i}(j)} \left\{ r_{t,i}(j) k_{t,i}^{ext}(j) - (r_t^d + \chi) k_{t,i}^{ext}(j) \right\}$$

st. (3) and (5)

Where r_t^d is the cost of funds (the deposit interest rate), and χ represents intermediation costs that banks incur. This problem implies that the interest rate charged is the following.

$$r_{t,i}(j) = \mu(r_t^d + \chi) + \xi_{t,j} \quad (6)$$

In the last expression, $\xi_{t,j}$ represents the non-negative multiplier related to the resource constraint (5). Note that this multiplier is strictly positive only when there is a binding deposit interest rate ceiling. The reason is that, under a free deposit interest rate, r_t^d will adjust to guarantee that any demand for funds from banks will be satisfied at the equilibrium interest rate.

Equation (6) implies that the ceiling generates a higher observed spread between deposit and lending interest rates. The spread is normally explained by intermediation costs and markups imposed by banks. However, the ceiling adds a premium equal to the multiplier of the resource constraint. Therefore, it is straightforward to see that μ represents the markup that banks would charge only once the deposit interest rate is liberalized.

Bank's problem when a SOE asks for credit is very similar. The maximization problem is the following,

$$\begin{aligned} \pi_{t,soe}^b(j) = \max_{r_{t,soe}(j)} & \left\{ r_{t,soe}(j)k_{t,soe}(j) - (r_t^d + \chi - \kappa)k_{t,soe}(j) \right\} \\ \text{st.} & \text{ (4) and (5)} \end{aligned}$$

The only difference with respect to the POE version is the presence of a subsidy per unit of capital lent to SOEs: κ . We introduce this subsidy as a reduced form representation of the implicit guarantees that benefit SOEs. As before, from the first order conditions of the problem we get,

$$r_{t,soe}(j) = \mu(r_t^d + \chi - \kappa) + \xi_{t,j} \quad (7)$$

For simplicity, we will focus on a symmetric equilibrium in the banking sector. This implies that all banks are going to be identical and, therefore, we can drop the subscript j from expressions (6) and (7). In addition, notice that from (6) we know that the interest rate charged POEs is the same for every firm (ie. the interest rate does not depend on i). The last two remarks imply that we can write the two equilibrium interest rates as,

$$r_{t,poe} = \mu(r_t^d + \chi) + \xi_t \quad (8)$$

$$r_{t,soe} = \mu(r_t^d + \chi - \kappa) + \xi_t \quad (9)$$

3.4 Government

Since we are going to be working with stationary equilibria, we assume that the government has a balanced budget. The budget constraint is given by,

$$G_t + \kappa \int_0^1 k_{t,soe}(j) dj = T_{c,t} + T_t + \pi_t^b \quad (10)$$

Where,

$$\pi_t^b = \int_0^1 \pi_{t,soe}^b(j) dj + \int_{P_{ext}} \int_0^1 \pi_{t,i}^b(j) dj di$$

The left hand side of (10) represents government expenditure: government consumption (G_t), and subsidies to banks (κ time the amount lent to SOEs). Further, the right hand side is total revenue: consumption taxes ($T_{c,t}$), lump sum taxes (T_t) and profits from banks (π_t^b).

3.5 Distortions

As noted in the introduction, this paper focuses on two important distortions. The first one is a deposit interest rate ceiling, which implies that the deposit interest rate in China cannot exceed a certain value r^- determined by the government. As shown in Section 1, the fact that average deposit interest rate is very low (even lower than the average annual inflation rate) indicates that the ceiling seems to be binding. Hence, in our model, the equilibrium with the interest rate is set at $r_t^d = r^-$. This implies that lending interest rates are given by,

$$r_{t,poe} = \mu(\bar{r} + \chi) + \xi_t \quad (11)$$

$$r_{t,soe} = \mu(\bar{r} + \chi - \kappa) + \xi_t \quad (12)$$

Where $\xi_t > 0$ as we are assuming that the ceiling binds. Given that the deposit rate is fixed in this equilibrium, lending rates (or the multiplier) are going to adjust to clear the capital market.

The situation changes once r_t^d is liberalized. In this case, the multiplier ξ_t becomes zero as there is no deposits shortage. This means that the lending interest rates are given by,

$$r_{t,poe} = \mu(r_t^d + \chi) \quad (13)$$

$$r_{t,soe} = \mu(r_t^d + \chi - \kappa) \quad (14)$$

With a free deposit interest rate both lending and deposit rates are going to adjust to clear the market. These rates are going to be linked through (13) and (14).

The second distortion are the implicit guarantees that SOEs enjoy. Financial intermediaries understand that lending to SOEs is less risky. In particular, they believe that the government would foot the bill in the event of a default. This is translated into a lower lending interest rate for SOEs with respect to POEs.

For simplicity and bearing in mind the early 2000s bank bailout experience in China, we model this distortion as a subsidy from the government to banks. In particular, we assume a linear subsidy with a rate κ . This means that the government gives bankers κ units of goods per unit lent to SOEs. What is the effect of this subsidy on lending interest rates? In equilibrium both SOEs and POEs receive credit, therefore, banks marginal profit from lending to SOEs and POEs should be the same. Using (11) and (12) or (13) and (14), this implies that the following equality must be satisfied,

$$r_{t,soe} + \mu\kappa = r_{t,poe} \quad (15)$$

And it is clear from (15) that, given a banking sector mark up μ , the subsidy rate κ is going to be pinned down using the SOE vs. POE spread.

4 Equilibrium

We are dealing with two different types of equilibria: one in which the deposit ceiling is in place and other where the deposit interest rate can be freely set in the market. The two types of equilibrium differ in the way the capital markets clear.

In the equilibrium with a deposit interest ceiling, the deposit interest rate is treated as a parameter and the rates that clear the capital market are the lending interest rates. In this case, the two rates will be defined according to (11) and (12). Notice that both interest rates reflect the severity of scarcity in the deposit market through the value of the multiplier ξ_t . On the other hand, in the equilibrium without the ceiling both deposit and lending interest rates clear the market. In this case, the rates are linked through (13) and (14).

In order to define the equilibrium, let $A := [0, \infty)$ be the space of possible asset holdings, and E the space of possible entrepreneurial abilities (the support of $\mu(e)$). We define below the equilibrium with a binding deposit interest rate ceiling.

Definition 1. *A competitive equilibrium with a binding deposit interest ceiling \bar{r} is a set of policy rules $\{ a_{t+1}(a_t, e_t), c_t(a_t, e_t), l_t^{int}(a_t, e_t), l_t^{ext}(a_t, e_t), k_t^{int}(a_t, e_t), k_t^{ext}(a_t, e_t), k_{t,soe},$*

$l_{t,soe}$ }, prices $\{ r_{t,poe}^l, r_{t,soe}^l, w_t \}$, multipliers $\{\xi_t\}$ and fiscal policy $\{\tau_c, G_t, T_t, \kappa\}$ such that given an initial distribution Γ_0 and for all t ,

1. Given the prices $r_{t,poe}^l, w_t$, the policies $l_t^{int}(a_t, e_t), l_t^{ext}(a_t, e_t), k_t^{int}(a_t, e_t), k_t^{ext}(a_t, e_t)$ solve the POEs problem.
2. Given $r_{t,soe}^l, w_t$, the policies $k_{t,soe}$ and $l_{t,soe}$ satisfy equations (1) and (2).
3. $\{a_{t+1}(a_t, e_t), c_t(a_t, e_t)\}$ solve the household problem taking the prices as given.
4. $r_{t,poe}^l, r_{t,soe}^l$ and ξ_t satisfy equations (11) and (12)
5. Markets clear,

$$k_{t,soe} + \int \int_P [k_t^{int}(a_t, e_t) + k_t^{ext}(a_t, e_t)] \Gamma_t(da, de) = \int \int a_t \Gamma_t(da, de)$$

$$l_{t,soe} + \int \int_P [l_t^{int}(a_t, e_t) + l_t^{ext}(a_t, e_t)] \Gamma_t(da, de) = \int \int_{P^c} \Gamma_t(da, de)$$

where P is the set of households that are entrepreneurs and produce. That is,

$$P := \{(a_t, e_t) \in A \times E : w_t \leq \max\{\pi_t^{int}(a_t, e_t), \pi_t^{ext}(a_t, e_t)\}\}$$

6. The government budget constraint (10) holds.
7. Define the measurable set $\mathcal{A} \times \mathcal{E}$, where \mathcal{A} is composed by elements from A and \mathcal{E} by elements from E . The endogenous distribution of agents evolves according to,

$$\Gamma_{t+1}(\mathcal{A} \times \mathcal{E}) = \int_{A \times E} Q((a, e), \mathcal{A} \times \mathcal{E}) \Gamma_t(da, de)$$

where Q_t is a transition function that is defined by,

$$Q((a, e), \mathcal{A} \times \mathcal{E}) = I_{\{a_{t+1}(a,e) \in \mathcal{A}\}} \left[p_e I_{\{e \in \mathcal{E}\}} + (1 - p_e)(1 - I_{\{e \in \mathcal{E}\}}) \int_{\mathcal{E}} \mu(de) \right]$$

The equilibrium when we let the deposit interest rate to change is similar to definition

1. We present that definition below,

Definition 2. A competitive equilibrium without a deposit interest ceiling is a set of policy rules $\{ a_{t+1}(a_t, e_t), c_t(a_t, e_t), l_t^{int}(a_t, e_t), l_t^{ext}(a_t, e_t), k_t^{int}(a_t, e_t), k_t^{ext}(a_t, e_t), k_{t,soe}, l_{t,soe} \}$, prices $\{ r_{t,poe}^l, r_{t,soe}^l, w_t, r_t^d \}$ and fiscal policy $\{\tau_c, G_t, T_t, \kappa\}$ such that given an initial distribution Γ_0 and for all t ,

1. All conditions from definition 1 hold, excepting condition 4.
2. $r_{t,poe}^l$, $r_{t,soe}^l$ and r_t^d satisfy equations (13) and (14)

In this paper we will focus on stationary equilibria. These equilibria are such that $\Gamma_{t+1} = \Gamma_t$ for all t .

Definition 3. A stationary equilibrium is a competitive equilibrium such that the distribution of agents Γ^* is invariant and satisfies,

$$\Gamma^*(\mathcal{A} \times \mathcal{E}) = \int_{\mathcal{A} \times \mathcal{E}} Q((a, e), \mathcal{A} \times \mathcal{E}) \Gamma^*(da, de)$$

5 Functional Forms and Calibration

The model presented in section 3 is suitable, in our view, to analyze the long term impact of financial reforms in China. In the following sections we will calibrate the model to match important moments in the Chinese economy and then use the model as our laboratory to run counterfactuals. Our calibration is described below.

For the household and POEs problems we follow Buera and Shin (2013) and assume standard utility and production functions,

$$U(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

$$f(e, k, l) = e (k^\alpha l^{1-\alpha})^{1-\nu}$$

Where σ represents the relative risk aversion parameter, α is the capital share and is assumed to be equal to that of the SOE sector, ν is the Lucas (1978) span-of-control parameter. Moreover, we assume that the entrepreneur ability is drawn from a Pareto distribution with shape parameter η and lower bound e_{low} ,

$$\mu(e) = 1 - \left(\frac{e}{e_{low}} \right)^{-\eta} \text{ for all } e \geq e_{low}$$

We calibrate the model using some parameters that are standard in the literature. We set the risk aversion parameter to σ equal to 1.5,⁸ the capital depreciation rate δ at 0.06

⁸This value implies a Elasticity of Intertemporal Substitution (EIS) of 0.6, consistent with values documented in Havranek and others (2013)

Table 2. Calibrated Parameters

Moments	Data	Model	Parameter
Nominal deposit interest rate	330 bps	330 bps	$\bar{r} = 0.008$
SOEs vs POEs spread	200 bps	200 bps	$\kappa = 0.02/1.1$
POEs nominal loan rate	786 bps	793 bps	$\beta = 0.892$
Collateral (% of loan)	137%	137%	$\lambda = 1.73$
Banks overhead cost (% of assets)	1.15%	1.15%	$\chi = 0.0115$
VAT rate	17%	17%	$\tau_c = 0.17$
Government consumption (% GDP)	13.5%	13.5%	$g = 0.135$
Labor share SOEs	18.4%	21.5%	$e_{low} = 0.945$ $\eta = 3.63$
Labor held by top 5% private firms	46.0%	46.5%	
Labor held by top 10% private firms	57.2%	58.8%	
Labor held by top 20% private firms	70.4%	70.7%	
Labor held by top 30% private firms	78.9%	77.6%	
Labor held by top 40% private firms	84.9%	82.2%	

and the capital elasticity α to 0.4 which are values that are commonly used. We also set $\nu = 0.21$ and the probability of keeping the same level of entrepreneurial ability $p_e = 0.894$ following Buera and Shin (2013). We assume the TFP of the SOE sector A equal to 1 as a normalization.

The banking sector markup parameter μ is particularly hard to calibrate when the economy faces a interest rate ceiling. The main reason is that any estimation of that markup in China is contaminated by the scarcity effect through the multiplier ξ_t .⁹ Nevertheless, there is a large literature estimating markups in the banking sector. These papers estimate Lerner Indexes for different countries around the world. In particular, we follow Anzoategui and others (2012) that estimate markups for other BRIC countries between 5 percent and 15 percent. We pick the median value value of that range and set $\mu = 1.1$ in our baseline calibration. The rest of the parameters are calibrated to match some relevant moments.

Table 2 shows that our model can reasonably match the selected moments of the Chinese economy. These moments were computed using different sources. The nominal deposit interest rate was set at the ceiling as of summer 2014. Further, we take a 200 bps spread between POEs and SOEs lending rates from Ferri and Liu (2010), and average POE lending interest rate was computed using data from CEIC Data and NBS.¹⁰

The value of collateral as a percentage of the loan comes from the World Bank’s Enterprise Survey for China (data for 2012)¹¹. Moreover, Bank’s overhead cost as a percentage of bank’s assets was taken from Beck and others (2000), we are using the average between

⁹See equations (11) and (12) for example.

¹⁰Notice that we are assuming an annual inflation rate of 2.5%

¹¹See <http://www.enterprisesurveys.org/>

2000 and 2011 from this database ¹².

We use the current VAT rate to calibrate the consumption tax whereas the government consumption to GDP ratio is the 2000-12 average from NBS. On the other hand, the labor share for SOEs is a five-year average (2009-13) of SOE urban employment over total urban employment (data from CEIC). Finally, the labor distribution across private firms was taken from NBS for 2009.

6 Results

We use the calibrated model to assess the impact of (i) liberalizing the deposit interest rate and (ii) removing implicit guarantees.

6.1 Liberalizing Deposit Interest Rates

Figure 6 compares two stationary equilibria with and without the deposit rate ceiling. Without the ceiling, the model predicts an increase in the deposit interest from the ceiling of 330 bps to around 580 bps. At the same time, the lending interest rate is expected to decline by around 50 bps for both POEs and SOEs. As a consequence, the capital intensity in the economy increases.

This increase in the capital stock boosts GDP by around 4 percent, while lowers the economy's total TFP. This reduction in TFP is mainly due to two factors. First, the model's assumption of diminishing marginal returns to capital implies that higher capital stock is associated with lower productivity. Second, the additional stock of capital goes to both productive POEs and less productive SOEs which still enjoy implicit guarantees from the government. This implies that additional capital ends up in SOEs hands negatively affecting the overall TFP in the economy.

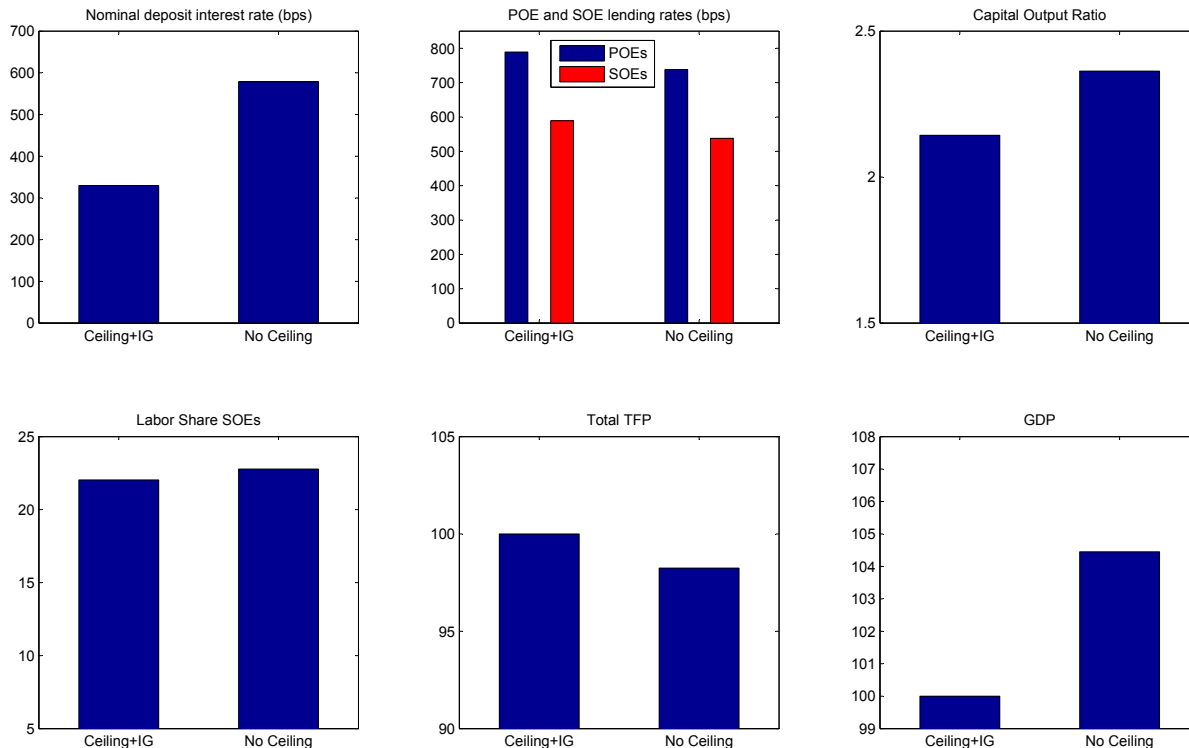
To provide some intuition for the results, Figure 7 depicts the capital market in the model. K^s and K^d represent the supply and demand for capital respectively. The equilibrium with the deposit interest ceiling is represented in red. In this equilibrium, the deposit interest rate is fixed and the total stock of capital is determined at $K^s(r) = K^*$. Hence, the supply of capital that is distributed across POEs and SOEs is given by a vertical line at K^* (in red). The point in which the demand for capital crosses this vertical line determines the lending interest rate (red) r^l that clears the market.

When the ceiling is removed, the economy moves from the red to the green equilibrium, where the undistorted demand and supply curves cross. The removal of the ceiling will trigger stronger competition across banks to get more deposits, lifting the deposit interest rate. Furthermore, this increase in the return on savings will increase the stock of deposits in the banking system, creating more resources available to invest in POEs and SOEs. Banks will have to compete in order to attract more borrowers, thereby reducing the lending interest rate.

This movement in the deposit and lending rates will shrink the margins in the banking system. Moreover, since we assume monopolistic competition, the margins are going to

¹²http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/FinStructure_April_2013.xlsx

Figure 6. Impact of Liberalizing Deposit Interest Rate

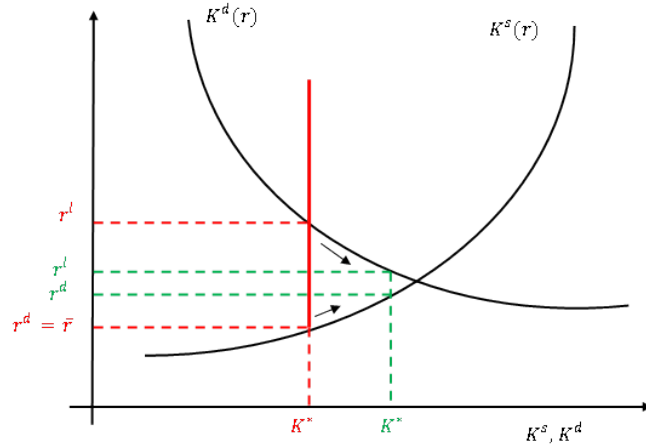


fall to a point to which profits are determined by the markup level μ . Therefore, the new equilibrium will depend on the value of the mentioned parameter, or in other words, on the degree of competition among Chinese banks. If competition is low (μ is high) then margins will not decrease as much and the effects in the economy will be milder. This fact is reflected in Figure 8. The figure shows the equilibrium outcomes when the ceiling is removed for different levels of markups.

It is straightforward to conclude from the figure that when markups are higher, the magnitude of the increase (decrease) in deposit (lending) interest rates is lower. In particular, when banking competition is low ($\mu = 1.3$) deposit interest rate increases only to a level of 500 bps, but when $\mu = 1.1$ deposit rate goes up to around 580 bps. Lending interest rate remain in a higher level when competition is lower. Moreover, the effects on GDP, TFP and capital output ratio are reduced when banking competition is lower.

Summing up, we conclude that the effects of the liberalization are expansionary but might have negative effects on banks profits. It is also important to note that the model does not take into account any possible risk shifting behavior in the banking sector. Such risk shifting would change the composition in the banks' portfolio and would tend to increase lending interest rates. A risk taking bank would set a higher lending rate which tends to

Figure 7. Impact of Liberalizing the Deposits Interest Rate, Intuition



draw riskier applicants and projects, offsetting the pressure for lower lending rates through tougher competition. As documented in the literature, stronger competition among banks could lead to increased incentives for banks to take risk, which in turn could harm financial stability (Vives, 2010) for literature review on competition and banking stability). It has been noted in country level studies that increased competition following liberalization and deregulation led to increased risk taking by banks. These include, for example, the US in the 1980s (see Edwards and Mishkin (1995) and Spain (Salas and Saurina, 2003).

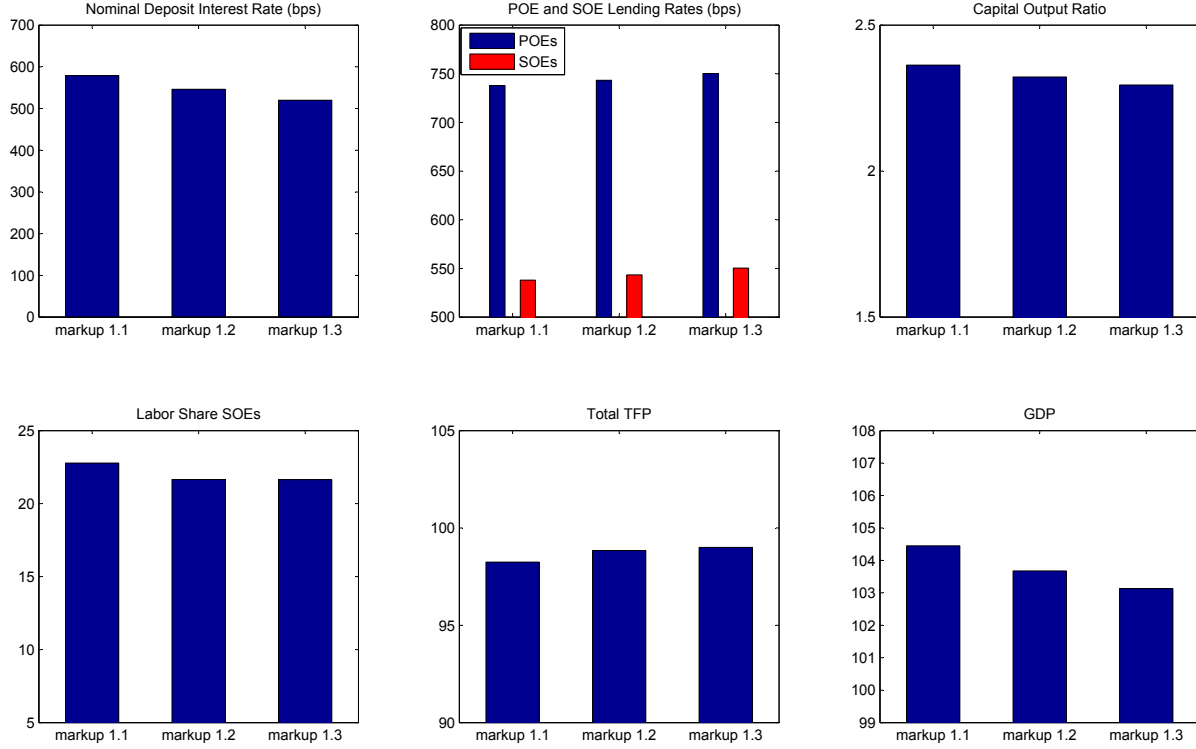
6.2 Liberalizing Deposit Interest Rate and Removing Implicit Guarantees

While the effects on real activity of the deposit rate liberalization are purely quantity based (output grows because of an increase in the stock of capital), gains from removing implicit guarantees are based on efficiency increase. Figure 9 shows the effects of removing implicit guarantees in addition to the deposit interest rate liberalization. The impact of this additional reform can be seen by comparing the second and third bars in the graphs. Without implicit guarantees, deposit rate is pushed downward and POEs experience a significant fall in their lending rate. With less capital available, capital intensity decreases.

Furthermore, the labor share of SOEs drops from 22 percent to around 12 percent. With better allocation of capital and labor in the economy, GDP increases through efficiency gains. In particular, GDP goes up by around 1 percent and total TFP by 3 percent.

We provide some intuition of these results in Figure 10. In this graph we abstract from the difference between r^l_{poe} and r^d since both rates will move in the same direction. The first order effect of this reform is a shift to the left of the demand for capital. This is because SOEs do not have a government subsidy anymore as a consequence of the reform. This shift will generate a reduction in the deposit rate and the lending rate to POEs. As a second order effect, lower interest rates will then allow more POEs to have access to credit which will increase income and savings. This increase in savings is represented by a shift to the

Figure 8. Liberalization and Banking Competition



right of the savings curve.

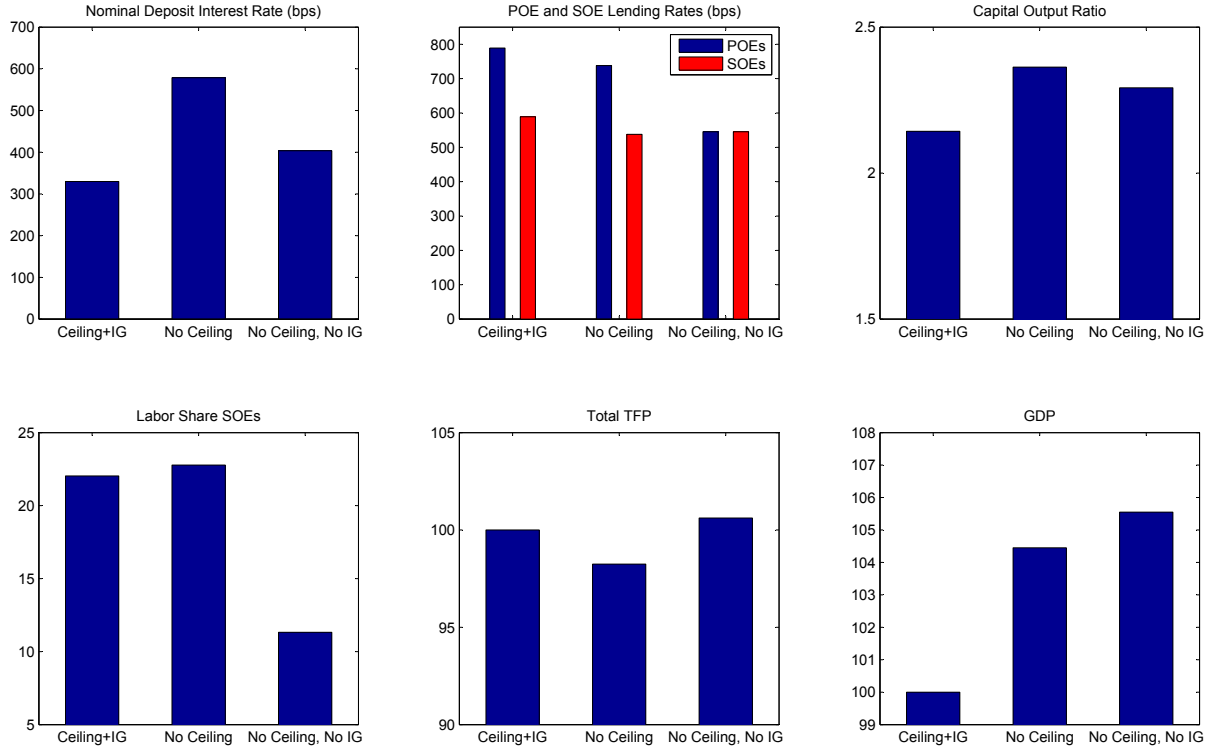
The two shifts of the demand and supply curve will lead to lower interest rates. While the effects on the stock of capital is ambiguous in theory, the capital intensity of the economy is reduced in our calibration, suggesting that the effect from lower demand of capital outweighs the subsequent increase in savings.

Finally, note that SOEs witness a slight rise in their lending interest rates (around 20 bps). This increase is less than 200 bps (the subsidy rate that is removed by the reform) because of general equilibrium effects. From equation (15) we know that in our model the SOEs lending interest rate (r_{soe}^l) satisfies,

$$r_{soe}^l = r_{poe}^l - \mu\kappa$$

where κ is the subsidy rate and r_{poe}^l is the POEs lending rate. Hence, keeping fixed r_{poe}^l , a reduction in $\mu\kappa$ from 200 bps to zero would trigger an increase of 200 bps in r_{soe}^l . However, as shown in Figure 10, interest rates (and in particular r_{poe}^l) move downward in equilibrium. This general equilibrium effects in turn tends to reduce the cost of funds to SOEs partially counteracting the initial increase in r_{soe}^l as a consequence of the subsidy removal.

Figure 9. Impact of Getting Rid of Implicit Guarantees



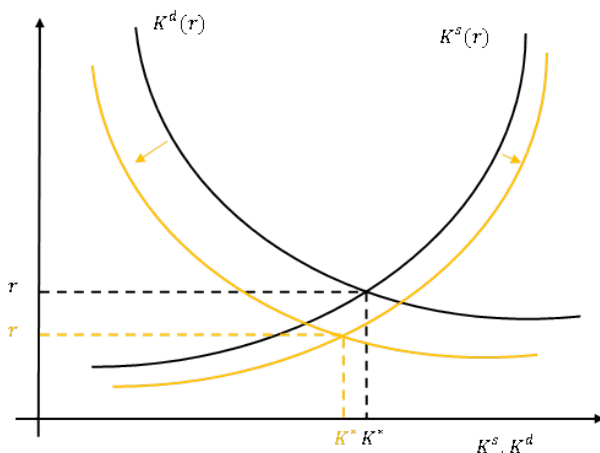
6.3 Taking into Account Other Reforms

China is in the process of introducing other reforms that could shift the aggregate savings curve to the left. Two examples are reforms to strengthen social safety nets and the recent lift of the one-child policy. We take into account the impact of these reforms on savings by introducing a shock to the discount factor β . Without making a judgment on the size of the impact, we present an illustrative exercise by calibrating the shock so that the total stock of savings does not change after the interest rate liberalization. The result of this exercise is shown in Figure 11.

Intuitively, how the economy reacts to liberalization depends on how elastic savings are to changes in interest rates. The more inelastic the savings curve is, the lower the impact of interest rate liberalization.¹³ If savings do not change, the stock of capital to be invested in POEs or SOEs remains fixed. As a consequence, any impact on GDP will come from a

¹³Nabar (2011) for example argues that the Chinese households save with a target level of saving in mind. When the return to saving decline, it becomes more difficult to meet a target and households increase their saving to compensate. Therefore an increase in real deposit rates may lower household saving.

Figure 10. Getting Rid of Implicit Guarantees, Intuition



better allocation of resources. The first two bars in the charts in Figure 11 show precisely that. As a result of the liberalization and other reforms, deposit rates rise contributing to an increase in private sector (and POEs) income. This in turn boosts private investment, reducing SOE share in the economy and, therefore, increasing productivity.

Comparing the first two bars in the charts in Figure 11 with those in Figure 9, we see a reduced impact on GDP in the former. This is not surprising given that 11 assumes that capital resources are fixed.

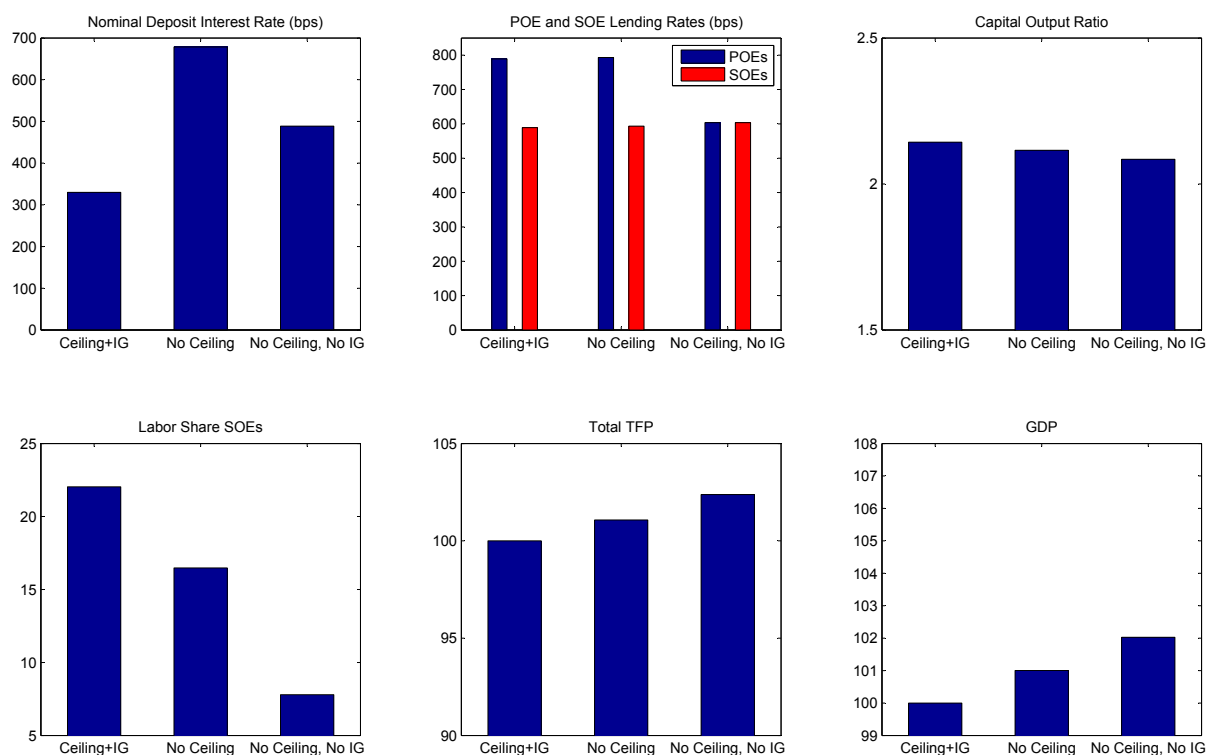
Adding the second reform of removing the implicit guarantees leads to a similar result as in Figure 9, including the decrease in deposit rate and a reduction in POE lending rates. With savings fixed, the resulting increase in total TFP in Figure 11 is higher than in the previous case. Even though the capital stock falls compared to the situation prior to financial reforms, there is still an increase in output that is entirely due to a boost in aggregate productivity.

7 Conclusion

Financial sector reforms in China are progressing at an uneven pace. The liberalization of interest rates has been completed, although PBC still maintains some control over rates through “window guidance”. Progress in removing implicit state guarantees has been slower.

Our key finding is that steps taken so far, although important, are not sufficient. With implicit state guarantees still in place, banks have little incentives to seek better projects and correctly price risk. Economic efficiency suffers, preserving a system too dependent on debt and investment as an engine of growth. Perversely, the partial financial sector liberalization could make the problem of inefficiency bigger, as higher deposit rates may lure

Figure 11. Full Reform with β Shock



larger savings, which may still be channeled to less efficient investment by SOEs and other companies enjoying public support. While the paucity of data prevents formal analysis, the experience with partial liberalization of the system through WMPs points to this risk: additional savings flowing through this channel appear to be at least partly directed to inefficient projects, often promoted by local government. Moreover, there is a risk that competitive pressures in the financial sector in combination with implicit guarantees would lead to an excessive risk taking, potentially leading to financial instability and increasing the cost of public sector support.

Removing implicit guarantees is key to more efficient growth. It would reduce savings and capital intensity, while directing credit to more efficient private sector enterprises and boosting total factor productivity. It is a difficult reform due to the powerful lobby of SOEs (Hong and Nong, 2012) and concerns about social stability, as inefficient enterprises would have to shrink, laying off workers. And while permitting more defaults is necessary, it may have negative repercussions for the stability of the financial system unaccustomed to risks. However, these obstacles will only rise over time, as liberalizing other parts of the

financial system without the removal of implicit guarantees will increase the overreliance on credit and lead to more risk taking. The authorities will need to tread carefully to minimize threats to financial stability, but the time to act is now.

Appendix: Algorithm to Compute Stationary Equilibria

The procedure we employ follows Quadrini (2000). We discretize the space of assets using a grid of 5,000 points. The Pareto distribution of entrepreneurial ability is approximated using the same methodology as in Buera and Shin (2013), we are using 10 grid points. Given the parameter values and the grids, the procedure we employ is as follows:

1. Guess an initial $\frac{k_{soe}}{l_{soe}}$ ratio and a lump sum tax T ;
2. Using equations (1), (2), and (15) compute r_{soe}^l , r_{poe}^l and w . With this prices, solve the value function for the agents and get decision rules.
3. Using the policies from the previous step get the stationary distribution of agents by simulation.
4. With the stationary distribution and the labor and capital market clearing conditions, get a new ratio $\frac{k_{soe}^*}{l_{soe}^*}$. If this ratio differs from the initial guess by more than a tolerance value go back to step 1 updating the ratio $\frac{k_{soe}}{l_{soe}}$, if not go to the following step.
5. Using the stationary distribution from the last step, check whether the budget constraint (10) holds. If the balance is zero stop, if not update the lump sum tax, go back to step 1 and repeat until convergence.

Note that for equilibria in which the deposit interest rate is fixed at the ceiling, r^d is fixed at the value \bar{r} . When we liberalize the deposit rate, because of our assumption of monopolistic competition in the banking sector we have that $r^d = \frac{r_{poe}^l}{\mu} - \chi$, where χ is the intermediation cost for banks and μ is the markup.

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