# FINANCIAL REPRESSION AND CAPITAL CONTROLS IN THE CHINESE ECONOMY

ZHENG LIU, MARK M. SPIEGEL, AND JINGYI ZHANG

Abstract. This paper introduces an overlapping generations model with financial repression and capital account restrictions, similar to policies which currently prevail in the Chinese economy. Financial repression takes the form of directing banks to lend to state-owned enterprise (SOE) firms at favorable terms relative to private enterprise (POE) firms, while capital account restrictions prohibit domestic citizens from participating in foreign asset markets. These two policies are linked, as restrictions on domestic capital outflows under China's capital control policy provides banks with deposits at the below-market rates that SOE lending activity under financial repression returns. Our overlapping generations framework is particularly well-suited to the analysis of incomplete markets, as well as those of transition, as the unborn are incapable of engaging in any risk-sharing. Under this framework, we investigate the long-studied question of the desirable "order of liberalization" for the Chinese case. Our analysis demonstrates that in keeping with the traditional literature on liberalization sequencing, Chinese household welfare is higher when financial repression is eased prior to the opening of the nation's capital account.

*Date*: February 28, 2018.

*Key words and phrases.* Capital controls, financial repression, China, state-owned eneterprises.

*JEL classification*:

Preliminary and incomplete. Please do not cite without permission. Liu: Federal Reserve Bank of San Francisco; Email: Zheng.Liu@sf.frb.org. Spiegel: Federal Reserve Bank of San Francisco; Email: Mark.Spiegel@sf.frb.org. Zhang: Shanghai Advanced Institute of Finance, Shanghai Jiao Tong University; Email: jyZhang.11@saif.sjtu.edu.cn. 

# I. Introduction

Financial repression and capital controls are the two main sources of policy-induced distortions in Chinese economy. Financial repression takes the form of distortions on credit extension, primarily in the form of ensuring credit extension to state-owned enterprise (SOE) firms at favorable terms relative to China's private sector, or POE firms.[1] Meanwhile, China's capital control regime restricts participation of domestic citizens in international asset markets as well as foreign participation in Chinese asset markets, driving a wedge between domestic and international rates of return.

In a variety of policy announcements, China has signaled its intention to eventually liberalize both policies. However, these liberalizations are likely to move gradually to avoid large disruptions to real and financial activity in China. The gradual pace at which liberalization is likely to take place raises the question of the desirable *relative* pace of liberalization of these two distortions should be. The proper order of capital account and financial liberalization has been long studied. For example, Eichengreen et al. (2011) demonstrate that capital account liberalization can adversely impact countries with poorly-developed financial markets. Similarly, Chinn and Ito (2006) argue that capital account liberalization can be detrimental in countries with insufficiently developed institutions. Based on such considerations, many have argued that bank reform in China should move first before the country begins to commence its capital account liberalization (e.g. Hsu (2016).

In this paper, we develop a DSGE model with overlapping generations to evaluate the benefits of sequencing financial and capital account liberalization with financial liberalization first. We evaluate a two-country model, concentrating on home country conditions. Final goods in the home country are produced as a composite of intermediate inputs from monopolistically-competitive SOEs and competitive POEs. These firms face a need to finance their working capital through bank borrowing.

Households live for two periods, working and consuming a portion of their income when young, and consuming the rest in retirement.

We study a calibrated version of the model and explore the optimal financial repression and capital control policy that maximize social welfare in the steady state. We then explore the optimal policy reform order on financial repression and capital

[1]For simplicity, we only consider heterogeneity between SOE and POE firms. However, in practice large POE firms would also have no difficulty obtaining lending from Chinese commerical banks. Nevertheless, in practice they primarily raise funds in bond and equity markets, leaving SOEs the primary beneficiaries of Chinese financial repression.

control with counterfactual analysis. In particular, we could study the transitional dynamics where either financial repression or capital control is liberalized faster than the other, and then evaluate the welfare gains under different policy reform regimes.

Our model illustrates a tradeoff between external and internal efficiency in opening the capital account. In particular, relaxing capital controls improves the allocation between domestic investment and foreign investment, but under financial repression also shifts resources from the more productive POEs to less productive SOEs. SOEs are less sensitive than POEs to the increase in the market lending rate that follows easing capital controls because SOEs continue to borrow under the distorted directed lending rate. As a result, we find that under our calibration the optimal steady state level of capital controls is increasing in the magnitude of domestic financial repression.

However, because SOE output is sub-optimal due to monopolistic competition in that sector, we find a non-zero level of financial repression is an optimal second-best steady state policy. Moreover, the optimal steady state lvel of financial repression is found to be increasing in the intensity of steady state capital account restrictions.

We next turn to optimal transition policy when, as in China, the share of output in the SOE sector is gradually declining. We examine the relative welfare implications of alternative timing of liberalizations of financial repression and the capital account. Our analysis confirms that under our calibration immediate liberalization of financial repression is optimal, while for any timing of financial repression liberalization it is optimal to delay liberalizing the capital account until most of the transition in the share of SOE output has taken place.

The remainder of this paper is divided into five sections: Section 2 introduces our model. Section 3 describes our calibration methodology. Section 4 reviews our quantitative results. Section 5 concludes.

## II. Model

We consider a global economy with two countries—home and foreign. We focus on the home country and assume that the foreign country is passive in the sense to be made clear below. The home country is populated by a continuum of identical and infinitely-lived households. The representative household consumes a final good, and supplies labor to firms. The final good is a composite of intermediate goods produced by two types of firms: SOEs and POEs. Both types of firms face working capital constraints. Each firm finances wages payments using bank loans.

SOE sector has monopolistic competition and POE sector has perfect competition. Thus, SOE firms under-produce and government subsidies to SOEs in the form of directed lending should improve efficiency. SOE has lower TFP than POE.

Household deposit at a representative bank, receiving a risk-free rate. The bank has 3 uses of funds: directed lending to SOEs, unrestricted lending to domestic firms (SOEs and POEs), and to foreigners. Financial repression takes the form of directed lending to low-productivity SOEs by setting a minimum share of directed lending in total domestic lendings. Capital controls take the form of income tax on foreign assets.

II.1. **The representative household sector.** We consider an overlapping generations economy. Households live for two periods. They are born in period 1 (young) and retire in period 2 (old). The young work and receive labor income. They consume part of their labor income and save the rest for retirement when they are old, and will finally consume their remaining income assets. In particular, consider a representative household of a generation born at time $t$. It has the following utility function:

$$\max_{C_t^y, C_{t+1}^o} \mathrm{E}\left\{\ln(C_t^y) - \Psi_h \frac{H_t^{1+\eta}}{1+\eta} + \beta \ln(C_{t+1}^o)\right\}, \tag{1}$$

where $C_t^y$ is the consumption of the household when young, $C_{t+1}^o$ is its consumption when old, $H_t$ is its labor hours when young.

The household allocates its labor income among consumption, bank deposit $D_t$, firm stock $S_t$, physical capital $K_t^o$ and physical investment $I_t$ when young. Note that $K_t^o$ denotes the amount of physical that the young acquire from the old while $I_t$ denotes the amount of new investment in physical capital. Assume that, given acquired capital $K_t^o$, to form new investment $I_t$, the young needs to pay additional capital adjustment cost $\frac{\Omega_k}{2}(\frac{I_t}{K_t^o} - \frac{\bar{I}}{K_t^o})^2 K_t^o$, where $\frac{\bar{I}}{K_t^o}$ denotes the steady-state ratio of $\frac{I_t}{K_t^o}$.

The budget constraint facing households of the generation born at time $t$ in each period is given by:

$$C_t^y + D_t + q_t^s S_t + q_t^k K_t^o + I_t + \frac{\Omega_k}{2}(\frac{I_t}{K_t^o} - \frac{\bar{I}}{\bar{K}_t^o})^2 K_t^o = w_t H_t + T_t + T_t^g, \tag{2}$$

$$C_{t+1}^o = R_t D_t + (q_{t+1}^s + \pi_{t+1}) S_t + [q_{t+1}^k (1-\delta) + r_{t+1}^k](K_t^o + I_t) - T_{t+1}, \tag{3}$$

where $q_t^s$ and $q_t^k$ denotes the price of firm stock and physical capital, respectively, in period $t$. $\pi_t$ denotes the firm stock dividends distributed to the stockholder. $r_t^k$ denote the capital rents paid by firms. $w_t$ denotes the real wage rate, $R_t$ is the gross interest rate on household savings determined from information available in period $t$. $\delta$ denotes the depreciation rate of the physical capital. $T_t$ denotes the lump-sump bequests that the old grant the young in period $t$. We assume that the total amount of the bequests is a certain fraction of the wealth of the old:[2] $T_t^g$ is the government transfer to the young as the government collect income tax on foreign investment.[3]

$$T_t = \tau\{R_{t-1}D_{t-1} + (q_t^s + \pi_t)S_{t-1} + [q_t^k(1-\delta) + r_t^k](K_{t-1}^o + I_{t-1})\}, \tag{4}$$

The optimizing conditions are summarized by the following equations:

$$\Lambda_t^y = \frac{1}{C_t^y}, \tag{5}$$

$$\Lambda_t^o = \frac{1}{C_t^o}, \tag{6}$$

$$w_t = \frac{\Psi H_t^\eta}{\Lambda_t^y}, \tag{7}$$

$$1 = \mathrm{E}_t \beta R_t \frac{\Lambda_{t+1}^o}{\Lambda_t^y}, \tag{8}$$

$$1 = \mathrm{E}_t \beta \frac{q_{t+1}^s + \pi_{t+1}}{q_t^s} \frac{\Lambda_{t+1}^o}{\Lambda_t^y}, \tag{9}$$

$$q_t^k + \frac{\Omega_k}{2}(\frac{I_t}{K_t^o} - \frac{\bar{I}}{\bar{K}_t^o})^2 - \Omega_k(\frac{I_t}{K_t^o} - \frac{\bar{I}}{\bar{K}_t^o})\frac{I_t}{K_t^o} = \mathrm{E}_t\beta[q_{t+1}^k(1-\delta) + r_{t+1}^k]\frac{\Lambda_{t+1}^o}{\Lambda_t^y}, \tag{10}$$

$$1 + \Omega_k(\frac{I_t}{K_t^o} - \frac{\bar{I}}{\bar{K}_t^o}) = \mathrm{E}_t\beta[q_{t+1}^k(1-\delta) + r_{t+1}^k]\frac{\Lambda_{t+1}^o}{\Lambda_t^y},. \tag{11}$$

where $\Lambda_t^y$ and $\Lambda_t^o$ denotes the Lagrangian multiplier for the two budget constraints.

Denote $K_t$ as the aggregate amount of physical capital by the end of period $t$. Then,

$$K_t = K_t^o + I_t, \tag{12}$$

$$K_t^o = (1-\delta)K_{t-1}, \tag{13}$$

II.2. **The consumption goods sector.** The consumption goods are a composite of intermediate goods produced by firms in the SOE sector and the POE sector. Denote by $Y_{st}$ and $Y_{pt}$ the products produced by SOE firms and POE firms, respectively. The quantity of the production of the consumption goods $Y_t$ is given by

$$Y_t = Y_{st}^{\phi_t} Y_{pt}^{1-\phi_t}, \tag{14}$$

[2]Bequests are allowed in the model to ensure a reasonable value for the saving rate $R_t$ in the steady state.

[3]Whether $T_t^g$ is transfered to the old or the young does not affect the result of the paper.

where $\phi_t \in (0,1)$ measures the share of SOE goods.

Denote by $p_{st}$ and $p_{pt}$ the relative price of SOE products and POE products, respectively, both expressed in final consumption good units. Cost-minimizing by the wholesale good producer implies that

$$Y_{st}p_{st} = \phi_t Y_t, \quad Y_{pt}p_{pt} = (1-\phi_t)Y_t. \tag{15}$$

The zero-profit condition in the wholesale sector implies that the sectoral prices are related through

$$1 = (\frac{\phi_t}{p_{st}})^{\phi_t}(\frac{(1-\phi_t)}{p_{pt}})^{1-\phi_t}. \tag{16}$$

II.3. **The intermediate goods sector.** We now present the environment in the SOE and POE intermediate goods sectors. We focus on a representative firm in each sector $j \in \{s, p\}$.

A firm in sector $j$ produces a homogeneous intermediate good $Y_{jt}$ using capital $K_{jt}$ and household labor $H_{jt}$, with the production function

$$Y_{jt} = A_{jt}(K_{jt})^{1-\alpha}(H_{jt})^{\alpha}, \tag{17}$$

where $A_{jt}$ denotes productivity of firms in sector $j$, and the parameter $\alpha \in (0,1)$ is input elasticities in the production technology.

Productivity $A_{jt}$ contains a common deterministic trend $g^t$ and a sector-specific stationary component $A^m_{jt}$ so that $A_{jt} = g^t A^m_{jt}$. The stationary component $A^m_{jt}$ follows the stochastic process

$$\ln A^m_{jt} = (1-\rho_j)\ln \bar{A}_j + \rho_j \ln A^m_{j,t-1} + \epsilon_{jt}, \tag{18}$$

where $\bar{A}_j$ is the steady-state level of $A^m_j$, $\rho_j \in (-1,1)$ is a persistence parameter, and the term $\epsilon_{jt}$ is an i.i.d. innovation drawn from a log-normal distribution $N(0,\sigma_j)$.

Firms face working capital constraints. In particular, they need to pay a fraction $\theta$ of wage bills before production takes place. Firms finance their working capital payments through bank loans, $B_{jt}$ at the interest rate $R_{jt}$ and repay these loans after the production by the end of the period. The working capital constraint for a firm in sector $j \in \{s,p\}$ is given by

$$B_{jt} = \theta(w_t H_{jt} + r^k_t K_{jt}). \tag{19}$$

Denote $\epsilon_j$ as the elasticity of subjection among firms in sector $j$. We assume SOE sector has monopolistic competition and POE sector has perfect competition, which implies that $0 < \epsilon_s < +\infty$ while $\epsilon_p = +\infty$. The demand curve faced by a firm in sector $j$ is then given by.

$$Y_{jt} = (p_{jt}/\bar{p}_{jt})^{-\epsilon_j}\bar{Y}_{jt}. \tag{20}$$

where $p_{jt}$ and $Y_{jt}$, respectively, denote the price and the output of the individual firm in sector $j$. $\bar{p}_{jt}$ and $\bar{Y}_{jt}$ , respectively, denote the aggregate price and the aggregate output in sector $j$

The firm's profit maximization problem is then given by,

$$p_{jt}Y_{jt} + B_{jt} - w_t H_{jt} - r_t^k K_{jt} - R_{jt}B_{jt}. \tag{21}$$

subject to the production constraint (17), (23) and (20).

We focus on a symmetric equilibrium in which $p_{jt} = \bar{p}_{jt}$,

$$w_t H_{jt}(1 - \theta + R_{jt}\theta) = \alpha Y_{jt} p_{jt} \frac{\epsilon_j - 1}{\epsilon_j}. \tag{22}$$

$$r_t^k K_{jt}(1 - \theta + R_{jt}\theta) = (1 - \alpha) Y_{jt} p_{jt} \frac{\epsilon_j - 1}{\epsilon_j}. \tag{23}$$

Both SOE firms and POE firms are owned by the household. As the POE sector is perfectly competitive, only SOE firms earn positive profits and pay dividends.

$$\pi_t S_t = Y_{st} p_{st} \frac{1}{\epsilon_s}. \tag{24}$$

The supply of the firm stock is fixed at unity $S_t = 1$.

II.4. **Banks.** Financial intermediation takes place through a continuum of competitive representative commercial banks, which we model in terms of single representative bank. At the beginning of each period $t$, the bank obtains household deposits $D_t$ at interest rate $R_t$. The bank has 3 uses of funds: directed lending to SOEs $B_{gt}$, unrestricted lending to domestic firms $B_t$, and to foreigners $B_t^f$. Financial repression takes the form of directed lending to low-productivity SOEs by setting a minimum share of directed lending in total domestic lendings.

$$B_{gt} \geq \gamma_t (B_{gt} + B_t) \tag{25}$$

where $\gamma_t$ is the financial control parameter. The higher $\gamma_t$, the higher financial control.

Capital controls take the form of income tax on foreign assets $\mu$. Denote $R_t^*$ as the foreign interest rate. Then banks' effective return on foreign assets is given by, $(1 - \mu)R_t^*$. Here $\mu_t$ is the capital control parameter. The higher $\mu_t$, the higher capital control.

Assume that the net interest rate on directed lending is zero. The representative bank's profit maximization problem is given by,

$$B_{gt} + R_{pt}B_t + (1-\mu)R_t^* B_{ft} - R_t D_t \tag{26}$$

subject to the financial restriction constraint (25) and the flow of funds constraint,

$$D_t \geq (B_{gt} + B_t) \tag{27}$$

Then the optimization condition is given by,

$$R_t = \gamma_t + (1-\gamma_t)R_{pt} = (1-\mu)R_t^*. \tag{28}$$

Note that the SOE loans have two components: directed lending loans $B_{gt}$ with no interest and unrestricted lending $B_t - B_{pt}$. Assume that the amount of directed lending loans that each SOE firm could get is proportional to its production scale. The average SOE loan rate $R_{st}$ is then given by,

$$R_{st} = \frac{B_{gt} + R_{pt}(B_t - B_{pt})}{B_{gt} + (B_t - B_{pt})}. \tag{29}$$

II.5. **Market clearing.** We assume that foreign goods and domestic consumption goods are perfect substitutes. The trade surplus is given by,

$$NX_t = Y_t - C_t^y - C_t^o - I_t - \frac{\Omega_k}{2}(\frac{I_t}{K_t^o} - \frac{\bar{I}}{\bar{K}_t^o})^2 K_t^o. \tag{30}$$

The labor market and the capital market clears,

$$H_t = H_{st} + H_{pt}. \tag{31}$$

$$K_{t-1} = K_{st} + K_{pt}. \tag{32}$$

Summing up all sectors' budget constraints, we could obtain the balance of payments condition in our model,

$$NX_t + (R_{t-1}^* - 1)B_{f,t-1} = B_{ft} - B_{f,t-1} + \Delta_t. \tag{33}$$

Note that the last term $\Delta_t = (R_{st}B_{st} + R_{pt}B_{pt} - R_{s,t-1}B_{s,t-1} - R_{p,t-1}B_{p,t-1})$ emerges because of the time gap between domestic loan repayment (by the end of each period) and domestic deposit repayment (at the beginning of next period).

## III. Calibration

We solve the model numerically based on calibrated parameters. The calibrated value of the parameters are displayed in Table 1.

A period in the model corresponds to ten years. We set the subjective discount factor $\beta = 0.665$, corresponding to an annualized discount rate of 0.96. We set $\eta = 2$, implying a Frisch labor elasticity of 0.5, which lies in the range of empirical studies. We calibrate $\Psi_h = 38$ such that the steady state value of labor hour is about one-third of total time endowment (which itself is normalized to 1). For the parameters in the capital accumulation process, we calibrate $\delta = 0.651$, implying an annual depreciation rate of 10%. We set $\Omega_k = 1$, which lies in range of the empirical estimates of DSGE models. We set the foreign interest rate $r^* = 1.629$, implying an annualized rate of 5%. We set $\tau$, the transfer from old to young, to 0.73 to target a steady-state value of $B_{ft}/D_t$ of 3%, which is consistent with the share of foreign-currency deposits in total deposits in the banking sector in China.

For the parameters related to intermediate goods producers, we set the elasticity of substitution among SOE firms $\epsilon = 20$, implying an average gross markup of 5%, which is consistent with the average spread in profit margins between SOEs and POEs. We normalize the scale of SOE TFP to $A_s = 1$ and calibrate the scale of POE TFP parameter at $A_p = 1.42$, consistent with the TFP gap estimated by Hsieh and Klenow (2009). The parameter $\phi$, the production share of SOE input, is an important parameter in the following policy exercise, where a permanent fall in $\phi$ captures in the persistent fall in share of SOE sector in Chinese economy over the last two decades. We set $\phi = 0.43$ as the benchmark and the initial state to target the share of SOE revenue in the industrial sector in 2010 and set $\phi = 0.32$ as the final state to target the share of SOE revenue in the industrial sector in 2016.

For the policy parameters, we set the share of directed lending $\gamma = 0.4$ to be consistent with the fact that the share of SOE loans in total domestic loans in the banking sector has been stable at 50% from 2010 to 2016. We set the tax rate on foreign investment gains to $\mu = 0.1$, implying an annulized tax rate of 1%. The SOE revenue share in industrial sector has been declining over the last 10 years to 0.3 in 2016.

## IV. Quantitative Results

IV.1. **Optimal steady-state capital control policy.** We begin by exploring how equilibrium allocations and welfare depend on the capital control policy. The model

Table 1. Calibration

| Parameter | Description | Value |
|---|---|---|
| $\beta$ | Household discount rate | 0.665 |
| $\eta$ | Inverse of labor supply elasticity | 2 |
| $\Psi_h$ | Utility weight of labor | 38 |
| $\delta$ | Capital depreciation rate | 0.651 |
| $\Omega_k$ | Capital adjustment cost | 5 |
| $r^*$ | Foreign interest rate | 1.629 |
| $\tau$ | Transfer from old to young | 0.73 |
| $\theta$ | Fraction of working capital | 1 |
| $\epsilon$ | Elasticity of substitution among SOE firms | 20 |
| $A_s$ | SOE TFP | 1 |
| $A_p$ | POE TFP | 1.42 |
| $\phi$ | Share of SOE output | 0.43 |
| $\gamma$ | Share of directed lending | 0.4 |
| $\mu$ | Tax rate on foreign investment | 0.1 |

implies a tradeoff between external efficiency and internal efficiency as to relaxing capital control. In particular, relaxing capital control improves the allocation between domestic investment and foreign investment. However, in the presence of financial repression, relaxing capital control increases domestic lending rate and shifts resources from more productive POEs to less productive SOEs, as SOEs are less sensitive to the increase in market lending rate than POEs because the rate on directed lending is exogenous to changes in the market rate.

This tradeoff is illustrated in Figure 1, which displays the relations between the steady-state capital control policy ($\mu$) and several macroeconomic variables. Relaxing capital control ($\mu$ decreases) increases domestic interest rate. In the presence of financial repression, POEs loan rate are more sensitive to domestic interest rate changes than SOE loan rate. Consequently, resources shifts from productive POEs to unproductive SOEs and the aggregate TFP falls. Meanwhile, reducing tax rate on foreign investment $\mu$ raises the foreign asset holdings and increase wealth gains from foreign investment. We can see that the representative household's setady-state welfare has a hump-shaped relation with $\mu$ and reaches its maximum at $\mu^* = 0.04$.

Figure 2 displays the optimal capital control policy under different degree of financial repression $\gamma$. When $\gamma$ increases, the share of restricted lending increases and SOEs loan rate become even less sensitive to market rate changes. As a result, the TFP worsening effect of relaxing capital control policy becomes larger. Therefore, the optimal capital control becomes stricter and correspondingly the optimal tax on foreign investment increases.

IV.2. **Optimal steady-state financial repression policy.** We next explore how equilibrium allocations and welfare depend on the financial repression policy. In our model, the presence of monopolistic competition among SOEs discourage SOEs from producing at the desired level. Financial regression manipulates SOEs' funding cost to be lower than the market rate and therefore could help mitigate the distortion caused by monopolistic competition.

Figure 3 displays the relations between the steady-state financial repression policy ($\gamma$) and several macroeconomic variables. We can see that relaxing financial repression ($\gamma$ decreases) leads to a shift from SOEs to POEs. Both the social welfare and the aggregate TFP is maximized when the share of SOE input equals its share in the aggregate production function. We can see that the monopolistic competition among SOEs makes it optimal to set $\gamma$ positive.

Figure 4 displays the optimal financial repression policy under different degree of capital control $\mu$. When $\mu$ increases, domestic deposit rate falls, which reallocate resources from SOEs to POEs. Therefore, the optimal share of directed lending increases to offset this reallocation effect.

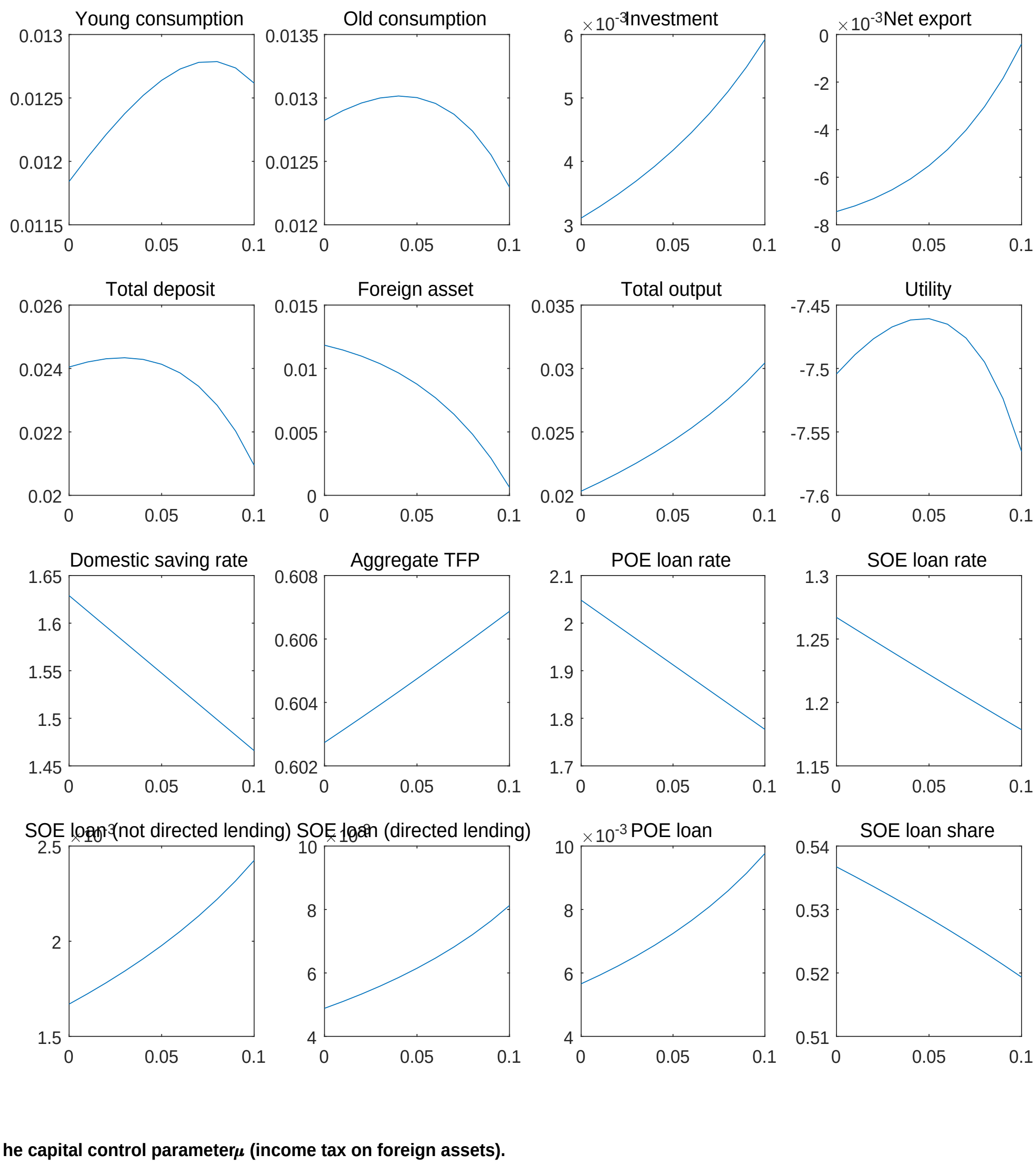



FIGURE 1. Steady-state implications of the capital control policy ($\mu$) under baseline calibration. The x axis is the capital control parameter $\mu$.

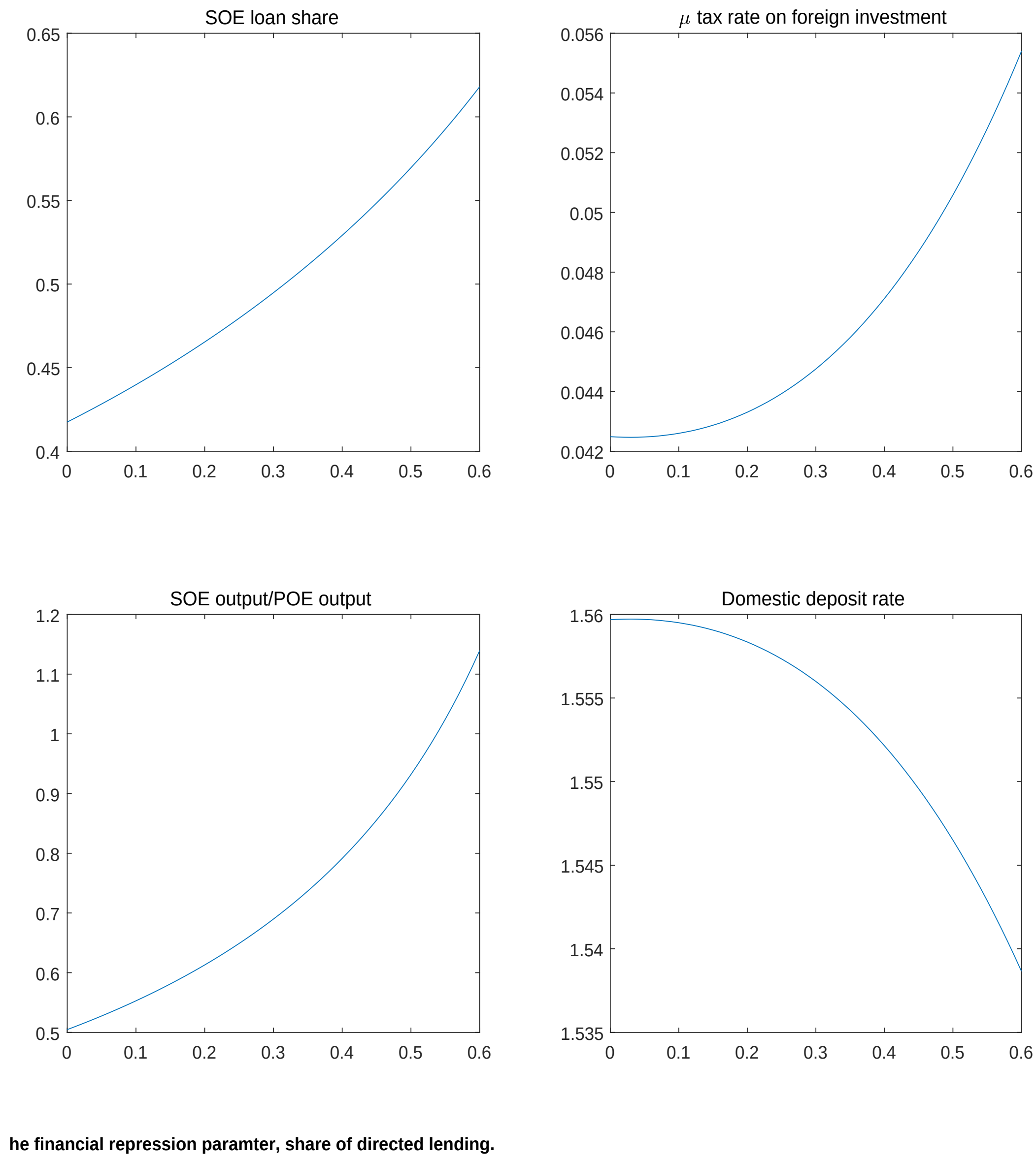



FIGURE 2. Optimal capital control policy under different degree of financial repression $\gamma$. The x axis is the financial repression parameter $\gamma$.

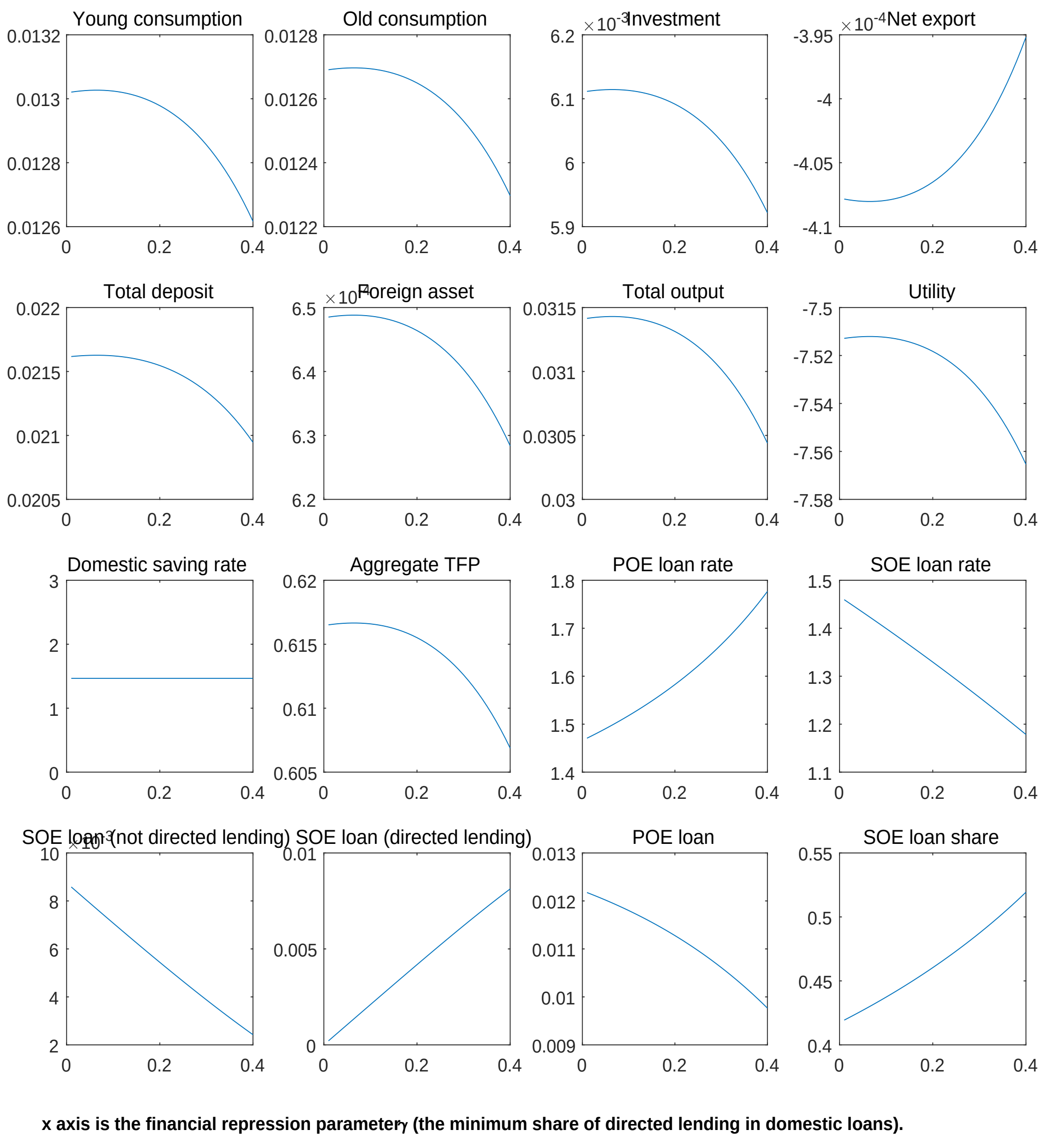



FIGURE 3. Steady-state implications of the financial repression policy ($\gamma$) under baseline calibration. The x axis is the financial repression parameter $\gamma$.

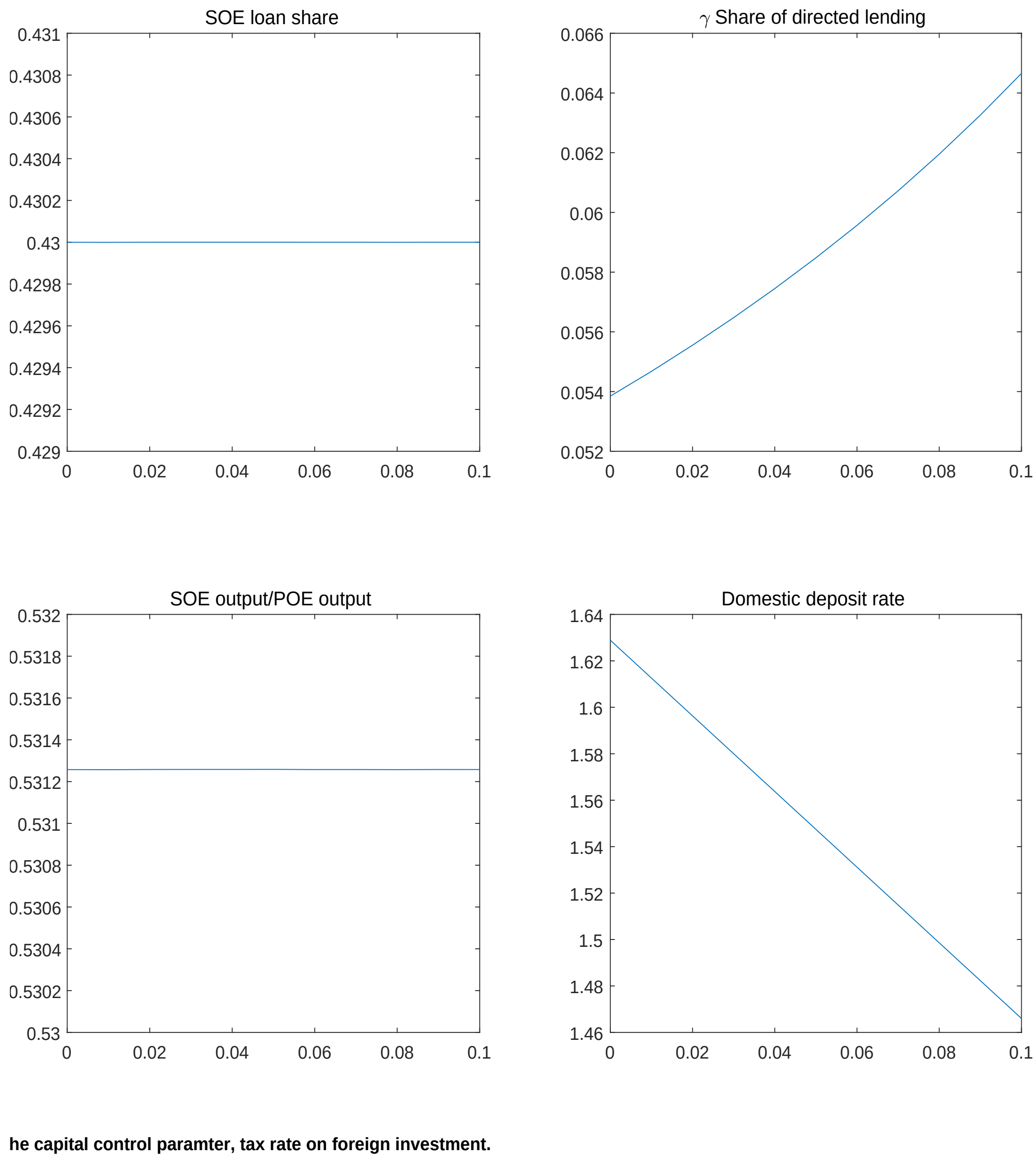



FIGURE 4. Optimal financial repression policy under different degree of capital control $\mu$. The x axis is the capital control parameter $\mu$.

IV.3. **Policy Exercise.** Chinese economy has experienced a persistent fall in the SOE sector relative to the POE sector over the last two decades. We first explores how this change will affect the optimal capital control policy and financial repression policy in the long run. Figure 5 displays the optimal capital control policy and financial repression policy that maximizes steady-state social welfare under various values of $\phi$ (the share of SOE input in the aggregate output function). We can see that when $\phi$ falls, it is optimal to reallocate resources from SOEs to POEs. Therefore, the optimal share of directed lending falls. Meanwhile, the optimal tax rate on foreign interest rate rises as the domestic saving rate should fall in order to faciliate the shift towards POEs.

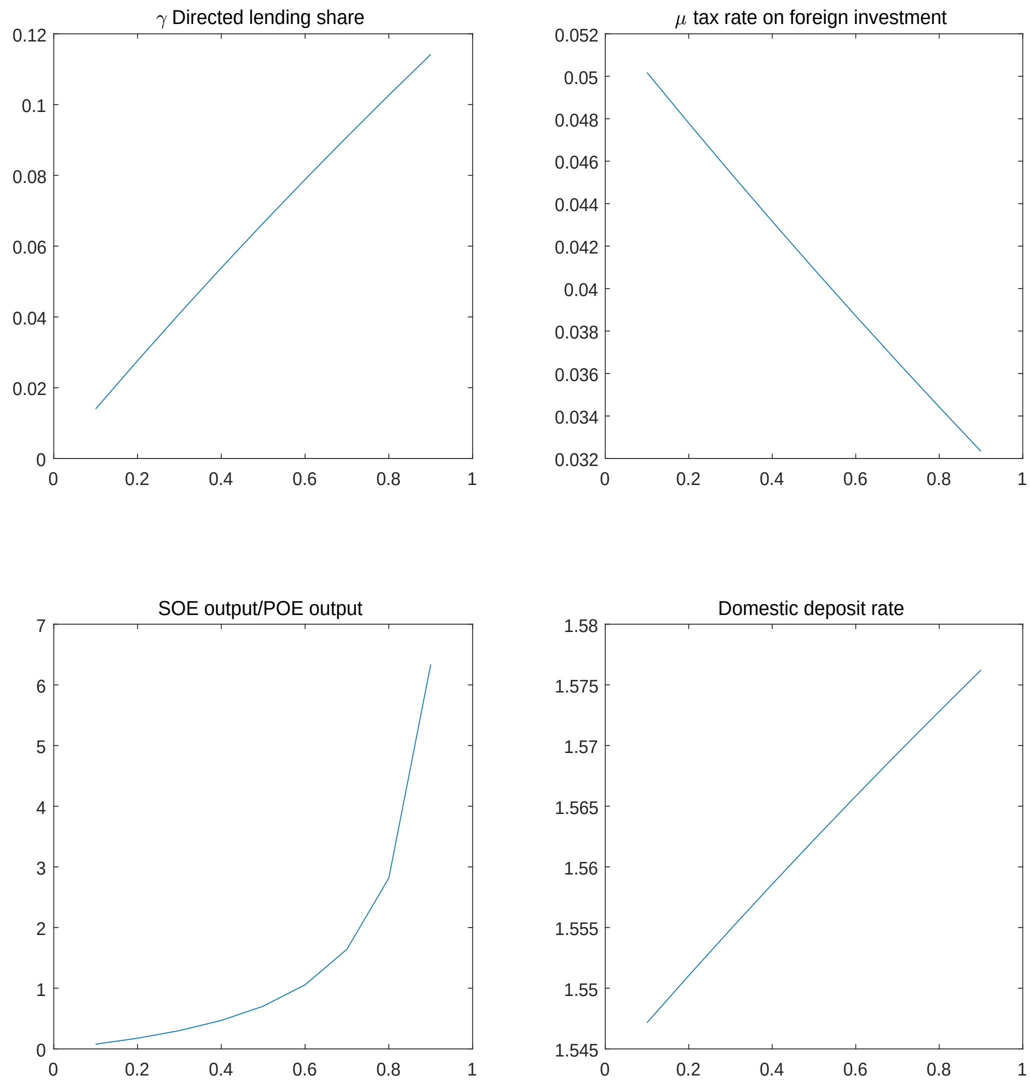
We now consider a counterfactual experiment in which the share of SOE input $\phi$ falls in period $t = 1$. We examine the role of financial repression and capital control policy in the economy's transition to the new steady state.

In particular, we consider the following structural changes. The economy starts in period $t = 0$ with the share of SOE input $\phi_0 = 0.43$ and the financial repression policy and the capital control policy are at their calibrated values of $\gamma_0 = 0.4$ and $\mu_0 = 0.1$. Note that both $\gamma_0$ and $\mu_0$ are over their own optimal steady-state value, implying both financial repression and capital control are too tight at the initial steady state. Starting from period $t = 1$, the share of SOE input $\phi_t$ falls to $\phi_1 = 0.32$ and the government could choose to liberalize the financial repression or the capital control over the transition. As to financial repression, we assume that the government keeps $\gamma_t$ unchanged at $\gamma_0$ before period $t = T_\gamma$ and liberalize financial repression to $\gamma_t = \gamma_1$ after period $t = T_\gamma$. As to capital control, we assume that the government keeps $\mu_t$ unchanged at $\mu_0$ before period $t = T_\mu$ and liberalize capital control to $\mu_t = \mu_1$ after period $t = T_\mu$. The transition path is then given by,

$$\begin{aligned}
\phi_t: &\quad \phi_t = \phi_0 \quad if \quad t = 0, \phi_t = \phi_1 \quad if \quad t \geq 1, \\
\gamma_t: &\quad \gamma_t = \gamma_0 \quad if \quad t \leq T_\gamma - 1, \gamma_t = \gamma_1 \quad if \quad t \geq T_\gamma, \\
\mu_t: &\quad \mu_t = \mu_0 \quad if \quad t \leq T_\mu - 1, \mu_t = \mu_1 \quad if \quad t \geq T_\mu.
\end{aligned}$$

where $\phi_0 = 0.43$, $\phi_1 = 0.32$, $\gamma_0 = 0.4$, $\mu_0 = 0.1$.

We then compute the welfare (the sum of the value functions for the old and the young) along the transition path, including the periods when the economy settles down in the new steady state. In particular, we define the welfare $V_1$ as the discounted sum




**he share of SOE output in the aggregate output function.**

FIGURE 5. Optimal capital control policy and financial repression policy under various SOE input shares $\phi$. The x axis is the SOE input shares $\phi$

of utility flow at t = 1 as follows,

$$V_1 = \sum_{t=1}^{\infty} \beta^t (\ln(C_t^y) - \Psi_h \frac{H_t^{1+\eta}}{1+\eta} \ln(C_t^o)), \tag{34}$$

We could express the welfare $V_1$ as a function of the degree of liberalization $(\mu_1, \gamma_1)$ and the timing of liberalization $(T_\mu, T_\gamma)$.

We first examine how the timing of liberalization affect the welfare along the transition path. In particular, we consider different pairs of $(T_\mu, T_\gamma)$, which corresponding to different timing of liberalization, and, for each pair, optimize the degree of liberalization for $(\mu_1, \gamma_1)$ to maximize the welfare evaluated along the transition path $V_1$. Figure 6 displays the numerial results.

The left panel displays the welfare evaluated along the transition path at optimal degree of liberalization under various pairs of liberalization timing. We can see that for any given timing of capital control liberalization $T_\mu$, it is always optimal to liberalize financial repression immediately. This is reasonable as financial repression could help facilitate the transition by shifting resources from the SOE sector the POE sector.

The left panel also suggests that, for any given timing of financial repression liberalization $T_\gamma$, it is better to postpone the liberalization of capital control to period $t = 2$ rather than liberalize immediately at period $t = 1$. As the transition is driven by a fall in SOE output share and calls for resource reallocation from SOEs to POEs, liberalizing capital control immediately will raise domestic deposit rate and shift resources from POEs to SOEs, thus amplifying the distortion. Therefore, it is optimal to liberalize the capital control at period $t = 2$, after most of shift from SOEs to POEs has been implemented.

Note that financial repression plays an important role in driving the resource reallocation effect of capital control. In particular, it is because of the presence of directed lending such that SOEs become less sensitive to market interest rates than POEs and capital control liberalization could shift resources from POEs to SOEs by raising market interest rates. Indeed, the role of financial repression is also shown in the left panel: the welfare gain of postponing capital control liberalization from $T_\mu = 1$ to $T_\mu = 2$ becomes larger when the liberlization of financial repression occurs latter. For robustness checks, we also find similar results when examining the relation between the timing of capital control liberalization $T_\mu$ and the welfare along the transition path under the same financial repression path.

The middle panel displays the optimal degree of capital control after liberalization under various pairs of liberalization timing. We can see that the optimal degree of capital control after liberalization is lower if the time of capital control liberalization $T_\mu$ is higher. This suggests that, if the liberalization of capital control is postponed, then the degree of the liberalization should be more aggressive, which could help speed up the transition in the pre-liberalization period through the expectation channel.

The middle panel also suggests that, the optimal degree of capital control after liberalization is higher if the time of financial repression liberalization $T_\mu$ is higher. This is because, as previously discussed, postponing financial repression could undermine the welfare gains in liberalizing capital control and therefore makes the optimal capital control stricter.

The right panel displays the optimal degree of financial repression after liberalization under various pairs of liberalization timing. We can see that, the optimal degree of financial repression is not sensitive to the timing of liberalization.

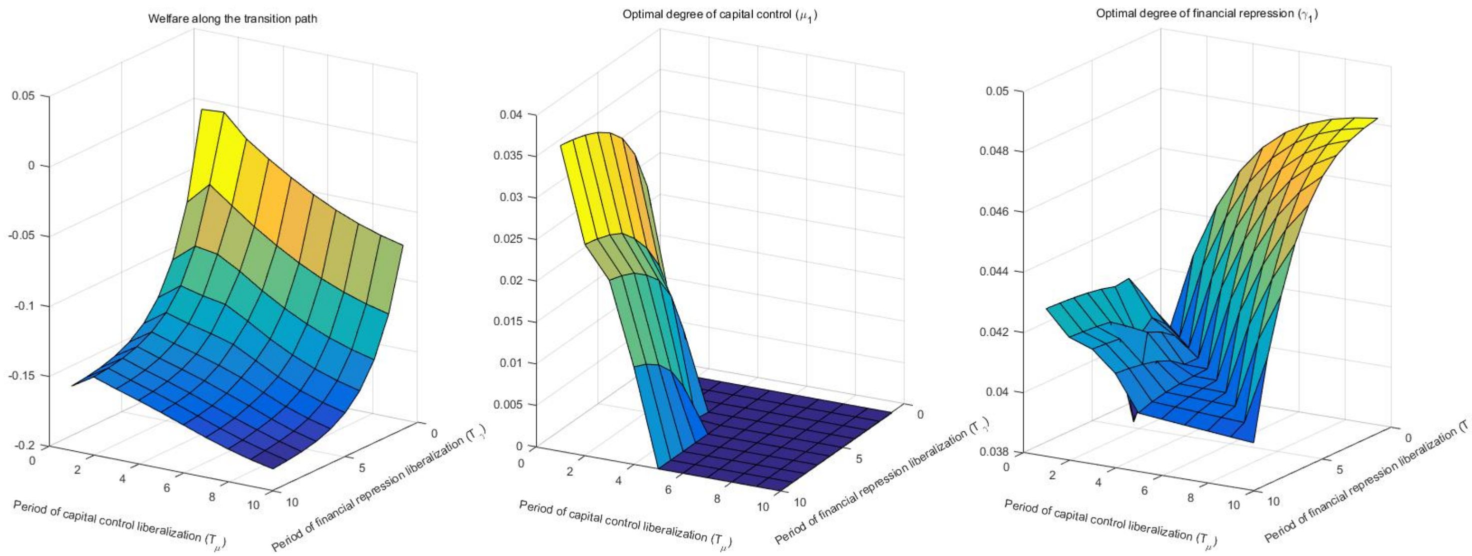



FIGURE 6. Welfare effect and optimal degree of liberalization under various pairs of liberalization timing. The transition path is as follows:

$$\phi_t: \quad \phi_t = \phi_0 \quad if \quad t = 0, \phi_t = \phi_1 \quad if \quad t \geq 1,$$

$$\gamma_t: \quad \gamma_t = \gamma_0 \quad if \quad t \leq T_\gamma - 1, \gamma_t = \gamma_1 \quad if \quad t \geq T_\gamma,$$

$$\mu_t: \quad \mu_t = \mu_0 \quad if \quad t \leq T_\mu - 1, \mu_t = \mu_1 \quad if \quad t \geq T_\mu.$$

where $\phi_0 = 0.43$, $\phi_1 = 0.32$, $\gamma_0 = 0.4$, $\mu_0 = 0.1$.

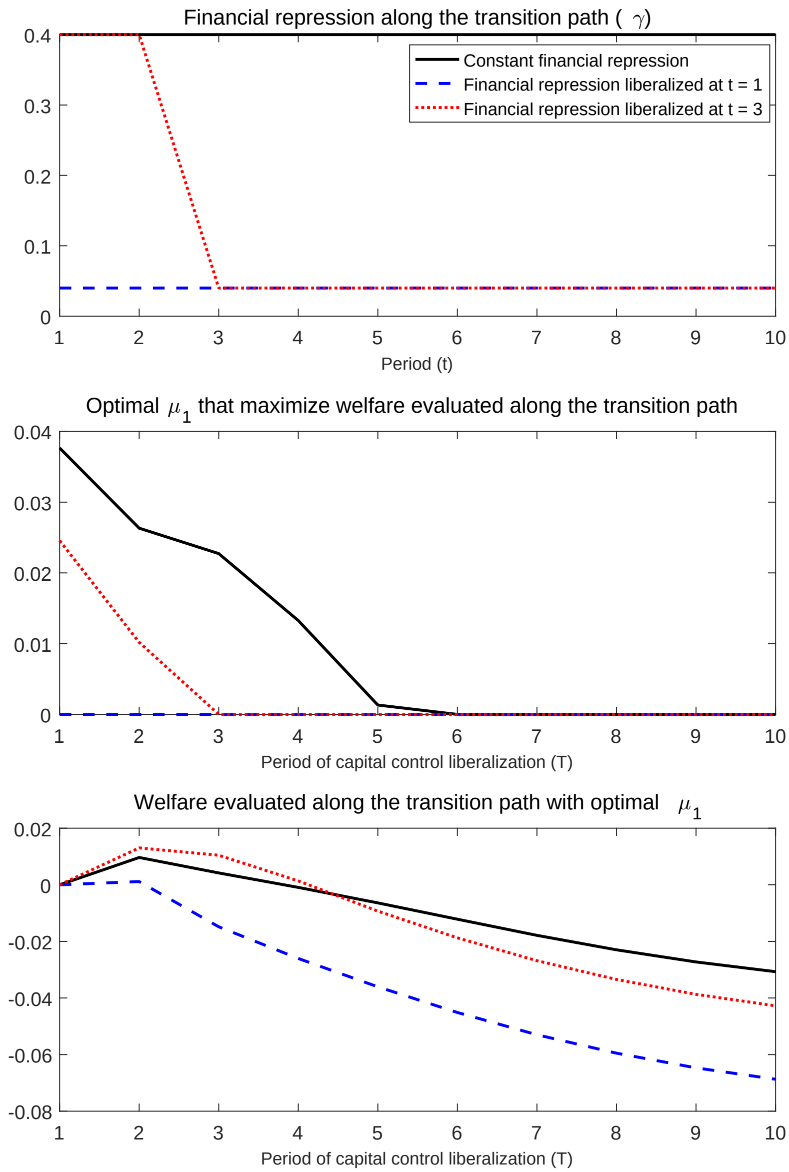



FIGURE 7. Welfare effect and optimal degree of capital control under various timing of capital control liberalization

The transition path is as follows:

$$\phi_t: \quad \phi_t = \phi_0 \quad if \quad t = 0, \phi_t = \phi_1 \quad if \quad t \geq 1,$$

$$\gamma_t: \quad \gamma_t = \gamma_0 \quad if \quad t \leq T_\gamma - 1, \gamma_t = \gamma_1 \quad if \quad t \geq T_\gamma,$$

$$\mu_t: \quad \mu_t = \mu_0 \quad if \quad t \leq T_\mu - 1, \mu_t = \mu_1 \quad if \quad t \geq T_\mu.$$

where $\phi_0 = 0.43$, $\phi_1 = 0.32$, $\gamma_0 = 0.4$, $\mu_0 = 0.1$.

## V. Conclusion

TO BE DONE.

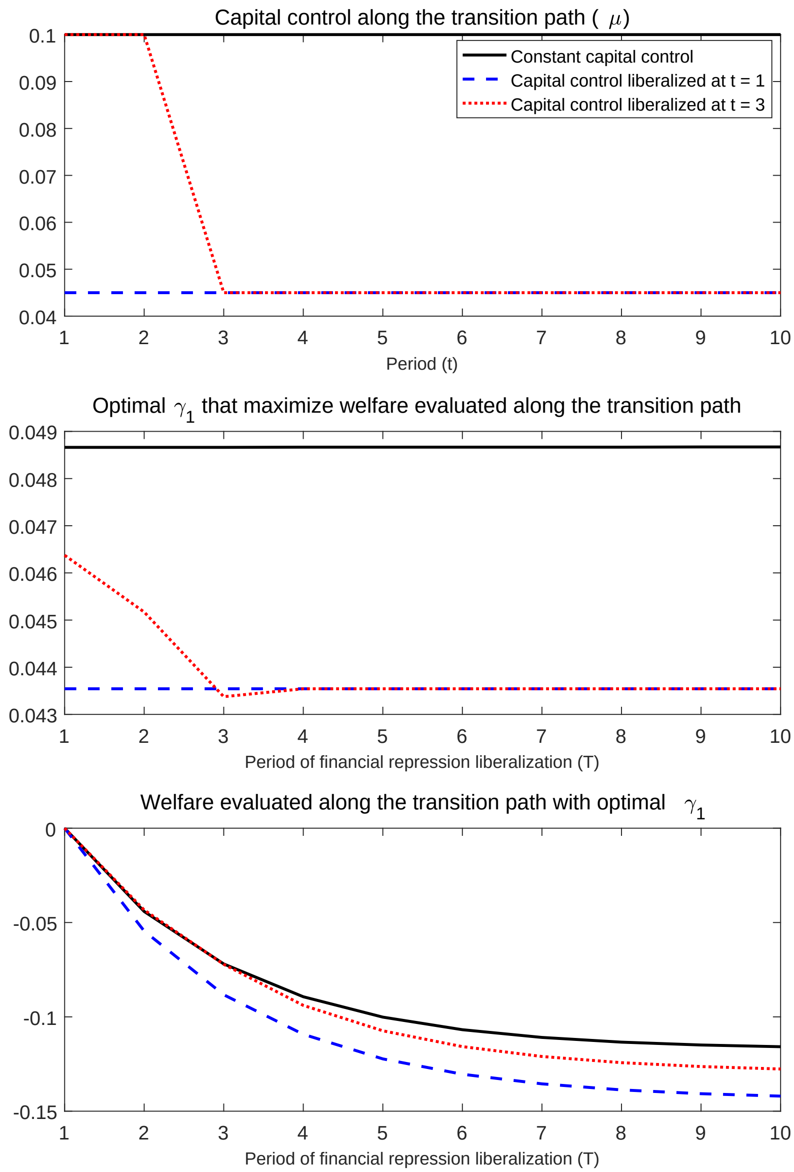



FIGURE 8. Welfare effect and optimal degree of financial repression under various timing of financial repression liberalization

The transition path is as follows:

$$\phi_t: \quad \phi_t = \phi_0 \quad if \quad t = 0, \phi_t = \phi_1 \quad if \quad t \geq 1,$$
$$\gamma_t: \quad \gamma_t = \gamma_0 \quad if \quad t \leq T_\gamma - 1, \gamma_t = \gamma_1 \quad if \quad t \geq T_\gamma,$$
$$\mu_t: \quad \mu_t = \mu_0 \quad if \quad t \leq T_\mu - 1, \mu_t = \mu_1 \quad if \quad t \geq T_\mu.$$

where $\phi_0 = 0.43$, $\phi_1 = 0.32$, $\gamma_0 = 0.4$, $\mu_0 = 0.1$.

## References

Chinn, M. and H. Ito (2006). What matters for financial development? *Journal of Development Economics 81*, 163–192.

Eichengreen, B., R. Gullapalli, and U. Panizza (2011). Capital account liberalization, financial development and industry growth: A synthetic view. *Journal of International Money and Finance 30*, 1090–1106.

Hsu, S. (2016). China's banking sector as the foundation of financial reform. *Asia and the Pacific Policy Studies 3*(2), 244–248.