

Interest-Rate Liberalization and Capital Misallocations¹

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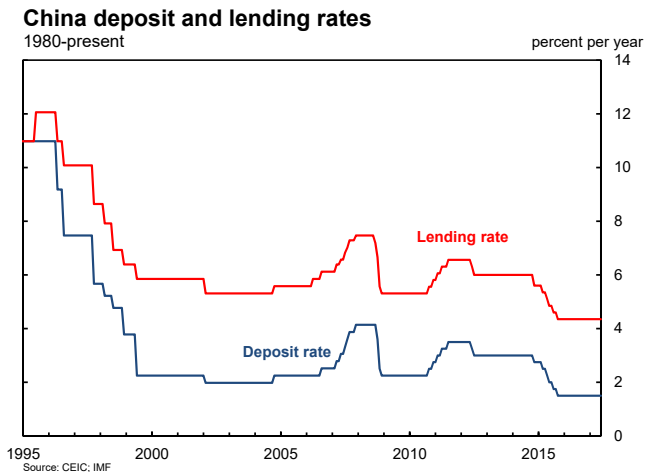
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China's interest rates have been tightly regulated



Recent liberalization: lending rates (2013); deposit rates (2015)

Standard theory: Financial liberalization improves productivity

- Financial frictions lead to misallocation and depressed productivity (e.g., Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Buera, et al. 2011; Midrigan and Xu, 2014; Moll, 2014)
- Alleviating financial frictions improves capital allocation and productivity

With multiple distortions, consequences of financial liberalization less clear

- China's SOEs have distorted incentives
 - ▶ SOEs (broadly defined) help provide public goods: need to maintain employment, not just maximizing profit (Bai, et al, 2006)
 - ▶ Government subsidizes inefficient SOEs to keep them alive: soft budget constraints (Lin, et al, 1998; Lin and Tan, 1999)
 - ▶ SOEs also have superior access to credit (Brandt and Zhu, 2000)
- Financial liberalization may exacerbate SOE over-investment, partly undoing the benefits of liberalization
- Studying full consequences of financial liberalization requires GE framework with multiple distortions

Interest-rate liberalization incurs tradeoff in GE model

- Analytical results: two-sector model with firm heterogeneity and credit constraints
 - 1 Interest-rate liberalization improves within-sector capital allocation
 - 2 but exacerbates misallocation across sectors (SOE over-investment)
 - 3 Overall effects on TFP and welfare ambiguous
- Calibrated quantitative model:
 - ▶ Interest-rate liberalization can reduce productivity and welfare
 - ▶ SOE reforms can alleviate/eliminate welfare loss from financial liberalization
- Implications for sequencing of reforms: SOE reforms should precede financial liberalization

A static model

- Two types of firms: state-owned enterprises (SOEs) with measure μ and private-owned enterprises (POEs) with measure $1 - \mu$; Each firm endowed with h units of capital
- SOE firm uses 1 unit of capital to produces $z^s \varepsilon$ units output, with TFP z^s and idiosyncratic productivity $\varepsilon \sim \mathbf{F}(\varepsilon)$
- POE firm uses 1 unit of capital to produces $z^p \varepsilon$ units output, where TFP $z^p > z^s$
- Interest rate wedge: $r^l = r^d + \phi$
 - ▶ Base model: ϕ controlled by gov't, r^l and r^d endogenous
 - ▶ Isomorphic setup: r^d controlled by gov't, r^l and ϕ endogenous

POE's problem

- POE firm with productivity ε maximizes profit

$$\max_{\{k^P(\varepsilon), l^P(\varepsilon), s^P(\varepsilon)\}} z^P \varepsilon k^P(\varepsilon) - (r^d + \phi) l^P(\varepsilon) + r^d s^P(\varepsilon),$$

- Flow-of-funds constraint

$$k^P(\varepsilon) = h + l^P(\varepsilon) - s^P(\varepsilon),$$

- Borrowing constraint

$$l^P(\varepsilon) \leq \theta^P h,$$

- Constraint on savings

$$0 \leq s^P(\varepsilon) \leq h.$$

SOE's problem

- SOE firm's objective function

$$\tau z^s \varepsilon k^s(\varepsilon) - \left(r^d + \phi\right) I^s(\varepsilon) + r^d s^s(\varepsilon),$$

- $\tau > 1$: distorted SOE incentive
 - ▶ Parsimony for soft budget constraints: gov't subsidies, monopoly rents, or fixed costs
 - ▶ SOE's private MPK exceeds social MPK $\Rightarrow$ incentive to expand scale
- Flow-of-funds constraints

$$k^s(\varepsilon) = h + I^s(\varepsilon) - s^s(\varepsilon)$$

- Borrowing constraint

$$I^s(\varepsilon) \leq \theta^s h$$

- Constraint on savings

$$0 \leq s^s(\varepsilon) \leq h$$

- SOEs have easier access to credit: $\theta^p < \theta^s$

Aggregation and market clearing

- Capital market clearing condition

$$\mu \int k^s(\varepsilon) d\mathbf{F}(\varepsilon) + (1 - \mu) \int k^p(\varepsilon) d\mathbf{F}(\varepsilon) = h.$$

- Aggregate output

$$Y = \mu \int z^s \varepsilon k^s(\varepsilon) d\mathbf{F}(\varepsilon) + (1 - \mu) \int z^p \varepsilon k^p(\varepsilon) d\mathbf{F}(\varepsilon).$$

Capital allocations

- There exist two cutoff productivity levels $\underline{\varepsilon}^j$ and $\bar{\varepsilon}^j$ for each sector $j \in \{s, p\}$ such that

$$s^j(\varepsilon) = \begin{cases} h & \text{if } \varepsilon < \underline{\varepsilon}^j \\ 0 & \text{if } \underline{\varepsilon}^j \leq \varepsilon \end{cases}$$

$$l^j(\varepsilon) = \begin{cases} 0 & \text{if } \varepsilon < \bar{\varepsilon}^j \\ \theta^j h & \text{if } \bar{\varepsilon}^j \leq \varepsilon \end{cases}$$

$$k^j(\varepsilon) = \begin{cases} 0 & \text{if } \varepsilon < \underline{\varepsilon}^j \\ h & \text{if } \underline{\varepsilon}^j \leq \varepsilon < \bar{\varepsilon}^j \\ (1 + \theta^j) h & \text{if } \bar{\varepsilon}^j \leq \varepsilon \end{cases}$$

- The cutoff productivity levels are given by

$$\underline{\varepsilon}^j = \frac{r}{z^j \tau^j}, \quad \bar{\varepsilon}^j = \frac{r + \phi}{z^j \tau^j}$$

Macro effects of interest rate liberalization

- Liberalization (lower ϕ) $\Rightarrow$ capital flows from POE to SOE

$$\frac{\partial K^S}{\partial \phi} < 0, \quad \frac{\partial K^P}{\partial \phi} > 0.$$

- Liberalization raises TFP for POE, but not necessarily for SOE
 - ▶ Higher deposit rate $\rightarrow$ low productivity firms become savers, boosting within-sector TFP
 - ▶ But across-sector capital reallocation exacerbates SOE over-investment, offsetting TFP gains
- Net effects on aggregate TFP ambiguous

A dynamic model

- Generalize static model to incorporate (1) endogenous capital accumulation; (2) decreasing returns
- Firm in sector $j \in \{s, p\}$ has DRS production function

$$y_t^j = \left[\left(z^j \varepsilon_t^j k_t^j \right)^\alpha \left(n_t^j \right)^{1-\alpha} \right]^\eta$$

where ε_t^j denotes idiosyncratic productivity.

- Flow-of-funds constraint

$$k_t^j = l_t^j + h_t^j - s_t^j$$

where h_t^j is net worth carried over from $t - 1$

- Borrowing constraint

$$0 \leq l_t^j \leq \theta^j h_t^j$$

- Constraint on savings

$$0 \leq s_t^j \leq h_t^j$$

Firm's decision problem

- Firm in sector $j \in \{s, p\}$ maximizes value function

$$V_t^j(h_t^j, \varepsilon_t^j) = d_t^j(h_t^j, \varepsilon_t^j) + \beta \frac{\Lambda_{t+1}}{\Lambda_t} \int V_{t+1}^j(h_{t+1}^j, \varepsilon_{t+1}^j) d\mathbf{F}^j(\varepsilon_{t+1}^j)$$

- Flow dividend d_t^j is given by

$$d_t^j(h_t^j, \varepsilon_t^j) \equiv \tau^j R_t \left(z^j \varepsilon_t^j k_t^j \right)^{\tilde{\alpha}} + (1 - \delta) k_t^j - (1 + r_{lt}) l_t^j + (1 + r_{dt}) s_t^j - h_{t+1}^j$$

where $R_t \equiv (1 - \gamma) \left(\frac{\gamma}{W_t} \right)^{\frac{\gamma}{1-\gamma}}$ is the pre-subsidy return on capital

The representative household

- Utility function

$$\sum_{t=0}^{\infty} \beta^t \log C_t$$

- Budget constraint

$$C_t + \frac{B_{t+1}}{1 + r_{dt}} + \sum_{j=\{s,p\}} \int x_{i,t+1}^j (P_{it}^j - d_{it}^j) di \leq W_t N_t + B_t + \sum_{j=\{s,p\}} \int x_{it}^j P_{it}^j di - T_t$$

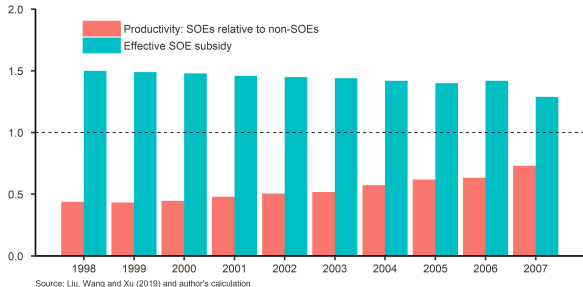
- Borrowing constraint

$$\frac{B_{t+1}}{1 + r_{dt}} \geq 0$$

- Under interest rate controls, low deposit rate $\Rightarrow B_{t+1} = 0$

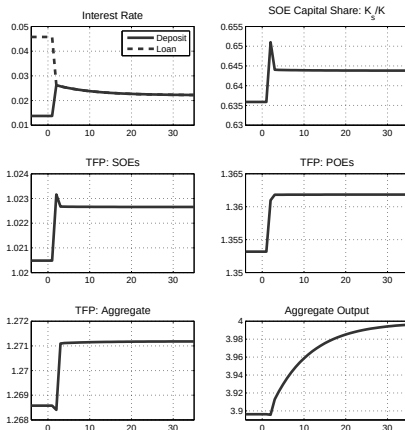
Calibration

- Fixed parameters: $\beta = 0.96$, $\delta = 0.1$, $\alpha = 0.5$, $\eta = 0.85$, and $\phi = 0.032$
- Calibrate τ^j , θ^j , Z^j , and σ^j using China's Annual Survey of Industries, 1998-2007



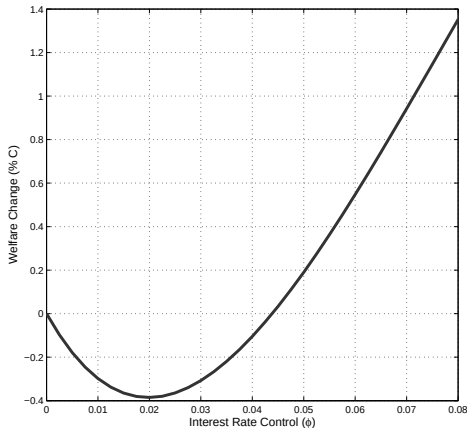
- Calibrated values: $\frac{\tau^s}{\tau^p} = 1.43$, $\frac{Z^p}{Z^s} = 1.92$, $\frac{\theta^s}{\theta^p} = 1.80$, $\frac{\sigma^p}{\sigma^s} = 1.23$

Transition dynamics following liberalization (set $\phi = 0$)



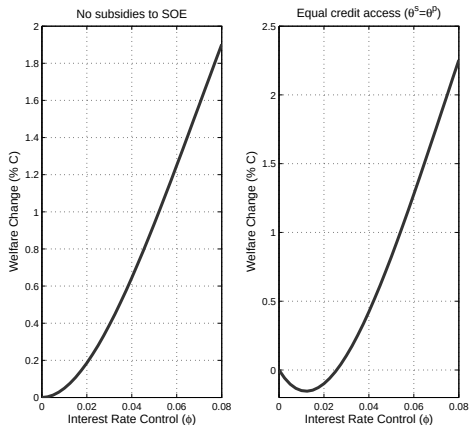
- Tradeoff b/n within-sector TFP gains and across-sector misallocation
- Short run drops in TFP and output; permanent increase in long run

Transition welfare following liberalization (set $\phi = 0$)



- Removing interest-rate wedge leads to modest welfare loss (0.28% consumption equivalent)

SOE reforms reduce or eliminate welfare losses from interest-rate liberalization



Empirical evidence for model's reallocation mechanism

- Testable empirical implication: interest-rate liberalization can hurt productivity in the presence of distorted allocations
- Empirical specification:

$$\Delta Y_{mt} = \beta_0 + \beta_1 \times D_{mt} + \beta_2 \times \Delta \phi_t + \beta_3 D_{mt} \times \Delta \phi_t + \beta_4 \times X_{mt} + \delta_m + \rho \Delta Y_{m,t-1} + \varepsilon_{mt}$$

where ΔY_{mt} denotes labor productivity growth in industry m

- Distortion dummy:

$$D_{mt} \equiv \mathbf{1} \left(z_{mt}^{\text{aut},x\%} \geq z_{mt}^{\text{borr},x\%} \right), \quad x \in \{1, 2, 5\}$$

where $z_{mt}^{\text{aut},x\%}$ and $z_{mt}^{\text{borr},x\%}$ denote TFP of bottom $x\%$ of, respectively, financially autarkic firms and borrower firms in industry m

- Estimate empirical specification using firm-level data (NBS)

Response of labor productivity to changes in interest-rate wedge

ΔY_{mt}	(1)	(2)	(3)
$\Delta \phi_t$	-0.723^{**} (0.299)	-0.753^{**} (0.313)	-0.765^{**} (0.308)
$D_{mt} \times \Delta \phi_t$	0.921^{**} (0.456)	0.970^{**} (0.486)	0.979^{**} (0.491)
D_{mt}	-0.020 (0.053)	-0.019 (0.049)	-0.027 (0.052)
Number of Observations	2,806	2,806	2805
Number of Industries	476	476	476
Controls	Y	Y	Y

- Reducing ϕ *lowers* productivity if industry has distorted allocation
- Without distorted allocation, reducing ϕ raises productivity

Other evidence for model's reallocation mechanism

- Gao, Ru, Townsend, Yang (2017): Bank entry deregulation of 2009 → new entrant banks mostly lent to SOEs (less productive but safe); increased competition between new and incumbent banks raised loan quality and borrowing firms' efficiency
- Chang, Liu, Spiegel, Zhang (2017): cutting required reserve ratio raises SOE loan shares, investment shares, and stock returns
- Cong, Gao, Ponticelli, Yang (2018): sharp credit expansion from fiscal stimulus reallocated capital to SOEs, despite their lower productivity

Conclusion

- Under multiple sources of distortions, complete interest-rate liberalization may not be desirable
- Financial liberalization incurs tradeoff between within-sector productivity gains and across-sector misallocations (SOE over-investment)
- SOE reforms should precede financial liberalization