Modeling the Tournament of Officials

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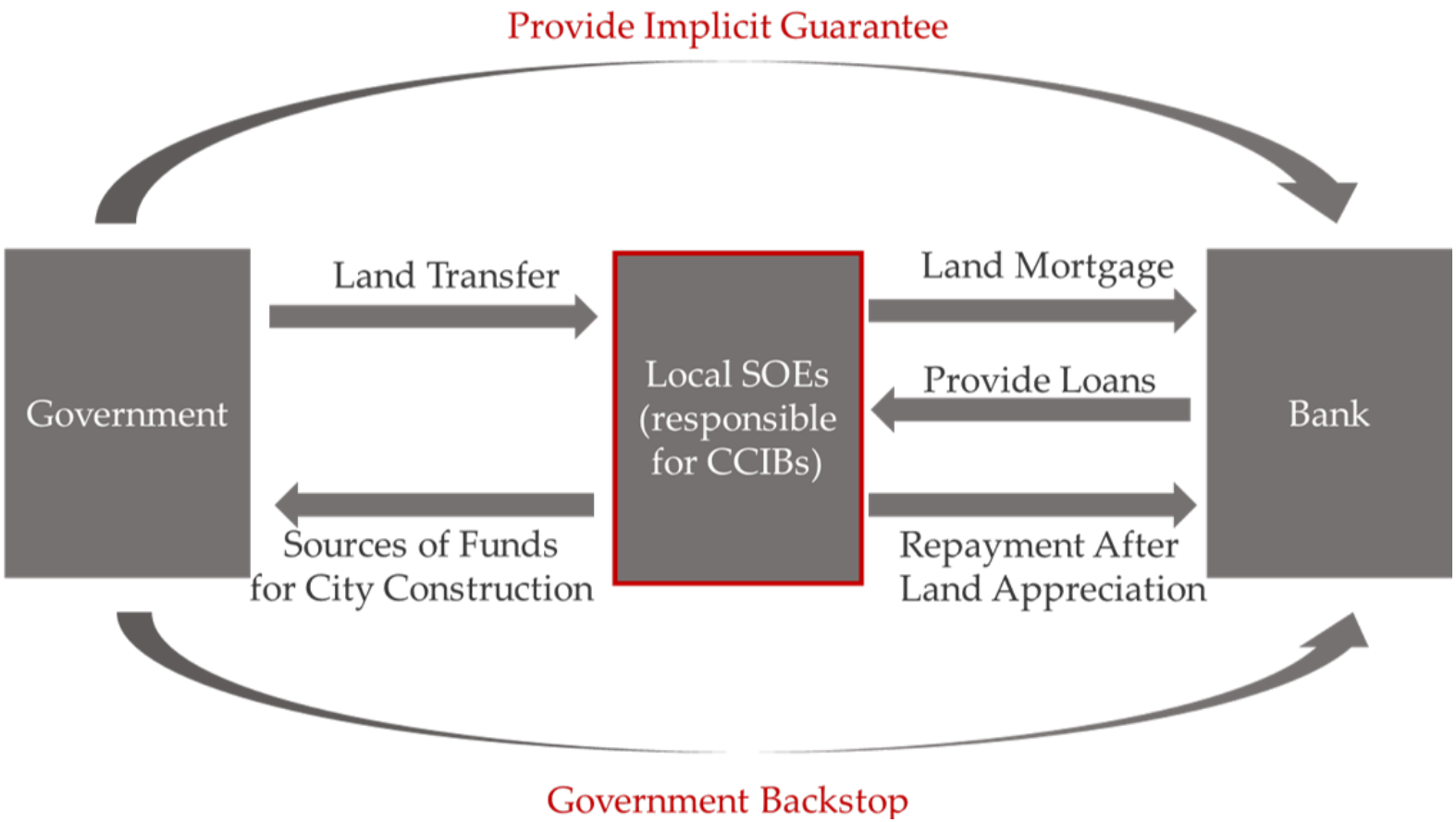
February 8, 2023

Overview

1. Question: Why Local Governments Borrow so Much?
   - Facts
   - Theories
2. Xiong (2018): The Mandarin Model of Growth
   - Model Setup
   - Selfish Official: Underinvestment
   - Overcome Underinvestment Problem by Tournament
   - Problem: Excessive Leverage
3. Discussion

City Construction Investment Bond (CCIB)



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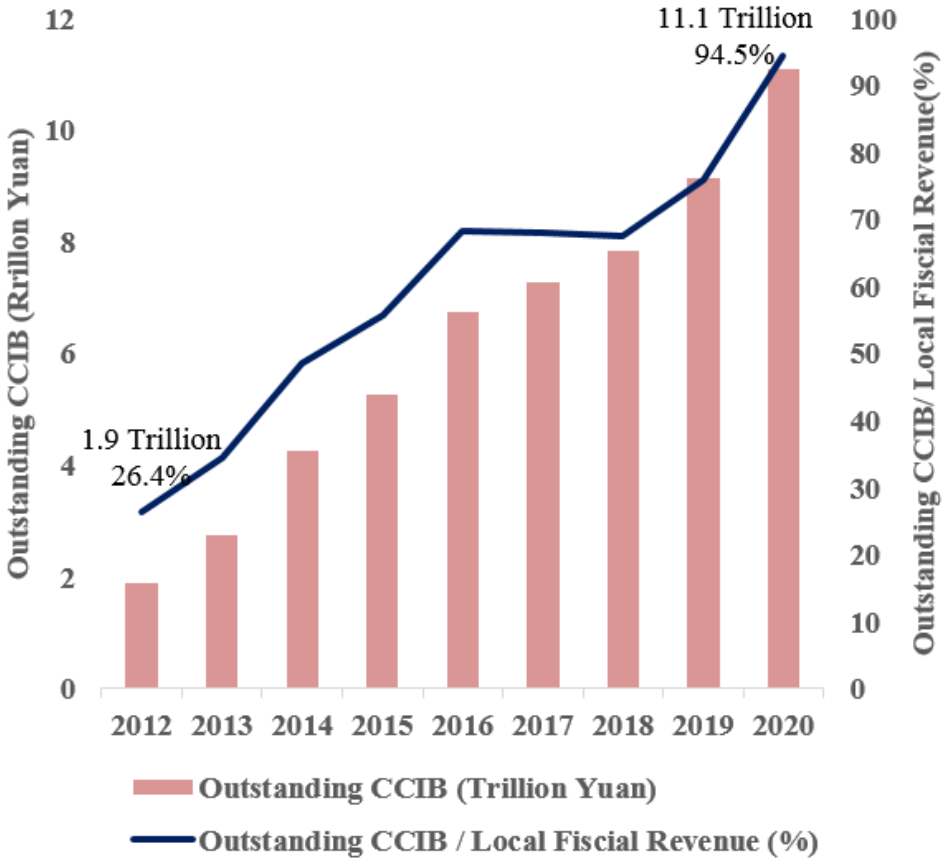

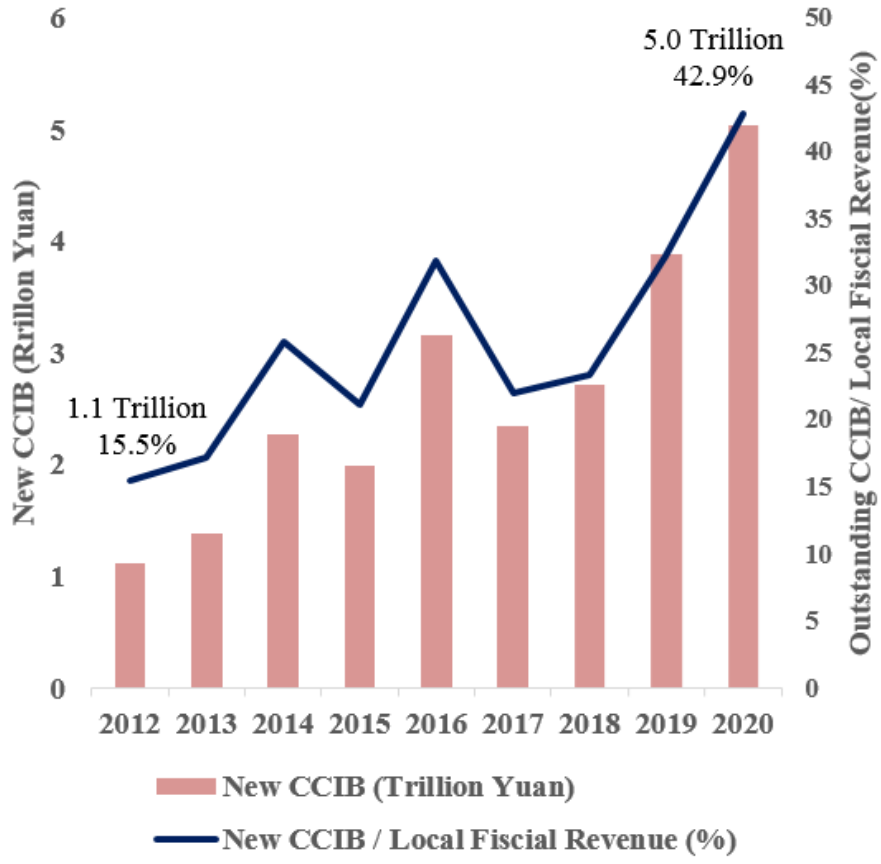

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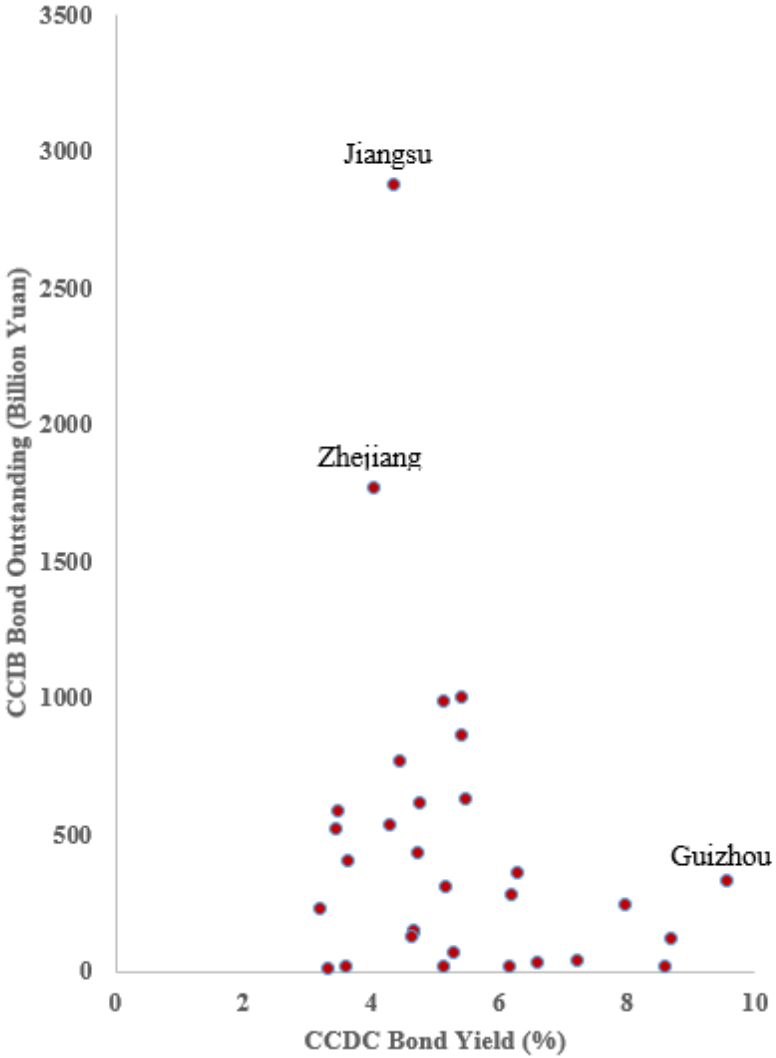

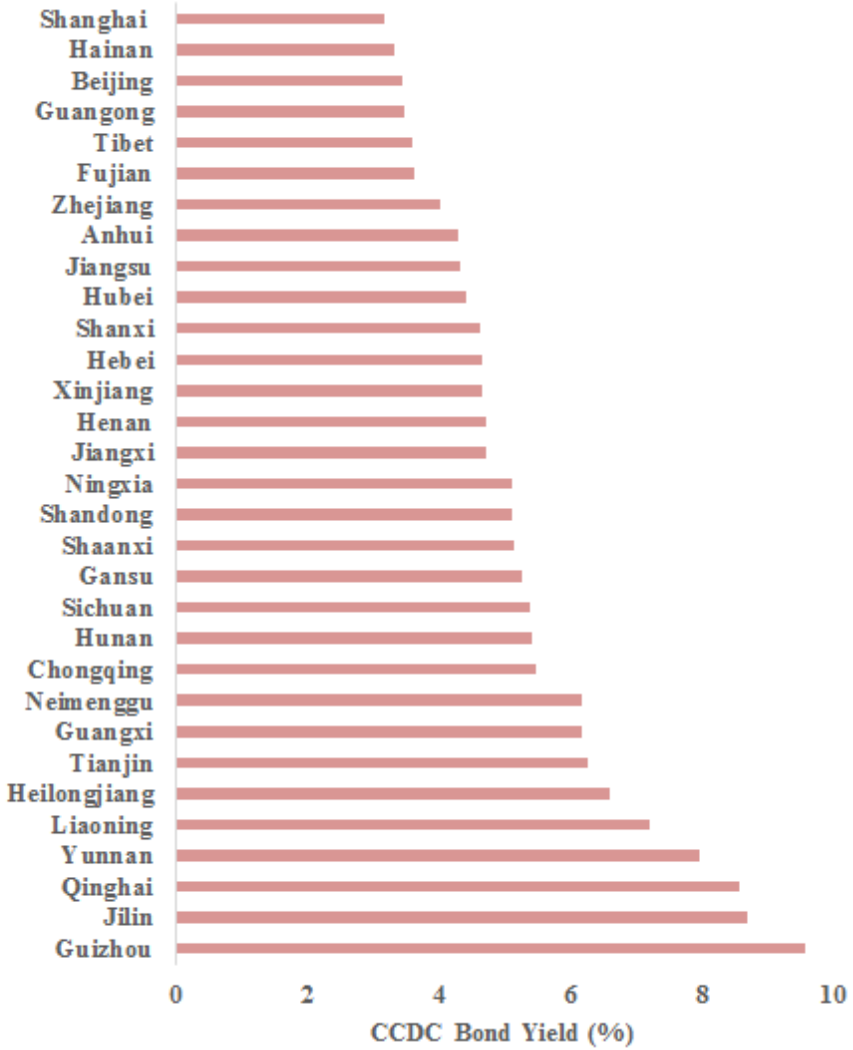

Theories

- Theory 1: Tournament of Officials
  - Debt↑ ⇒ GDP↑ ⇒ likelihood of promotion↑
    - Li and Zhou (2005), Zhou (2007), etc.
    - Luo and She (2015), Chen and Li (2015), etc.
  - But questions remain:
    - How to endogenize officials' debt decisions in the macro model?
    - What is the impact of tournament on social welfare?
- Theory 2: Mismatch of Revenue and Responsibility
  - Empirical: Ji et al. (2019): tournament in East, mismatch in the West
- Theory 3: Mismatch of Term
  - Classical theory: Alberto and Guido (1990);
  - Luo and She (2015): Official terms: 4-5 years Bond: >7 years.

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3. Discussion

Mechanism

- **Basic assumption:** social infrastructure are **long-last public goods**
  - $\Rightarrow$ You cannot exclude others and future people from gain from it.

- What is the gain/loss if a official invest in infrastructure:
  - Selfish (or shortsighted) officials:
    - Loss: government spending$\downarrow$: $\Rightarrow$ enjoyment$\downarrow$; prob. of win election$\downarrow$;
    - Gain: Productivity$\uparrow$ $\Rightarrow$ tax in my term$\uparrow$.
  - Selfless social planner (Social Optimal):
    - Additional gain: productivity$\uparrow$ $\Rightarrow$ people's earning $\Uparrow$.
  - Selfish (or shortsighted) officials with tournament:
    - Additional gain: my ability in eyes of central government $\uparrow$ $\Rightarrow$ prob. of promotion$\Uparrow$.

Representative Firms

- There are M regions indexed by $i = 1, 2, ..., M$:
  - Each region is a open economy with perfect capital flow;
  - Interest rate is exogenously given on R;
  - Labor market is local:
  - Each region have labor supply $L_{it} = 1$, earning wage Φ_{it}.
- Production function:

$$Y_{it} = A_{it} K_{it}^{\alpha_i} L_{it}^{1-\alpha_i} G_{it}^{1-\alpha_i} \tag{1}$$

  - G_{it}: Public infrastructure (electricity, roads, schools, etc)
  - G_{it} are public goods invested by local governments.

Representative Firms

- Firms' problem:

$$\max_{\{K_{it},L_{it}\}} A_{it}K_{it}^{\alpha_i}L_{it}^{1-\alpha_i}G_{it}^{1-\alpha_i} - \Phi_{it}L_{it} - RK_{it} \tag{2}$$

- By solving the firms problem with $L_{it} = 1$:

$$K_{it} = \left(\frac{\alpha_i A_{it}}{R}\right)^{1/(1-\alpha_i)} G_{it} \tag{3}$$

$$Y_{it} = \left(\frac{\alpha_i}{R}\right)^{\alpha_i/(1-\alpha_i)} A_{it}^{1/(1-\alpha_i)} G_{it} \tag{4}$$

  - K_{it} and Y_{it} are linear in G_{it}.

OLG Households

- Households' problem:

$$\max_{C_{it}^t, C_{it+1}^t} E_t \left\{ \ln \left(C_{it}^t \right) + \beta \ln \left(C_{it+1}^t \right) \right\} \tag{5}$$

$$\text{s.t. } C_{it}^t + S_{it}^t \leq (1-\tau)\Phi_{it} L_{it} \tag{6}$$

$$C_{it+1}^t = (1-\tau) R S_{it}^t \tag{7}$$

  - τ is the tax rate on wage and capital return.

OLG Households

- By solving out the problem:

$$C_{it}^{t} = \frac{1}{1+\beta}(1-\alpha_i)(1-\tau)\left(\frac{\alpha_i}{R}\right)^{\alpha_i/(1-\alpha_i)} A_{it}^{1/(1-\alpha_i)} G_{it} \tag{8}$$

$$C_{it+1}^{t} = \frac{\beta}{1+\beta} R(1-\alpha_i)(1-\tau)^2\left(\frac{\alpha_i}{R}\right)^{\alpha_i/(1-\alpha_i)} A_{it}^{1/(1-\alpha_i)} G_{it} \tag{9}$$

  - Consumption in each period is linear in G_{it}.

Local Officials

- Local government officials are **selfish (or shortsighted)**:
  - They care about earning of government officials E_{it}^{G}:

$$V\left(W_{it}\right) = \max_{E_{it}^{C}} E_t\left[\gamma \ln\left(E_{it}^{G}\right) + \beta V\left(W_{it+1}\right)\right] \tag{10}$$

  - Governments' wealth are tax and infrastructure stock:

$$W_{it} = \tau Y_{it} + \left(1 - \delta_G\right) G_{it} \tag{11}$$

  - Government pay their officials or invest in local infrastructure:

$$G_{it+1} + E_{it}^{G} = W_{it} \tag{12}$$

- Government problem is defined by (10), (11) and (12).

Local Officials

- For comparison, we can define a **social planner** problem:

$$V\left(W_{it}^{\text{planner}}\right) = \max_{C_{it}^{t}, C_{it}^{t-1}, E_{it}^{G}, G_{it+1}} E_t\left[\ln\left(C_{it}^{t}\right) + \ln\left(C_{it}^{t-1}\right) + \gamma \ln E_{it}^{G} + \beta V\left(W_{it+1}^{\text{planner}}\right)\right]$$

$$W_{it}^{\text{planner}} = Y_{it} + (1-\delta_G)\, G_{it}$$

$$C_{it}^{t} + C_{it}^{t-1} + E_{it}^{G} + C_{it+1} = W_{it}^{\text{planner}}$$

- Question: What is the problem of selfish government officials?

Selfish Official: Underinvestment

Proposition 1: Infrastructure of Selfish Officials

In each period, the selfish local government allocates a fixed fraction β of government budget to local infrastructure:

$$G_{it+1} = \beta \left[\tau Y_{it} + (1 - \delta_G) G_{it} \right]$$

Proposition 2: Infrastructure of Social Planner

In the first-best benchmark, the social planner allocates a fixed fraction β of the aggregate social budget to infrastructure:

$$G_{it+1}^{\text{planner}} = \beta \left[Y_{it} + (1 - \delta_G) G_{it} \right]$$

Information Asymmetry

- Question: how to solve the underinvestment problem?
- Tournament: local officials care about how their ability in the eyes of central government:

$$V(W_{it}) = \max_{G_{it+1}} E_t \left[\gamma \ln (W_{it} - G_{it+1}) + \chi_i (\hat{a}_{it+1} - \bar{a}_i) + \beta V(W_{it+1})\right]$$

  - $a_{it+1} \sim N(\bar{a}_{it+1}, \sigma_a^2)$ official's ability to boost local economy
  - Their ability in the eyes of central government is:

$$\widehat{a}_{it+1} = E\left[a_{it+1} \mid \{Y_{it+1}\}_{i=1,\ldots,M}\right]$$

Information Asymmetry

- Productivity is of each region is given by:

$$A_{it} = e^{f_t + a_{it} + \varepsilon_{it}}$$

  - $f_t \sim N\left(\bar{f}, \sigma_f^2\right)$ i.i.d. countrywide common shock;
  - $a_{it} \sim N\left(\bar{a}_i, \sigma_a^2\right)$ i.i.d. official's ability;
  - $\varepsilon_{it} \sim N\left(0, \sigma_\varepsilon^2\right)$ i.i.d. idiosyncratic noise.

- Information Asymmetry:
  - Local GDP Y_{it+1} is known to central government;
  - Local infrastructure stock G_{it+1} is unknown to central government,
  - **However, central government known the maximization problem of local official and deduct G^*_{it+1} from Y_{it+1}.**

Signal Jamming Mechanism

$$\ln\left(Y_{it+1}\right) = \frac{1}{1-\alpha_i}\left(f_{t+1} + a_{it+1} + \varepsilon_{it+1}\right) + \frac{\alpha_i}{1-\alpha_i}\ln\left(\frac{\alpha_i}{R}\right) + \ln\left(G_{it+1}\right)$$

- To infer the ability of local officials, central government expected G^*_{it+1} and deduct irrelevant parts and form a statistic z_{it+1}:

$$z_{it+1} \equiv (1-\alpha_i)\left\{y_{it+1} - \left[\frac{\alpha_i}{1-\alpha_i}\ln\left(\frac{\alpha_i}{R}\right) + \ln\left(G^*_{it+1}\right)\right]\right\}$$

Signal Jamming Mechanism

- In the eyes of local government officials:

$$z_{it+1} = f_{t+1} + a_{it+1} + \varepsilon_{it+1} + (1 - \alpha_i)\left[\ln\left(G_{it+1}\right) - \ln\left(G^*_{it+1}\right)\right] \quad (13)$$

- In equilibrium:

$$z_{it+1} = f_{t+1} + a_{it+1} + \varepsilon_{it+1} \quad (14)$$

Signal Jamming Mechanism

$$\ln\left(Y_{it+1}\right) = \frac{1}{1-\alpha_i}\left(f_{t+1} + a_{it+1} + \varepsilon_{it+1}\right) + \frac{\alpha_i}{1-\alpha_i}\ln\left(\frac{\alpha_i}{R}\right) + \ln\left(G_{it+1}\right)$$

- Central government cannot separate the effects of a_i and $\ln(G)$;
  - $\Rightarrow$ **Pretending to be smart** gives local official incentives to rise G.

Signal Jamming Mechanism

- Question: Why does this mechanism work when central government know local official will cheat them?

Signal Jamming Mechanism

- Using the **property of joint normal distribution** (see Appendix):

$$\begin{aligned}\hat{a}_{it+1} =& E\left[a_{it+1} \mid \{z_{it+1}\}_{i=1,\ldots,M}\right] \\ =& \bar{a}_i + h_1\left(z_{it+1} - \bar{z}_{it+1}\right) - h_2 \sum_{j\neq i}\left(z_{jt+1} - \bar{z}_{jt+1}\right) \\ =& \bar{a}_i + h_1\left[\left(f_{t+1} - \bar{f}\right) + \left(a_{it+1} - \bar{a}_i\right) + \varepsilon_{it+1} + (1-\alpha_i)\left(\ln G_{it+1} - \ln G^*_{it+1}\right)\right] \\ & - h_2 \sum_{j\neq i}\left[\left(f_{t+1} - \bar{f}\right) + \left(a_{jt+1} - \bar{a}_j\right) + \varepsilon_{jt+1} + (1-\alpha_j)\left(\ln G_{jt+1} - \ln G^*_{jt+1}\right)\right]\end{aligned}$$

  - $h_1 > 0$ and $h_2 > 0$ are parameters:

$$h_1 = \frac{\sigma_a^2\left(\sigma_a^2 + \sigma_\varepsilon^2 + (M-1)\sigma_f^2\right)}{\left(\sigma_a^2 + \sigma_\varepsilon^2\right)\left(\sigma_a^2 + \sigma_\varepsilon^2 + M\sigma_f^2\right)} \qquad h_2 = \frac{\sigma_a^2\sigma_f^2}{\left(\sigma_a^2 + \sigma_\varepsilon^2\right)\left(\sigma_a^2 + \sigma_\varepsilon^2 + M\sigma_f^2\right)}$$

Local Officials' Problem with Tournament

$$V(W_{it}) = \max_{G_{it+1}} E_t \left[\gamma \ln (W_{it} - G_{it+1}) + \chi_i (\hat{a}_{it+1} - \bar{a}_i) + \beta V(W_{it+1})\right]$$

- Take in above equations:

$$\max_{G_{it+1}} E_t \left[\gamma \ln (W_{it} - G_{it+1}) + \kappa_i \ln G_{it+1} + \beta V(W_{it+1})\right] \tag{15}$$

  - $\kappa_i = h_1(1-\alpha_i)\chi_i > 0$ is a parameter.

- Local Official's problem with tournament is defined as (15) with constraints (11), (12).

Tournament

Proposition 3: Infrastructure with Tournament

The officials' career concerns lead to greater infrastructure investment:

$$G_{it+1}^{\text{Tournament}} = \left[\frac{\kappa_i}{\gamma + \kappa_i}(1-\beta) + \beta\right](\tau Y_{it} + (1-\delta_G)\, G_{it})$$

Mechanism

- Selfish (or shortsighted) officials:

$$V\left(W_{it}\right)=\max_{E_{it}^{C}} E_t\left[\gamma \ln\left(E_{it}^{G}\right)+\beta V\left(W_{it+1}\right)\right]$$

$$G_{it+1}=\beta\left[\tau Y_{it}+\left(1-\delta_G\right)G_{it}\right]$$

- Social planner:

$$V\left(W_{it}^{\text{planner}}\right)=\max_{C_{it}^{t},C_{it}^{t-1},E_{it}^{G},G_{it+1}} E_t\left[\ln\left(C_{it}^{t}\right)+\ln\left(C_{it}^{t-1}\right)+\gamma \ln E_{it}^{G}+\beta V\left(W_{it+1}^{\text{planner}}\right)\right]$$

$$G_{it+1}^{\text{planner}}=\beta\left[Y_{it}+\left(1-\delta_G\right)G_{it}\right]$$

- Selfish officials with tournament:

$$V\left(W_{it}\right)=\max_{G_{it+1}} E_t\left[\gamma \ln\left(W_{it}-G_{it+1}\right)+\chi_i\left(\hat{a}_{it+1}-\bar{a}_i\right)+\beta V\left(\tau Y_{it+1}+\left(1-\delta_G\right)G_{it+1}\right)\right]$$

$$G_{it+1}^{\text{Tournament}}=\left[\frac{\kappa_i}{\gamma+\kappa_i}(1-\beta)+\beta\right]\left(\tau Y_{it}+\left(1-\delta_G\right)G_{it}\right)$$

Excess Leverage

- If we allowed the local government to borrow:

$$V(W_{it}) = \max_{G_{it+1}} E_t \left[\gamma \ln (W_{it} - G_{it+1}) + \chi_i (\hat{a}_{it+1} - \bar{a}_i) + \beta V(\tau Y_{it+1} + (1-\delta_G) G_{it+1})\right.$$

$$W_{it} = \tau Y_{it} + (1-\delta_G) G_{it} - RD_{it-1}$$

$$G_{it+1} + E_{it}^G = W_{it} + D_{it}$$

- The social planner's problem becomes:

$$V\left(W_{it}^{\text{planner}}\right) = \max_{G_{it+1}, C_{it}^t, C_{it}^{t-1}, E_{it}^G, D_{it}} E_t \left[\ln\left(C_{it}^t\right) + \ln\left(C_{it}^{t-1}\right) + \gamma \ln E_{it}^G + \beta V\left(W_{it+1}^{\text{planner}}\right)\right]$$

$$W_{it}^{\text{planner}} = Y_{it} + (1-\delta_G) G_{it} - RD_{it-1}$$

$$C_{it}^t + C_{it}^{t-1} + G_{it+1} + E_{it}^G = W_{it}^{\text{planner}} + D_{it}$$

Excess Leverage

Excessive Leverage of Officials

Both the officials and the social planner would choose a debt level of $d_{it} = D_{it}/G_{it+1}$ in interval $[0, (1-\delta_G)/R]$ based on problem:

$$\max_{d_{it}} \Psi \ln\left(\frac{1}{1-d_{it}}\right) + E_t\left[\ln\left(\tau\left(\frac{\alpha_i}{R}\right)^{\alpha_i/(1-\alpha_i)} A_{it+1}^{1/(1-\alpha_i)} + (1-\delta_G) - Rd_{it}\right)\right]$$

in which

$$\Psi^{\text{Planner}} = 1 \quad \leq \quad \Psi^{\text{Official}} = 1 + \frac{1-\beta}{\beta}\frac{\kappa_i}{\gamma+\kappa_i}$$

The officials debt choice is always higher than the planners and the officials debt choice is increasing with his career incentive parameter κ_i.

Excessive Leverage: Numerical Example

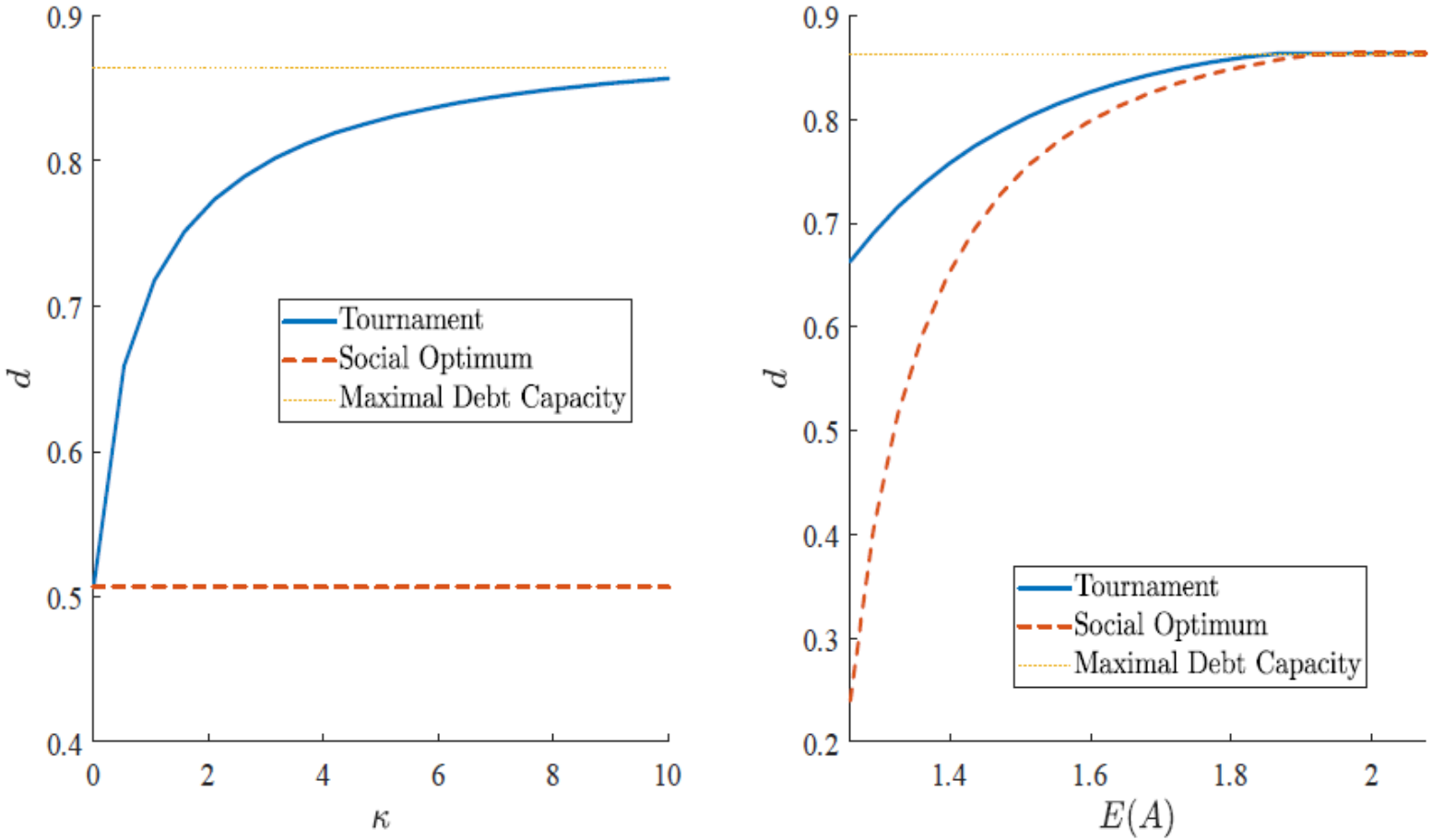

Figure 1: Leverage with Career Incentives and Expected Growth

Discussion

- Insights:
  - Theory of second best: use friction to correct friction;
  - Micro foundation: information friction in a bureaucratic system:
    - Why SOEs prefer to borrow and extend their scale;
    - *'Neijuan'*: e.g. *Ju Xiaolian* in Han Dynasty.

- Modeling simplification:
  - Technology A is not persistent $\Rightarrow$ forgettable past information;
  - All government investments are homogeneous and efficient;
  - Government are able to disinvest in infrastructure;
  - Partial equilibrium of small open economy;
  - No land market.

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Thanks for listening!