Macroprudential Policy Coordination with International Capital Flows

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Introduction

- Increasing interest and desire to implement macroprudential policy domestically (e.g., leverage limits, capital controls)
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- How should these policies be coordinated internationally?
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- How should these policies be *coordinated internationally*?
- In the absence of coordination, might countries over- or under-regulate?
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- We consider a 2-country, 2-good model following Brunnermeier and Sannikov (AEJ, 2015)
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  - Financial frictions in international equity markets
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Critical features:

- Competitive international markets for capital
- Financial frictions in international equity markets

Because of financial frictions, there is role for macroprudential policies to improve welfare.
Introduction

- Key mechanism: macroprudential regulation endogenously affects the stability—i.e., stationary distribution—of the global economy.
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- When both countries tighten, global economy is overall more stable

- But when one country tightens, that country is more stable, which gives it a benefit relative to the other

- Macroprudential “Beggar-thy-neighbor” policies: without coordination, countries have incentive to over-tighten
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Related Literature

- **Macro-finance:** Bernanke and Gertler (1989), Kiyotaki and Moore (1997)
Outline

- Model
- Characterizing Equilibrium
- Numerical Results
- Equilibrium Policies
Model
Setup, based on Brunnermeier and Sannikov (2015)

- Time is continuous and infinite
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- Two countries $A$ and $B$ that use capital to produce two intermediate consumption goods $a$ and $b$
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Setup, based on Brunnermeier and Sannikov (2015)

- Time is continuous and infinite
- Two countries A and B that use capital to produce two intermediate consumption goods $a$ and $b$
- Final consumption is Cobb-Douglas aggregate of goods $a$ and $b$

$$y_t = (y_t^a)^{1/2} (y_t^b)^{1/2}$$
Model
Setup, based on Brunnermeier and Sannikov (2015)

- Capital used to produce either good $a$ or $b$ using linear production technology
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- Country $A$ has productive advantage for good $a$ ($B$ for $b$)
- Given $k_t$ units of capital, can produce goods at rate:

  In Country $A$: \[ y^a_t = \bar{a}k_t > y^b_t = \underline{a}k_t, \]

  In Country $B$: \[ y^b_t = \bar{a}k_t > y^a_t = \underline{a}k_t \]
Model

Capital growth

- Productivity shocks modeled as shocks to capital directly, which evolves as a Brownian motion.
Model

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- Capital in country $I$ hit by exogenous, independent country-$I$ specific shocks
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$$\frac{dk_t}{k_t} = gdt + \sigma^I dZ^I_t,$$

where $dZ^I_t$ is a Brownian motion, and shocks $dZ^A_t$ and $dZ^B_t$ are independent and exogenous.
Model

Capital allocation

- Aggregate capital $K_t$ allocated across countries and across goods production
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- Aggregate supply of good $a$ and $b$ depend on capital allocations
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- Aggregate capital $K_t$ allocated across countries and across goods production
- Aggregate supply of good $a$ and $b$ depend on capital allocations
- Prices of goods $a$ and $b$ (terms of trade) depend on capital allocations
Capital trades in competitive international market—but financial frictions limit international credit flows to risk-free debt
Model
Markets

- Capital trades in competitive international market—but financial frictions limit international credit flows to risk-free debt
- Capital trades at unit price $q_t$ (i.e., $k_t$ units of capital cost $q_t k_t$), which evolves endogenously in equilibrium
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- Risk-free bond in zero net supply with endogenous return
Model

Financial frictions and macroprudential policy

- Due to un-modeled frictions, agents cannot issue equity in international markets (markets are incomplete across countries)
Model

Financial frictions and macroprudential policy

- Due to un-modeled frictions, agents cannot issue equity in international markets (markets are incomplete across countries)
- Regulations limit agents in country $I$ to leverage $L_t^I$ (leverage=debt/wealth)
Model

Agent preferences

- All agents have log utility with discount rate $\rho$
- Agents choose portfolio allocations across capital (with production type) and risk-free assets, subject to country-specific leverage constraints
Outline

▶ Model
▶ Characterizing Equilibrium
▶ Numerical Results
▶ Equilibrium Policies
Model
Equilibrium

Definition (Equilibrium)

Evolutions of capital allocations, capital price, and risk-free rate such that

1. All agents solve their optimal consumption and portfolio choice problems.
2. Capital, consumption, and debt markets clear.
Because countries cannot issue equity internationally, portfolio choices depend on level of wealth.

Hence, aggregate outcomes depend on relative wealth share in each country.
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Hence, aggregate outcomes depend on relative wealth share in each country.

Capital flows driven by aggregate wealth—countries borrow (inflows) when relatively poor.
Let $N_t$ be aggregate wealth of country $A$. State variable is

$$\eta_t \equiv \frac{N_t}{q_t K_t}$$

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Equilibrium consists of

1. Capital allocations and prices which are functions $\eta_t$
2. An endogenous law of motion for $\eta_t$
Equilibrium
Characterizing Equilibrium

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- Equilibrium consists of
  1. Capital allocations and prices which are functions $\eta_t$
  2. An endogenous law of motion for $\eta_t$

- Endogenous distribution of $\eta_t$ determines distribution of aggregate outcomes
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Numerical Results
Parametrization of key parameters

- Volatility of exogenous shocks: $\sigma^A = \sigma^B = 3\% \approx \text{volatility of TFP}$
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- Productivities: $\bar{a} = 1$ (normalization) and $a = 0.8 \ (25\% \text{ gains from trade})$
Numerical Results
Parametrization of key parameters

- Volatility of exogenous shocks: $\sigma^A = \sigma^B = 3\% \ (\approx \text{volatility of TFP})$
- Productivities: $\bar{a} = 1$ (normalization) and $a = 0.8$ (25% gains from trade)
- First solve with no prudential constraints
Numerical Results

Prices

(a) Capital price, $q_t$

(b) Terms of Trade: $P_a^t/P_b^t$
Numerical Results

Capital Holdings

(a) Capital held by country A, used for good $a$

(b) Country A Leverage
Numerical Results

Stationary Distribution of $\eta$: Economy is stable because terms of trade improve following bad shocks
Leverage regulation
Symmetric policy

- Now suppose countries choose symmetric leverage limits
- In aggregate, leverage limits are equivalent to limits on capital inflows
Leverage regulation
Symmetric policy

► Now suppose countries choose symmetric leverage limits
► In aggregate, leverage limits are equivalent to limits on capital inflows
► Consider \( L^A = L^B = L \in \{0.1, 0.5, 1\} \)
Symmetric leverage regulation


(a) Capital price, $q_t$

(b) Terms of Trade: $P_t^a/P_t^b$
Symmetric leverage regulation
Macroprudential Limits Improve Stationary Distribution of $\eta$

Economy more stable because prudential limits improve terms of trade hedge
Symmetric leverage regulation
Macroprudential Limits Improve Welfare

Figure: Welfare against the CDF transformation of $\eta$
Leverage regulation

Asymmetric policy

- Tighter symmetric policies lower capital prices and output but stabilize global system (similar tradeoff in Phelan, AEJ 2016)
Leverage regulation
Asymmetric policy

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- What are effects of *asymmetric* limits?
Leverage regulation
Asymmetric policy

- Tighter symmetric policies lower capital prices and output but stabilize global system (similar tradeoff in Phelan, AEJ 2016)
- What are effects of asymmetric limits?
- Main result: tighter regulation shifts stationary distribution toward other country
Asymmetric leverage regulation

Stationary Distribution of $\eta$: If $B$ tighter than $A$, $A$ is more likely to be relatively poor
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Coordinated regulation

Optimal policy

- Solve for optimal coordinated policy with
  1. Symmetric initial wealth $\eta_1 = 0.5$
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  2. Ex-ante expected welfare using equilibrium stationary distribution of $\eta$
Coordinated regulation

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- Then consider uncoordinated Nash equilibrium
Equilibrium policy

Fixed leverage limits, symmetric initial wealth.

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<th>$L^A$</th>
<th>$L^B$</th>
<th>$V^{A+B}(0.5)$</th>
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<td>0.0728</td>
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<td>Nash Eq’m</td>
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<tr>
<td>Competitive Eq’m</td>
<td>–</td>
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<td>-44.88</td>
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- Uncoordinated policy tighter than coordinated social optimum
Equilibrium policy

Fixed leverage limits to maximize ex-ante welfare.

<table>
<thead>
<tr>
<th></th>
<th>$L^A$</th>
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<th>$\mathbb{E}[V^{A+B}(\eta)]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social optimum</td>
<td>.0387</td>
<td>.0387</td>
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<tr>
<td>Nash Eq’m</td>
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<td>Competitive Eq’m</td>
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- Uncoordinated policy tighter than coordinated social optimum
Policy coordination

Results with fixed limits

“Beggar-thy-neighbor” result is quite robust varying $a$ and $\sigma$
Policy coordination

Results with fixed limits

- “Beggar-thy-neighbor” result is quite robust varying $a$ and $\sigma$
- We also consider counter-cyclical policy, with analogous results (Nash is tighter)
Conclusion

- Macroprudential regulation, when effective, increases economic stability.
- When international credit markets are imperfect, more stable countries are more likely to be relatively wealthy compared to less stable countries.
- As a result, tight macroprudential policy in one country provides strategic incentives for tight policy in the other.