International Capital Controls

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Motivation

Recent developments:

- Low rates in Advanced Economies
- Capital flows to Emerging Market Economies
- EME’s are concerned, e.g. Brazil
- US reduces QE
- Large outflows from EME’s, exchange rate instability
- Where do these funds end up?
- Could they be contributing to imbalances in recipient countries?
What we do

- We build a general equilibrium model with two regions and global investor

- Due to market incompleteness (collateral constraints) there is a possibility for overborrowing in recipient country

- Debt sensitive interest rates further increase vulnerability during crises
What we find

- Optimal to tax capital inflows ex ante (before crisis)

- Optimal tax rate declines during crisis and increases gradually after crisis
Model Structure

General equilibrium production-based asset pricing model:

- Two countries borrow from a global investor
- Debt is constrained by collateral (capital stock)
- Global interest rate is debt elastic
- Crisis is modelled as a low probability i.i.d. TFP shock
## Related Literature

<table>
<thead>
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<td>Sectors</td>
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<td>2</td>
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<tr>
<td>Interest rate</td>
<td>Increasing</td>
<td>Fixed</td>
<td>Increasing</td>
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<td>Instrument</td>
<td>debt tax</td>
<td>debt tax</td>
<td>debt tax</td>
<td>FX interv</td>
</tr>
<tr>
<td>Tax Rate</td>
<td>1.9%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>1.5%</td>
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</tbody>
</table>
Model Structure: Country $i = 1, 2$

Takes interest rate $R_t$ as given

$$\max_{c_t^i, x_t^i, b_{t+1}^i} E_0 \sum_{t=0}^{\infty} \frac{\beta^t}{1 - \sigma} \left( c_t^i - \theta \frac{h_t^{1+\gamma}}{1 + \gamma} \right)^{1-\sigma}$$

$$c_t^i + x_t^i + b_t^i - \frac{b_{t+1}^i}{R_{t+1}} = z_t^i k_t^i h_t^{1-\alpha}$$

$$k_{t+1}^i = k_t^i \left[ 1 - \delta + \Phi \left( \frac{x_t^i}{k_t^i} \right) \right]$$

$$\frac{b_{t+1}^i}{R_{t+1}} \leq \phi p_t^i = \phi q_t^i k_{t+1}^i$$

$$z_t^i = \begin{cases} 
    z_H & \text{with prob. } 1 - \pi \\
    z_L & \text{with prob. } \pi
\end{cases}$$
Model Structure: Global Investors

Interest rate is linearly increasing in debt:

\[ R_{t+1}(b^1_{t+1} + b^2_{t+1}) = \frac{(1 + \beta)(b^1_{t+1} + b^2_{t+1}) + e_2}{\beta e_1} \]

results from two period OLG problem of a global investor who smoothes endowment income \( e_1 > e_2 \) by saving \( b_{t+1} \):

\[
\max_{b_{t+1}} \quad U = \log(c_t) + \beta \log(c_{t+1}) \\
\]

\[
c_t + \frac{b_{t+1}}{R_{t+1}} = e_1, \quad c_{t+1} = e_2 + b_{t+1} \\
b_{t+1} = b^1_{t+1} + b^2_{t+1}
\]
Collateralized borrowing constraint allows for financial amplification effects:

- In booms, asset prices and borrowing capacity are high. Countries accumulate debt and expand the stock of capital. The price of capital rises, enabling economies to take on more credit.

- In busts, exogenous productivity shock triggers the constraint causing Fisherian debt deflation – a self-reinforcing feedback loop of declining asset prices, deteriorating balance sheets, and contracting economic activity.
Financial amplification entails credit externality:

- In booms, individuals do not internalize the fact that by borrowing more they are inflating asset prices.

- In busts, borrowers are unable to internalize negative effects of fire sales on collateral prices and aggregate financial fragility of the economy.
Model Dynamics: Contagion

Credit externality causes contagion:

- Deleveraging in a country affected by a bust leads to decline in global interest rate

- Other previously healthy economies over-borrow and become more vulnerable to future busts

- Risk of serial financial crises increases
Constrained Social Planner

- Takes interest rates as given
- Faces same collateral constraint, but
- Internalizes the effect of borrowing on asset prices

\[
\frac{b_{t+1}^i}{R_{t+1}} \leq \phi p_t^i(b_t^i) (\mu_t^i \lambda_t^i)
\]
Comparing Euler equations

Decentralized Equilibrium:

\[ u_{c,i}(1 - \lambda_i) = \beta R'E[u'_{c,i}] \]

Planner’s Equilibrium:

\[ u_{c,i}(1 - \lambda_i) = \beta R'E \left[ u'_{c,i} \left(1 + \phi \lambda'_i \frac{\partial p'_i}{\partial b'_i} \right) \right] \]

Interpretation of externality term:

- \( \frac{\partial p'_i}{\partial b'_i} \) captures asset price increase resulting from higher debt
- \( \phi \) reflects resulting relaxation in borrowing constraint
- \( u'_{c,i} \lambda'_i \) represents utility cost of constraint
Implementation of Optimal Regulation

Policymaker levies a state-contingent tax $\tau_i$ on collateralized borrowing from abroad

$$c^i_t + x^i_t + b^i_t - (1 - \tau^i_t)\frac{b^i_{t+1}}{R_{t+1}} = z^i_t(k^i_t)^\alpha (h^i_t)^{1-\alpha} + T^i_t$$

The debt tax introduces a wedge in the Euler equation:

$$u^i_{c,t}(1 - \lambda^i_t - \tau^i_t) = \beta R_{t+1}E[u^i_{c,t+1}]$$

and replicates the constrained social optimum if it is set to

$$\tau^i_t = \phi \beta R_{t+1} E \left[ u^i_{c,t+1} \lambda^i_{t+1} \frac{\partial p^i_{t+1}}{\partial b^i_{t+1}} \right] / u^i_{c,t}$$
Capital Inflow Taxation

- Macro-prudential policy aimed at reducing the inflow of excessive financial capital into the country by imposing a tax on foreign borrowing

- Unlike transactional Tobin’s tax on the flow of foreign capital, our tax is on the stock of foreign debt
First-order conditions of social planner:

**Debt**: \( u_{c,i}(1 - \lambda_i) = \beta R' E \left[ u'_{c,i} \left( 1 + \phi \lambda_i \frac{\partial p'_i}{\partial b'_i} \right) \right] \)

**Capital**: \( u_{c,i}(1 - \phi \lambda_i) = \beta E \left[ u'_{c,i} \frac{p'_i + \alpha y'_i - x'_i}{p_i} \right] \)

**Investment**: \( q_i = \left[ \Phi' \left( \frac{x_i}{k_i} \right) \right]^{-1} \)

**Labor**: \( \theta h_i^{\alpha} = (1 - \alpha) z_i \left( \frac{k_i}{h_i} \right)^{\alpha} \)

Solved by two-dimensional extension of endogenous grid method.
## Parameterization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>$\alpha$</td>
<td>Capital share</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Time discount rate</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Relative risk aversion</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Leverage ratio</td>
</tr>
<tr>
<td>$1/\gamma$</td>
<td>Frisch elasticity</td>
</tr>
<tr>
<td>$\theta$</td>
<td>36% labor supply</td>
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<tr>
<td>$\xi$</td>
<td>Elasticity of I/K to Tobin’s q</td>
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<tr>
<td>$y_H$</td>
<td>Output in booms</td>
</tr>
<tr>
<td>$z_{L}/z_H$</td>
<td>Productivity decline during crisis</td>
</tr>
<tr>
<td>$\pi$</td>
<td>Probability of crisis</td>
</tr>
</tbody>
</table>
Interest Rate Function

![Graph showing the interest rate function with debt, b, on the x-axis and interest rates on the y-axis, with Steady State points labeled R(b, z_L) and R(b, z_H).]
Simulation 1

Compare two scenarios:

- **Baseline:**
  - Country 1: shock in period $t = 4$.
  - Country 2: no shocks.

- **Contagion:**
  - Country 1: shock in period $t = 4$.
  - Country 2: shock in period $t = 2$. 
Simulation 1: Impulse Responses

solid - baseline scenario: one shock at \( t=4 \) in country 1

dashed - contagion scenario: baseline + shock at \( t=2 \) in country 2
Simulation 1: Optimal tax rate
## Simulation 1: Results

<table>
<thead>
<tr>
<th>% change</th>
<th>Baseline</th>
<th>Contagion</th>
<th>Baseline+Tax</th>
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<tbody>
<tr>
<td>Consumption</td>
<td>-13.7</td>
<td>-15.4</td>
<td>-12.1</td>
</tr>
<tr>
<td>Asset price</td>
<td>-29.7</td>
<td>-34.6</td>
<td>-25.0</td>
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<tr>
<td>Investment</td>
<td>-12.9</td>
<td>-15.2</td>
<td>-10.6</td>
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<tr>
<td>Capital</td>
<td>-1.2</td>
<td>-1.6</td>
<td>-1.0</td>
</tr>
<tr>
<td>Interest rate, %</td>
<td>2.7</td>
<td>1.2</td>
<td>1.5</td>
</tr>
<tr>
<td>CA/GDP reversal, %</td>
<td>5.0</td>
<td>6.2</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Simulation 2

Consider $t + 1$ scenarios:

- Scenario 0: Simultaneous shock in both countries
- Scenario $t > 0$: Domestic shock occurs $t$ periods after foreign shock

Compare immediate impulse responses in two equilibriums:

- Free market
- Social planner
Simulation 2: Impulse Responses

Domestic shock is delayed $t$ periods after a foreign shock. solid - social planner, dashed - free market.
Simulation 2: Impulse Responses

Domestic shock is delayed \( t \) periods after a foreign shock. solid - social planner, dashed - free market.
Conclusion

- Capital inflow taxation can prevent emerging economies from running large current account deficits that could jeopardize macroeconomic stability and overvaluation of asset prices.
- Social planner should impose a tax on foreign borrowing in the amount of 1.5%.
- Optimal taxation reduces consumption drop from 13.7% to 12.1% after crisis.
- Optimal taxation reduces current account reversal from 5% to 3% of GDP.
Further Research

- Add non-tradable sector to study the ex-post foreign exchange interventions as in Benigno et al. (2012) to address concerns about currency appreciation during booms and sudden depreciation during busts