Reserve Accumulation, Growth and Financial Crises

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Research questions

 ► What explains the spectacular accumulation of foreign exchange reserves in developing countries?

 ► Why do we observe a positive relationship between growth and current account surpluses?
Reserve accumulation in developing countries
GDP growth and current account (1980-2010)
GDP growth and reserve accumulation (1980-2010)
Empirical evidence

- Private inflows correlate positively with growth, while the opposite is true for public inflows (Gourinchas and Jeanne (2011), Alfaro, Kalemli-Ozcan and Volosovych (2011))

- These facts are hard to reconcile with the neoclassical growth model

- In the neoclassical growth model:
  - Faster growth is associated with higher capital inflows
  - The competitive equilibrium is efficient, hence no role for public intervention in capital flows
Our contribution

- We develop a theory of public intervention in capital flows

- Key elements:
  - Knowledge externalities in the tradable sector
  - International borrowing constraint

- The combination of these two elements provides an incentive for the government to accumulate reserves in order to stimulate growth
Our contribution (cont’d)

- Accumulation of reserves is associated with exchange rate undervaluation and faster growth
- Financial frictions create imperfect substitutability between private and public capital flows
- The possibility of using reserves during crises amplifies the positive relationship between reserve accumulation and growth
- The welfare gains from an appropriate reserve policy are substantial
- Model consistent with negative correlation between foreign aid and growth
Related literature

- **Theories of reserve accumulation:** Durdu et al. (2010), Jeanne and Ranciere (2011), Dooley et al. (2003), Aizenman and Lee (2007), Rodrik (2009), Korinek and Serven (2010)

Plan of the talk

- Model
- Explanation of the mechanisms
- Reserve management in an economy opening to capital flows
- Welfare
Model

- Small open economy

- Two sectors: tradable and non-tradable

- Households, firms, foreign investors, government
Households

- Expected lifetime utility

\[ E_0 \left[ \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma} \right] \]

- Consumption aggregator

\[ C_t = \left( C_t^T \right)^\omega \left( C_t^N \right)^{1-\omega} \]

- Supply inelastically one unit of labor during each period

- Budget constraint

\[ C_t^T + P_t^N C_t^N = W_t + \Pi_t^T + \Pi_t^N \]
Real exchange rate and non-tradable sector

- Real exchange rate

\[ P_t^N = 1 - \omega \frac{C_t^T}{\omega C_t^N} \]

- Firms in the non-tradable sector maximize

\[ \Pi_t^N = P_t^N (L_t^N)^{\alpha_N} - W_t L_t^N \]
Firms: tradable sector

- Produce using labor $L^T_t$, imported inputs $M_t$ and knowledge $X_t$

$$Y^T_t = (X_t L^T_t)^{\alpha_T} M_t^{1-\alpha_T}$$

- Dividends

$$\Pi^T_t = Y^T_t - W_t L^T_t - P^M M_t - B_{t+1} + RB_t - T_t$$

- Firms maximize

$$E_0 \left[ \sum_{t=0}^{\infty} \beta^t \lambda_t \Pi^T_t \right]$$
Working capital

- Working capital requirement: a fraction $\phi$ of the imported inputs has to be paid before production takes place

$$\phi P^M M_t = D_t^G + D_t^P$$

- work. cap. requirement
- gov. loans
- loans from foreign investors

- We assume a zero interest rate on intraperiod loans
Borrowing constraint

- To prevent defaults foreign investors impose the borrowing limit

\[-RB_t + D_t^P \leq \kappa_t X_t\]

- bonds maturing in period $t$
- intratemporal loan at time $t$
- credit shock

- Binding borrowing constraint interferes with:
  - Consumption smoothing
  - Import of intermediate goods
Knowledge accumulation

- Knowledge evolves according to

\[ X_{t+1} = \psi X_t + M_t^\xi X_t^{1-\xi} \]

- This is meant to capture spillovers of foreign knowledge through the imports of intermediate goods

- **Externality:** since knowledge is non-excludable firms do not internalize the impact of their actions on the future stock of knowledge
Discussion of growth process

- **Cross-country knowledge spillovers**: Klenow and Rodriguez-Clare (2005)


- ** Tradable sector as engine of productivity convergence**: Rodrik (2012)

- **Knowledge externalities**: Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992)
Government

- Collects taxes to finance reserve accumulation
- Uses reserves to provide working capital loans to firms (efficiency loss as in Gertler and Karadi (2009))

\[ FX_{t+1} = R^{FX} FX_t + T_t - D_t^G \frac{\theta}{1 - \theta} \]

- Reserves cannot be negative and pay a return lower than the world interest rate
Market clearing

- Tradable good

\[ C^T_t = Y^T_t - P^M M_t - B_{t+1} + RB_t - FX_{t+1} + R^{FX} FX_t - D^G_t \frac{\theta}{1 - \theta} \]

- Non-tradable good

\[ C^N_t = Y^N_t \]

- Labor

\[ L^T_t + L^N_t = 1 \]
Intervention - tranquil times

- When firms are not financially constrained an increase in reserves leads to a higher use of imported inputs and faster growth
  - Increase in the stock of reserves
  - Decrease in consumption of tradables
  - Real exchange rate depreciation
  - Wages decrease and firms in tradable sector employ more labor
  - Use of imported inputs increases
  - Faster accumulation of knowledge

- Focus on reserve accumulation rules of the form

\[ FX_{t+1} - R^{FX} FX_t = \chi Y_t^T \]
Intervention - tranquil times \( (FX_{t+1} - R^{FX} FX_t = \chi Y_t^T) \)
Intervention - crises

- When firms are financially constrained

\[ M_t = \frac{X_t \kappa_t + R B_t + D_t^G}{\phi P M} \]

- Government can increase the use of imported inputs by using foreign exchange reserves to finance working capital

- We assume that the government uses at most a fraction \( \chi^{WK} \) of its stock of reserves to finance working capital
Intervention - crises (cont’d)

- Credit shock
- GDP
- Imported inputs
- Real exchange rate
- Private foreign debt
- Foreign exchange reserves

- Lines represent: with intervention, w/o intervention

Time: 0, 0.2, 0.4, 0.6, 0.8, 1

Values: 5, 10, 15
To illustrate the properties of the model we look at the impact of policy on an economy that it is opening to capital flows (i.e. $B_0 = FX_0 = 0$)

1. We look at the effect on growth and capital flows by comparing an economy without intervention to one with the optimal policy rule ($\chi = 0.09, \chi^{WK} = 1$)

2. We compute the welfare gains from policy intervention

We assume two possible realizations for the credit shock

$k_H > k_L$
## Calibration

Table 1: Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Risk aversion</td>
<td>$\gamma$</td>
<td>2</td>
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<tr>
<td>Interest rate on private borrowing</td>
<td>$R$</td>
<td>1.04</td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\beta$</td>
<td>$1/R$</td>
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<tr>
<td>Labor share in output in tradable sector</td>
<td>$\alpha_T$</td>
<td>0.65</td>
</tr>
<tr>
<td>Labor share in output in non-tradable sector</td>
<td>$\alpha_N$</td>
<td>0.65</td>
</tr>
<tr>
<td>Share of tradable goods in consumption</td>
<td>$\omega$</td>
<td>0.341</td>
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<tr>
<td>Price of imported inputs</td>
<td>$P^M$</td>
<td>1</td>
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<tr>
<td>Borrowing limit</td>
<td>$\kappa_L$</td>
<td>0.1</td>
</tr>
<tr>
<td>Probability of bad credit shock</td>
<td>$1 - \rho_H$</td>
<td>0.1</td>
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<tr>
<td>Probability of exiting bad credit shock</td>
<td>$1 - \rho_L$</td>
<td>0.5</td>
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<tr>
<td>Working capital coefficient</td>
<td>$\phi$</td>
<td>0.33</td>
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<tr>
<td>Elasticity of TFP w.r.t. imported inputs</td>
<td>$\xi$</td>
<td>0.15</td>
</tr>
<tr>
<td>Constant in knowledge accumulation process</td>
<td>$\psi$</td>
<td>0.34</td>
</tr>
<tr>
<td>Interest rate on reserves</td>
<td>$R^{FX}$</td>
<td>1</td>
</tr>
<tr>
<td>Efficiency of government intervention during crises</td>
<td>$\theta$</td>
<td>0.5</td>
</tr>
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</table>
Reserve management, growth and capital flows

- Private NFA/GDP
- Reserves/GDP
- Current account/GDP
- Knowledge growth
- Probability binding constraint
- GDP
- Consumption of tradables
- Consumption of nontradables
- Real exchange rate

No intervention
Optimal policy
Social planner

- The social planner does not accumulate reserves
- The first best can be replicated by subsidizing the purchase of intermediate inputs
- Subsidies to exporters can conflict with trade agreements
- Reserve accumulation can be used to circumvent the restrictions imposed by trade agreements
Foreign aid

- Government receives debt $Z_{t+1}$ from foreign donors and rebates $H_t$ to households

$$Z_{t+1} = Z_t + H_t.$$  

- Inflows of foreign aid appreciate the real exchange rate and lead to slower growth
Foreign aid (con’td)

Private NFA/GDP

Public debt/GDP

Current account/GDP

Knowledge growth

Prob. binding constraint

GDP

Tradable consumption

Non-tradable consumption

Real exchange rate

Years since liberalization
Conclusions

▶ We provide a novel framework able to reproduce the positive correlation between reserve accumulation, current account surplus and growth observed in the data

▶ Future research:
  ▶ Interaction between reserve management and capital controls
  ▶ Global imbalances and reserve accumulation