

Precaution Versus Mercantilism: Reserve Accumulation, Capital Controls, and the Real Exchange Rate

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Motivating Questions

How does a nation's external asset affect its real exchange rate, and other macroeconomic variables?

- Traditional answer (Hume) is
higher NFA \implies higher RER & lower TBs
- Standard evidence: seminal work by **Lane and Milesi-Ferretti (2004)**

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Might this view be incomplete?

- New assumptions: role of **government** and its motives
- Some NFA wealth is not held by private sector, **reserves**
- Gov. may have motives to prefer buffer stock \uparrow (insurance/“precaution”)
- Gov. may have motives to prefer TB \uparrow (externality/“mercantilism”)

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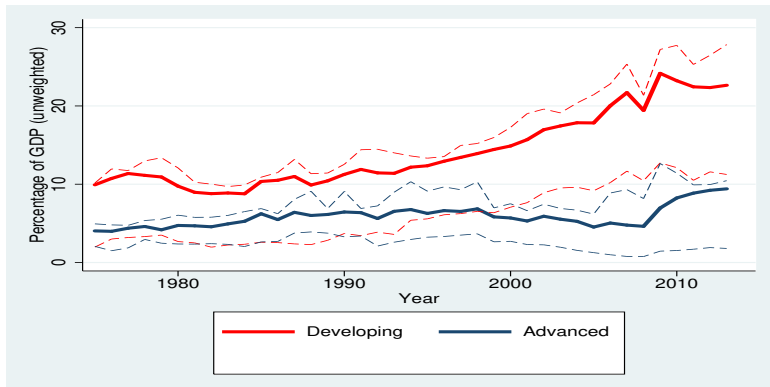
What does this paper do?

- **Break the simple association between NFA and RER**
- Revisit/extend the LMF results with evidence that $NFA \times R \neq RSRV$
- Optimal policy on 2 dimensions will require 2 instruments
- Present **a theoretical model of capital controls and reserve accumulation**
- Overall, effect of **capital account policy**

Reserve Accumulation: Facts

One of the most striking phenomena in global macro for last two decades.

- By 2011 global reserves exceeded \$10 trillion (14% of World GDP).
- Large increase concentrated in developing countries.



Avg. Reserve Accumulation / GDP (Source : IMF IFS)

Reserves Accumulations: Rationales

In theories of reserve accumulation, two motives are usually considered separately:

Mercantilist motive

- (Net) export in mfg. increases productivity (learning-by-doing externality).
- Amassing reserves devalues real exchange rate, boosts mfg. exports.
- Aizenman and Lee (2007), Jeanne (2013), Benigno and Fornaro (2012), Korinek and Servén (2016).

Precautionary motive

- Precautionary stockpiling as an insurance against BOP/financial crisis.
- Amassing reserves creates buffer for using in a sudden stop/flight.
- Obstfeld, Shambaugh and Taylor (2010), Jeanne and Ranciére (2011), Bianchi, Hatchondo, and Martinez (2016).

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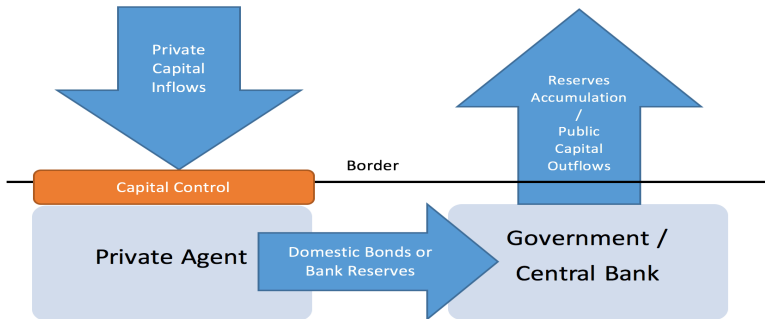
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We construct a simple integrated theoretical framework to account for real exchange rate determination incorporating **BOTH** views in one model.

We compare the predictions of the model to our data driven empirical findings.

Reserves, Capital Flows, and Current Account

Capital account policy



- If private agents (correctly) perceive reserves as their wealth, no decrease in current consumption (Ricardian Equivalence).
- To offset → capital account restriction.
- Thus, **reserves + capital controls**

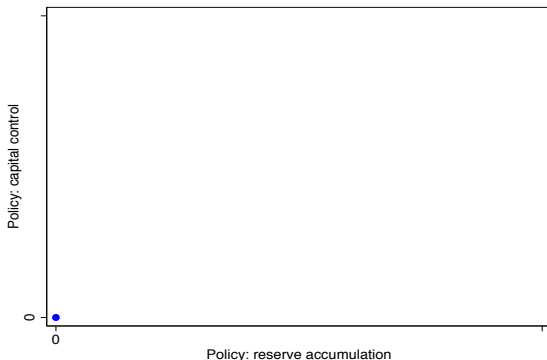
Preview: Model Intuition

Two distortions: financial crisis cost (ξ) and LBD externality (ν).

Two policy instruments: reserves ($rsrv$) and capital controls (tax indexed by κ).

Start from baseline: no financial crisis ($\xi = 0$), no LBD externality ($\nu = 0$).

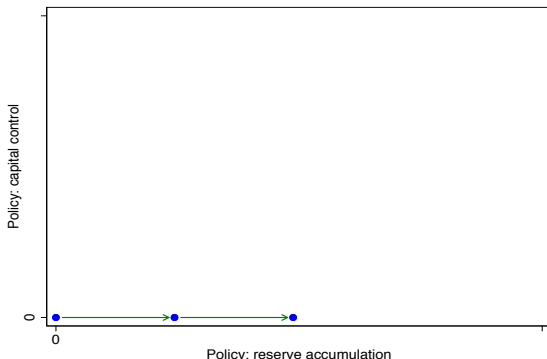
Laissez faire. Government chooses no reserves ($rsrv = 0$) and no capital controls ($\kappa = 0$), and so the laissez faire equilibrium (0,0) below is socially optimal.



Preview: Model Intuition

Deviate from baseline: increase crisis cost ($\xi \uparrow$), no LBD externality ($\nu = 0$).

Pure precautionary motive. Government increases reserves ($rsrv \uparrow$) but uses no capital controls ($\kappa = 0$), and the socially optimal equilibrium moves to the right.

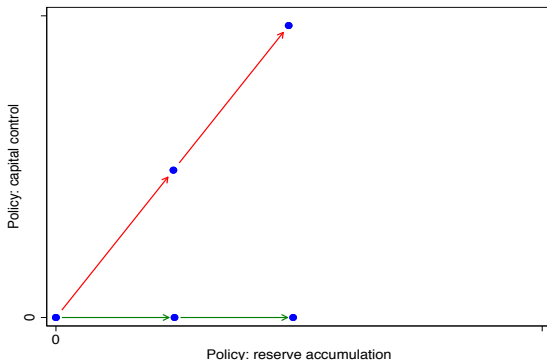


Preview: Model Intuition

Deviate from baseline: no financial crisis ($\xi = 0$), increase LBD externality ($\nu \uparrow$).

Pure mercantilist motive. Government increases reserves ($rsrv \uparrow$) and uses capital controls ($\kappa \uparrow$), and the socially optimal equilibrium moves up and right.

(Why? Ricardian equivalence, so controls are needed to ensure offsetting effects of private capital flows are only partial, then externality kicks in via $TB \uparrow$ and RER deval.)

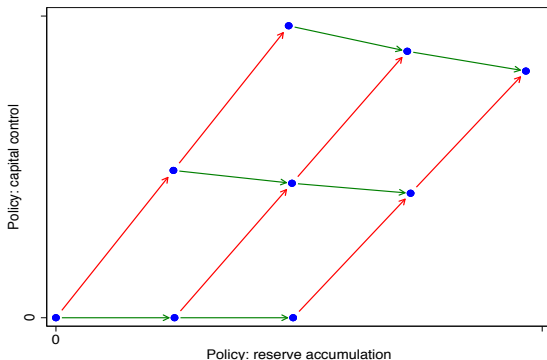


Preview: Model Intuition

Deviate more: when 2 distortions are present ($\xi \uparrow, \nu \uparrow$).

Policy tradeoff. Like before, but both policies are costly so there is a tradeoff when we are away from the extreme cases when only 0 or 1 distortions are present.

(Clearest for precautionary motive: when this rises, all else equal, the policymaker substitutes and the mercantilist motive is dialed back: reserves rise on net, but capital controls are relaxed)



Our Goal

Theory: **closed form** solutions for model with **2 motives** and **2 policy instruments**

- Capital account policies – reserve accumulations and capital controls.
- Mercantilist motive (export-driven growth, LBD externality).
- Precautionary motive (insurance against crisis).
- Also, a model of gross asset positions.

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Empirics: real exchange rate determination

- Relation between external assets ($NFA = NFA \times R + RSRV$) and RER;
 - positive association between $NFA \times R$ and RER (confirms previous findings)
 - negative association between RSRV and RER (new stylized fact)
- Role of capital controls (new stylized fact).

Additional empirics: trade balance, growth relationship consistent with theory

- association between capital account policies and trade surplus.
- association between capital account policies and growth of GDP / TFP.

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Effect of Capital Account Policy on RER, TB, and Growth

Real Exchange Rates : Definition

- Overall relative price level of a country,

$$RER^{CHN} = \frac{S \cdot P_{CHN}}{P_{Foreign}},$$

P_{CHN} is an overall price level (say, CPI) of China,

$P_{Foreign}$ is an overall price level of the foreign counterpart,

S is the nominal exchange rate (say, \$/RMB).

- When the level of **home price goes up** (P^{CHN} goes up),
RER goes up or appreciates.

Real Exchange Rates

Engel decomposition

$$RER_{CHN} = \frac{S \cdot P_{CHN}}{P_{Foreign}} = \frac{S \cdot (P_{CHN}^T)^\alpha (P_{CHN}^N)^{1-\alpha}}{(P_{Foreign}^T)^\alpha (P_{Foreign}^N)^{1-\alpha}},$$

Real Exchange Rates

Engel decomposition

$$\begin{aligned}
 RER_{CHN} &= \frac{S \cdot P_{CHN}}{P_{Foreign}} = \frac{S \cdot (P_{CHN}^T)^\alpha (P_{CHN}^N)^{1-\alpha}}{(P_{Foreign}^T)^\alpha (P_{Foreign}^N)^{1-\alpha}}, \\
 &= \underbrace{\left(\frac{P_{CHN}^N}{P_{CHN}^T} \right)^{1-\alpha}}_{\substack{\text{Home} \\ \text{Relative price of} \\ N \text{ to } T}} \cdot \underbrace{\left(\frac{S \cdot P_{CHN}^T}{P_{Foreign}^T} \right)}_{\substack{\text{Terms of Trade} \\ \text{Relative price of} \\ \text{Home } T \text{ to Foreign } T \\ = 1 \text{ if PPP holds}}} \cdot \underbrace{\left(\frac{P_{Foreign}^N}{P_{Foreign}^T} \right)^{\alpha-1}}_{\substack{\text{Foreign} \\ \text{Relative price of} \\ NT \text{ to } T \\ = \text{Constant}}}.
 \end{aligned}$$

Only looking at **long-run** relationships which the model speaks to (10 up to 30+ years).

I.e., what matters for medium / long-run movement of real exchange rate:

- Relative prices between sectors within a country matter,
- **NOT** deviations in Nominal Exchange Rate or from LOOP/PPP for tradables.

Empirics: Data

- 22 advanced countries and 53 developing countries, covering 1975 to 2007 (2011).
- Data Source : IFS-IMF, DOTS-IMF, External Wealth of Nations Mark II from Lane and Milesi-Ferretti (2007), Penn World Table (7,9), World Bank, OECD, and BIS Statistics, Barro and Lee (2013), Chinn and Ito (2008), Edwards (2007), Fernández, Klein, Rebucci, Schindler, and Uribe(2015), Quinn and Toyota (2008).
- We split the sample into subperiods (as in LMF(2004)):

| | | |
|-----------|---|----------|
| 1975–1985 | : | Period 1 |
| 1986–1996 | : | Period 2 |
| 1997–2007 | : | Period 3 |
| 2008–2011 | : | Period 4 |

Empirics: Dependent Variable and Controls

$$REER_{it} = \prod_{j \neq i} \left[\frac{P_i}{P_j} \right]^{W_{ij}}, \text{ where } W_{ij} = \text{ex+im trade share of } j \text{ with } i$$

$$NFAxR_{it} = \text{NFA net of Reserves}_{it} / \text{GDP}_{it}$$

$$RSRV_{it} = \text{Reserves}_{it} / \text{GDP}_{it}$$

$$TT_{it} = P^{ex} / P^{im}$$

$$YD_{it} = \prod_{j \neq i} \left[\frac{Y_i}{Y_j} \right]^{W_{ij}}$$

$$KAControl_{it} = -KAOPEN_{it} \quad (\text{Chinn-Ito measure})$$

$$KAClosed_{iT} = \text{Binary indicator based on } KAControl_{it} \text{ (g.t./l.t. median)}$$

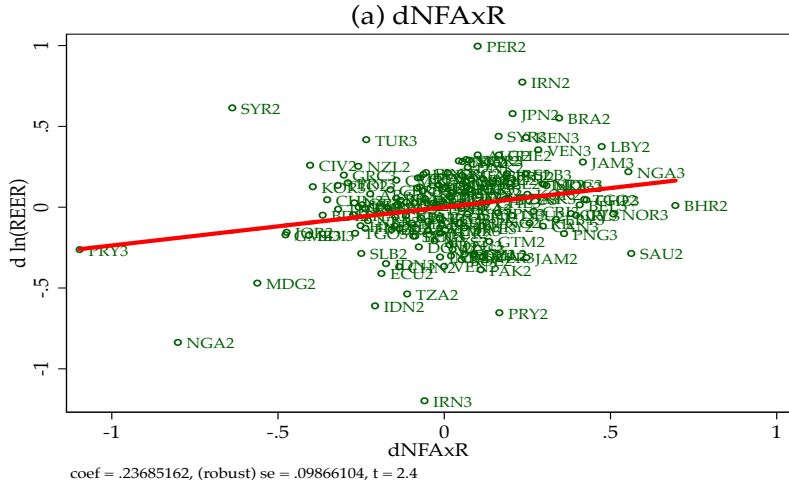
Empirics: REER / X-Sections / Period 123

Table 2: Determinants of the Real Effective Exchange Rate: Cross-Sectional Analysis

| Dependent variable: $\Delta \log(\text{REER})$ | Periods 12 (Average 86–96 minus Average 75–85) & 23 (Average 97–07 minus Average 86–96), Pooled Sample | | | | | |
|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------|--------------------|-----|----------------------|---------------------|
| | Full Sample | | Advanced Countries | | Developing Countries | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ΔNFAxR | 0.19* (1.84) | 0.24** (2.40) | -0.12 (-1.43) | NA | 0.20 (1.66) | 0.25** (2.17) |
| ΔRSRV | -0.89*** (-2.68) | 0.12 (0.35) | -0.01 (-0.02) | | -0.97** (-2.49) | -0.05 (-0.11) |
| $\Delta \text{RSRV} \times \text{KAClosed}$ | | -1.77*** (-3.77) | | | | -1.52*** (-2.81) |
| $\Delta \ln \text{YD}$ | 0.11 (0.98) | 0.10 (0.98) | 0.04 (0.28) | | 0.03 (0.26) | 0.02 (0.20) |
| $\Delta \ln \text{TT}$ | 0.07 (0.64) | 0.11 (1.02) | 0.34*** (2.87) | | 0.04 (0.31) | 0.07 (0.63) |
| Period23 Dummy | 0.10** (2.32) | 0.11*** (2.61) | -0.04 (-0.88) | | 0.20*** (3.43) | 0.19*** (3.40) |
| Observations | 150 | 150 | 44 | | 106 | 106 |
| Countries | 75 | 75 | 22 | | 53 | 53 |
| R^2 | 0.10 | 0.15 | 0.19 | | 0.13 | 0.17 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV}}$ | 0.00 | 0.76 | 0.82 | | 0.01 | 0.52 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV} \times \text{KAClosed}}$ | | 0.00 | | | | 0.00 |

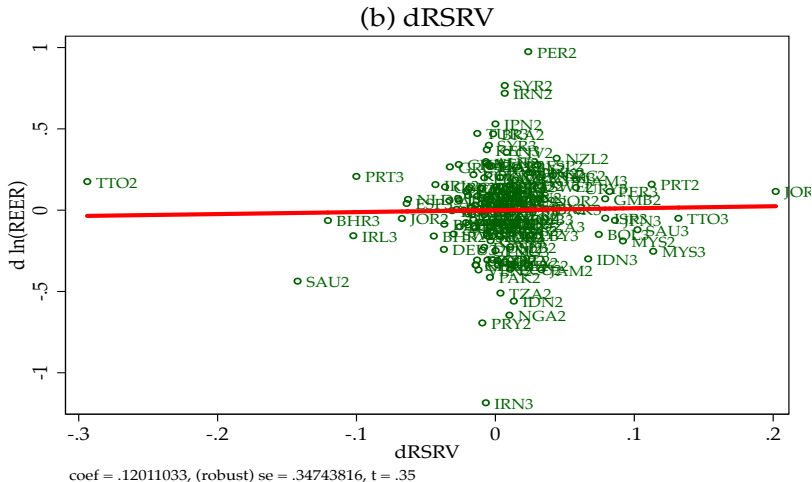
Empirics: REER / X-Sections / Period 123

Figure 1a: Real Exchange Rate Determination: Developing Countries, Period 123 (1975-2007)



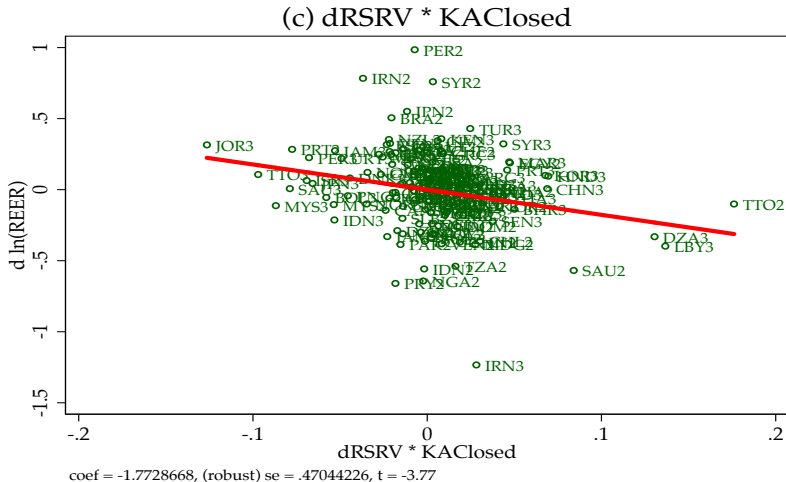
Empirics: REER / X-Sections / Period 123

Figure 1b: Real Exchange Rate Determination: Developing Countries, Period 123 (1975-2007)



Empirics: REER / X-Sections / Period 123

Figure 1c: Real Exchange Rate Determination: Developing Countries, Period 123 (1975-2007)



Empirics: REER / Panel / Period 123

Table 4: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects

| Dependent variable: log(REER) | Period 123 (1975–2007) | | | | |
|--------------------------------------------|------------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.17*** (2.74) | -0.03 (-0.63) | 0.19** (2.55) | 0.12 (1.56) | 0.21** (2.47) |
| RSRV | -0.98*** (-3.39) | 0.20 (0.63) | -0.89*** (-2.78) | -0.24 (-0.84) | -1.28*** (-3.88) |
| ln YD | 0.16** (2.10) | 0.05 (0.39) | 0.10 (1.28) | 0.22 (0.91) | 0.11* (1.86) |
| ln TT | -0.03 (-0.56) | 0.12 (1.54) | -0.06 (-0.90) | 0.06 (1.07) | -0.08 (-0.90) |
| Observations | 2,475 | 726 | 1,749 | 1,254 | 1,221 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R ² | 0.188 | 0.23 | 0.273 | 0.092 | 0.31 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.000 | 0.506 | 0.003 | 0.257 | 0.000 |

Notes: *, **, *** indicate significance at 10%, 5%, 1% levels. The REER increases when it appreciates.
t-statistics in parentheses based on heteroskedasticity consistent standard errors.

Empirics: REER / Panel / Period 12

Table 5: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects

| Dependent variable: log(REER) | Period 12 (1975–1996) | | | | |
|--------------------------------------------|-----------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.32*** (2.83) | 0.22* (1.74) | 0.30** (2.40) | 0.14 (1.39) | 0.42** (2.65) |
| RSRV | -0.48* (-1.75) | 0.38 (0.88) | -0.57** (-2.04) | -0.33 (-1.13) | -1.06*** (-2.95) |
| ln YD | 0.04 (0.31) | -0.10 (-0.37) | -0.05 (-0.35) | 0.42*** (2.85) | -0.21 (-1.51) |
| ln TT | 0.02 (0.36) | 0.13 (1.50) | -0.02 (-0.20) | 0.11 (1.42) | -0.06 (-0.55) |
| Observations | 1,650 | 484 | 1,166 | 836 | 814 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R ² | 0.158 | 0.26 | 0.25 | 0.24 | 0.209 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.020 | 0.725 | 0.016 | 0.164 | 0.001 |

Notes: *, **, *** indicate significance at 10%, 5%, 1% levels. The REER increases when it appreciates. *t*-statistics in parentheses based on heteroskedasticity consistent standard errors.

Empirics: REER / Panel / Period 23

Table 6: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects

| Dependent variable: log(REER) | Period 23 (1986–2007) | | | | |
|--------------------------------------------|-----------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.13** (2.21) | -0.07 (-1.57) | 0.17** (2.19) | 0.11** (2.06) | 0.23** (2.65) |
| RSRV | -0.90*** (-3.07) | -0.06 (-0.24) | -0.91** (-2.59) | -0.41* (-1.77) | -1.19*** (-3.33) |
| ln YD | 0.14* (1.69) | 0.05 (0.43) | 0.14 (1.50) | -0.10 (-0.57) | 0.19** (2.08) |
| ln TT | -0.18** (-2.38) | 0.11 (1.05) | -0.19** (-2.37) | -0.04 (-0.36) | -0.26*** (-3.00) |
| Observations | 1,650 | 484 | 1,166 | 836 | 814 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R ² | 0.174 | 0.17 | 0.21 | 0.067 | 0.267 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.001 | 0.986 | 0.003 | 0.033 | 0.000 |

Notes: *, **, *** indicate significance at 10%, 5%, 1% levels. The REER increases when it appreciates. *t*-statistics in parentheses based on heteroskedasticity consistent standard errors.

Other Specifications and Robustness

ALL ROBUST

Robustness :

- Continuous, instead of binary, measure of capital controls. [link](#)
- Without oil exporters. [link](#)
- Other REER measures. [link](#)
- Other capital control measures. [link](#)
- Crisis periods. [link](#)
- Dynamic OLS specification, incorporating possible cointegration between variables.

Basic Model: Exogenous Capital Account Policies

Develop a theory to account for new stylized facts from the empirical work.

Small open economy, 2 goods, 2 periods, 2 financial markets (domestic and int'l).

Infinitesimally small but identical agents.

Consumption good is

$$c_t = \left((\theta^T)^{\frac{1}{\sigma}} c_t^T^{\frac{\sigma-1}{\sigma}} + (\theta^N)^{\frac{1}{\sigma}} c_t^N^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}.$$

Utility maximization

$$\max_{\{c_{1,2}^T, c_{1,2}^N, d^*, a\}} \left\{ u(c_1) + \frac{1}{1+r^*} u(c_2) \right\},$$

where $u(\cdot)$ is standard CRRA utility function with risk-aversion parameter γ ,

Basic Model: Exogenous Capital Account Policies

subject to

$$\begin{aligned}c_1^T + p_1 c_1^N + a + \tau(d^*, \kappa) &\leq (1 + \omega)y^T + p_1 y^N + d^* + T_1, \\c_2^T + p_2 c_2^N + (1 + r^*)d^* &\leq (1 + \bar{g})y^T + p_2 y^N + (1 + r)a + T_2,\end{aligned}$$

where

c_t^T, c_t^N T and NT consumption

y^T, y^N T and NT endowment

p_t the price of the nontradable goods in period t

d^* external private debt

a domestic public asset (= reserves)

ω shock to initial level of wealth (endowment) of T sector

\bar{g} growth of future endowment of T sector

r^*, r international and domestic interest rates

$\tau(d^*, \kappa)$ “Pigouvian or Tobin” tax on d^* (indexed by policy κ)

T_t government lump-sum transfer (taxes are rebated)

Basic Model: Exogenous Capital Account Policies

Real exchange rate is

$$rer_t \equiv p_t.$$

The government budget constraint is

$$\begin{aligned} rsv^* + T_1 &\leq a + \tau(d^*, \kappa), \\ T_2 + (1+r)a &\leq (1+r^*)rsv^*, \end{aligned}$$

where rsv^* is the official external asset, that is reserve accumulation.

Assumption about tax function monotonicity and convexity.

Assumption 1

$$\begin{aligned} 1 > \tau_i(d^*, \kappa) &\geq 0 \quad \text{for } i = 1, 2, \\ \tau_{ij}(d^*, \kappa) &\geq 0 \quad \text{for } i, j = 1, 2. \end{aligned}$$

where $\tau_i(\cdot)$, $\tau_{ij}(\cdot)$ denote the partial derivative with respect to i th and j th arguments.

Basic Model: Exogenous Capital Account Policies

The feasible consumption sets are

$$\begin{aligned}c_1^T &= (1 + \omega)y^T - (rsrv^* - d^*), \\c_2^T &= (1 + g)y^T + (1 + r^*)(rsrv^* - d^*), \\c_1^N = c_2^N &= y^N.\end{aligned}$$

Note that $rsrv^*$ is *public* external assets, and $-d^*$ is *private* external asset.

The equilibrium conditions are then

$$\begin{aligned}\frac{\theta^N}{\theta^T} \frac{c_t^T}{c_t^N} &= p_t^\sigma = rer_t^\sigma, \quad \text{for } t = 1, 2; \\1 - \tau_1(d^*, \kappa) &= \frac{\lambda_2}{\lambda_1}, \\1 - \tau_1(d^*, \kappa) &= \frac{1 + r^*}{1 + r}.\end{aligned}$$

Note that τ_1 is a marginal tax rate, and λ_t is a Lagrangian multiplier.

Basic Model: Propositions - Standard Results

Standard wealth effect:

Proposition 1a

Given the level of reserve accumulation ($rsrv^$) and the degree of capital control parameter (κ), and increase in the current endowment of tradable goods (ω) will cause an appreciation of the current real exchange rate,*

$$\frac{\partial rer_1}{\partial \omega} \geq 0.$$

Proposition 1b

Given the level of reserve accumulation ($rsrv^$) and the degree of capital control parameter (κ), and increase in the current endowment of tradable goods (ω) will cause an increase in NFA ex. Reserves ($-d^*$)*

$$\frac{\partial (-d^*)}{\partial \omega} \geq 0.$$

Basic Model: Propositions - New Results

Reserve accumulation $rsrv^*$ as a fiscal instrument:

Proposition 2

Given current endowment (ω) and the degree of capital control index (κ), increasing reserve accumulation ($rsrv^$) will depreciate the current real exchange rate. That is,*

$$\frac{\partial rer_1}{\partial rsrv^*} \leq 0.$$

Capital control κ with $\tau_{12}(\cdot) \geq 0$:

Proposition 3

Given current endowment (ω) and reserve accumulation ($rsrv^$), increasing the degree of capital control index (κ) will depreciate the current real exchange rate. That is,*

$$\frac{\partial rer_1}{\partial \kappa} \leq 0.$$

Capital Account Policy and Trade Balance

Balance of Payment Accounting

$$\begin{aligned} & KA + ORT + CA \\ \equiv & KA + ORT + (TB + NI) \\ \equiv & 0. \end{aligned}$$

Then

$$\Delta NFA_{xR} + \Delta RSRV \approx \Delta TB.$$

[link](#)

Empirics: Trade Balance / Panel / Period 123

Trade Balances and Reserve Accumulations: Annual Panel with Fixed Effects

| Dependent variable: Net Exports | Period 123 (1975–2007) | | | | |
|-------------------------------------------------------|-------------------------|-----------------------|-------------------------|---------------------|-------------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFA _{xR} | 0.00 (0.22) | 0.06* (2.01) | -0.01 (-0.42) | 0.01 (0.30) | -0.00 (-0.12) |
| RSRV | 0.16** (2.16) | -0.25 (-1.40) | 0.20** (2.61) | 0.11 (1.03) | 0.24** (2.21) |
| Observations | 2379 | 705 | 1674 | 1211 | 1168 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R^2 | 0.08 | 0.30 | 0.09 | 0.08 | 0.10 |
| $p\text{-value: } \beta^{NFA_{xR}} \neq \beta^{RSRV}$ | 0.06 | 0.12 | 0.02 | 0.41 | 0.05 |

Notes: *, **, *** indicate significance at 10%, 5%, 1% levels. t -statistics in parentheses based on heteroskedasticity consistent standard errors.

Empirics: Trade Balance / Panel / Period 12

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| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFA _{xR} | -0.03 (-1.01) | 0.03 (1.22) | -0.04 (-1.16) | -0.02 (-0.26) | -0.03 (-1.18) |
| RSRV | 0.10 (0.96) | -0.05 (-0.26) | 0.11 (0.98) | 0.13 (0.87) | 0.09 (0.57) |
| Observation | 1574 | 463 | 1111 | 794 | 780 |
| Countries | 74 | 22 | 52 | 38 | 36 |
| R^2 | 0.04 | 0.23 | 0.05 | 0.05 | 0.05 |
| p-value: $\beta^{NFA_{xR}} \neq \beta^{RSRV}$ | 0.29 | 0.69 | 0.26 | 0.48 | 0.44 |

Notes: *, **, *** indicate significance at 10%, 5%, 1% levels. *t*-statistics in parentheses based on heteroskedasticity consistent standard errors.

Empirics: Trade Balance / Panel / Period 23

Trade Balances and Reserve Accumulations: Annual Panel with Fixed Effects

| Dependent variable: Net Exports | Period 23 (1986–2007) | | | | |
|-----------------------------------------------|--------------------------------|-----------------------|--------------------------------|---------------------|--------------------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFA _{xR} | 0.02 (0.86) | 0.04 (1.51) | 0.01 (0.57) | 0.00 (0.03) | 0.04 (1.55) |
| RSRV | 0.16** (2.00) | -0.31** (-2.81) | 0.20** (2.31) | 0.07 (0.82) | 0.25** (2.27) |
| Observations | 1600 | 480 | 1120 | 814 | 786 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R^2 | 0.07 | 0.25 | 0.09 | 0.09 | 0.10 |
| p-value: $\beta^{NFA_{xR}} \neq \beta^{RSRV}$ | 0.09 | 0.01 | 0.05 | 0.45 | 0.10 |

Notes: *, **, *** indicate significance at 10%, 5%, 1% levels. *t*-statistics in parentheses based on heteroskedasticity consistent standard errors.

Capital Account Policy and Trade Balance: Discussion

More than decade-long trade imbalances. Is it the nominal exchange rate?

- Staiger and Sykes (2008);
 - in the LR, nominal currency devaluation does not alter export price.
 - in the SR, its effect depends on firm's invoicing decision - LCP / PCP / DCP.

Our perspective

- Capital account policy persistently affects trade.
- Jeanne (2013), Korinek and Servén (2016).

Full Model: Endogenous Capital Account Policies

Endogenize capital account policies.

- Why does a government intervene?
- Or what can a government do/observe that private agents cannot do/observe?

Two motives for recent reserves increase,

- Precautionary motive : Crisis loss (ξ^T).
- Mercantilist motive : Export driven growth externality (ν).

Two policy instruments with two frictions,

- Liquid assets, assumed to be (marginally more) costly for private agents.
- Learning-by-doing externality from *aggregate* exports.

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- Liquid assets, assumed to be (marginally more) costly for private agents.
- Learning-by-doing externality from *aggregate* exports.

Closed form solutions for monotone mapping.

- ξ^T and $\nu \rightarrow rsv$ and κ (and implied rer).

Full Model: Endogenous Capital Account Policies : Setup

First period $t = 1$ is divided into two sub-periods;

- $t = 1- :$ Decision / contract for financial transaction.
- $t = 1+ :$ State realizes. Financial contract needs to be honored.

At $t = 1+$, crisis with fixed probability π ,

- Output loss : $\xi^T(\xi^N)$ share of in tradable (nontradable) endowments.
- Exclusion from international financial market.
- But government *rsrv* can be liquidated (at a cost η) if crisis occurs.

Full Model: Endogenous Capital Account Policies : Setup

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- Output loss : $\xi^T(\xi^N)$ share of in tradable (nontradable) endowments.
- Exclusion from international financial market.
- But government *rsrv* can be liquidated (at a cost η) if crisis occurs.

Learning by doing externality;

- $g = \bar{g} + g(ex_0, \nu)$, if no crisis,
- $\hat{g} = \bar{g}$, if crisis.

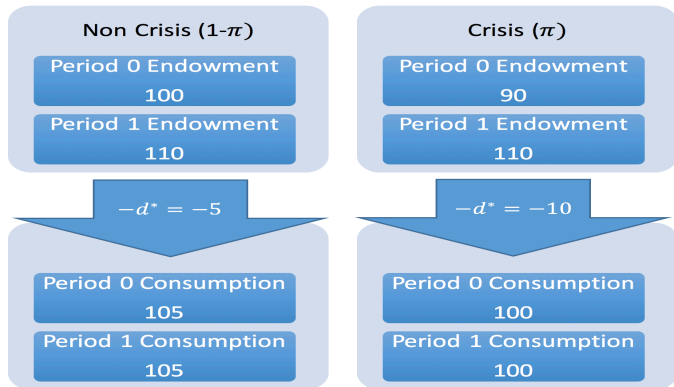
Full Model: Endogenous Capital Account Policies

Exercise I (Precautionary)

Turn OFF the **LBD** (ν), but **turn ON** the **crisis probability** (π),

$$\gamma = 1, \quad \sigma = 1 \quad y^T = 100, \quad \nu = 0, \quad \omega = 0, \quad \bar{g} = .1, \quad \xi = .1, \quad \pi \neq 0, \quad r^* = 0$$

w/o financial market exclusion



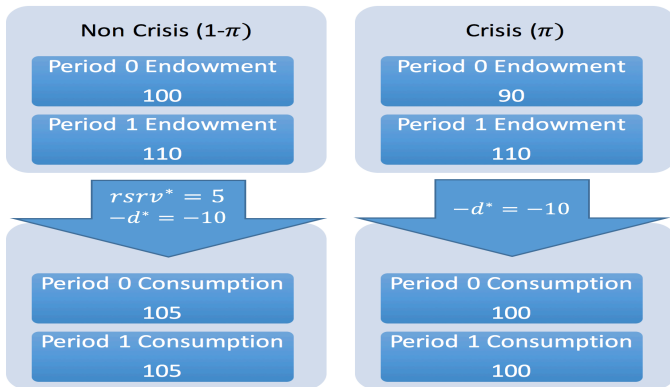
Full Model: Endogenous Capital Account Policies

Exercise I (Precautionary)

Turn OFF the **LBD** (ν), but **turn ON** the **crisis probability** (π),

$$\gamma = 1, \quad \sigma = 1 \quad y^T = 100, \quad \nu = 0, \quad \omega = 0, \quad \bar{g} = .1, \quad \xi = .1, \quad \pi \neq 0, \quad r^* = 0$$

w/ capital account policy



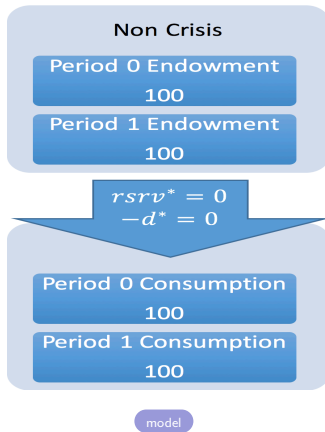
Full Model: Endogenous Capital Account Policies

Exercise II (Mercantilist)

Turn ON the **LBD** (ν), but **turn OFF** the **crisis probability** (π),

$$\gamma = 1, \quad \sigma = 1 \quad y^T = 100, \quad \nu = 0.1, \quad \omega = 0, \quad \bar{g} = 0, \quad \xi = 0.1, \quad \pi = 0, \quad r^* = 0$$

w/o capital account policy



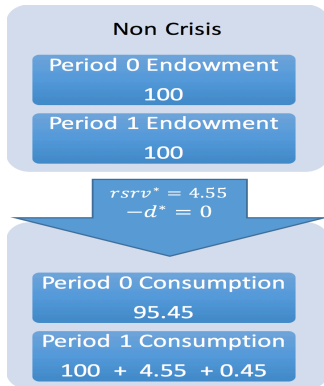
Full Model: Endogenous Capital Account Policies

Exercise II (Mercantilist)

Turn ON the **LBD** (ν), but **turn OFF** the **crisis probability** (π),

$$\gamma = 1, \quad \sigma = 1 \quad y^T = 100, \quad \nu = 0.1, \quad \omega = 0, \quad \bar{g} = 0, \quad \xi = 0.1, \quad \pi = 0, \quad r^* = 0$$

w/ capital account policy



Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Proposition 4

Fixing all other parameters, if an economy has a higher output loss in a crisis (ξ^T), optimal reserve accumulation increases while the real exchange rate is not affected.

$$\begin{aligned}\frac{\partial rsv^{*opt}}{\partial \xi^T} &= \frac{\partial d^{*opt}}{\partial \xi^T} > 0, \\ \frac{\partial rer_1^{opt}}{\partial \xi^T} &= 0.\end{aligned}$$

Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Proposition 5

Fixing all other parameters, if an economy has a higher growth externality (ν), optimal reserve accumulation increases while the real exchange rate is depreciated.

$$\begin{aligned}\frac{\partial rsv^{*opt}}{\partial \nu} &> 0, & \frac{\partial d^{*opt}}{\partial \nu} &= 0, \\ \frac{\partial rer_1^{opt}}{\partial \nu} &< 0.\end{aligned}$$

Full Model: Endogenous Capital Account Policies

Optimal Capital Account Policy

The **Optimal Capital Account Policy** is to set $rsrv^* = rsrv_1^{*opt}$, and optimal capital control κ satisfying

$$1 - \tau_1(d^{*opt}, \kappa) = \frac{(1 - \pi)\lambda_2^{*opt} + \pi\hat{\lambda}_2^{*opt}}{(1 - \pi)\lambda_1^{*opt} + \pi\hat{\lambda}_1^{*opt}}.$$

Theorem 1 (Precaution Versus Mercantilism)

All else equal, if an economy has a higher output loss in a crisis (ξ^T), the optimal degree of capital control decreases. And if an economy has a higher growth externality (ν), the optimal degree of capital control increases. That is,

$$\frac{\partial \kappa^{opt}}{\partial \xi^T} \leq 0, \quad \text{and} \quad \frac{\partial \kappa^{opt}}{\partial \nu} \geq 0.$$

Capital Account Policy and Growth

Capital account policy and growth.

- Is the policy statistically associated with growth?

Focus on period 23,

- Cross section and annual Panel.

[link](#)

Empirics: Capital Account Policy and Growth

Table 10: Cross Section: Capital Account Policy and Growth of Real GDP and TFP

| Dependent variable: | Period 2 and 3 (1986–2007) | | | |
|------------------------------------|----------------------------|------------------|---------------------|---------------------|
| | Real GDP per Capita Growth | | TFP Growth | |
| | All | w/o Oil | All | w/o Oil |
| | (1) | (2) | (3) | (4) |
| Δ RSRV | -0.65** (-2.02) | -0.54 (-1.01) | -0.47** (-2.37) | -0.61** (-2.48) |
| Δ RSRV \times KAClosed | 1.66*** (2.77) | 1.33* (1.80) | 0.59** (2.49) | 0.66** (2.37) |
| Initial Real GDP per capita or TFP | 0.06 (1.30) | 0.03 (0.59) | -0.54*** (-7.28) | -0.57*** (-6.04) |
| Schooling | 0.03** (2.24) | 0.03* (1.90) | 0.01 (1.43) | 0.01 (1.13) |
| Inst. Quality | -0.06 (-1.66) | -0.03 (-0.87) | 0.03*** (2.98) | 0.03* (1.80) |
| Trade Openness | 0.15*** (3.01) | 0.05 (0.57) | 0.01 (0.56) | 0.01 (0.27) |
| Credit to GDP | -0.00 (-0.33) | -0.00 (-0.09) | -0.00 (-0.77) | -0.00 (-0.32) |
| Terms of Trade (% change) | 0.09 (0.97) | 0.06 (0.63) | 0.03 (0.52) | -0.01 (-0.17) |
| Observations | 64 | 54 | 61 | 52 |
| Countries | 64 | 54 | 61 | 52 |
| R^2 | 0.39 | 0.29 | 0.70 | 0.69 |

Future Work

Capital account policies, sectoral productivity growth, and labor reallocation

- Choi and Pyun (2019)
- Effect of external capital account management on internal resource reallocation
- 1980–2012, 51 Advanced and Emerging countries
- The policy mix **increases labor productivity** only in **manufacturing** sector.
- The policy mix **increases** the **share of labor** and **rVA** in **manufacturing sector**.

Reserves and firm investment in Korea

- Choi, Pyun and Yun (work in progress)
- Korea, 1993–2017, KIS Value
- **Reserve crowds out firm investment**
 - especially when combined with high short-term debt
 - but not in exporting firms
- currently extend to incorporate with disaggregate bank balance sheet
- and extend to international firm with ORBIS dataset

Future Work(ctd)

(Level of) Reserve and forward premium

- Choi (work in progress)
- Datastream
- A country with **high reserves** tends to have **low forward premium** (low currency crash risk)
- High reserve negatively correlates with avg. carry, and NER skewness

Forward Premium

Conclusion

We provide new stylized facts.

- Capital account policy – reserves and capital controls – is associated with real exchange rate depreciation
- And it is more pronounced in developing countries over the last two decades.

We provide new guidance for real exchange rate determinations.

- The model incorporates both *Mercantilist* and *Precautionary* motives together.
- Embeds different rationale for private and public external asset holdings.
- Consistent with empirical evidence on NFA, reserves, RER, trade balance, and GDP growth.

Real Exchange Rates : Exercise

Simple Exercise

- $P_{CHN}^T = 10 \text{ yuan}$, $P_{CHN}^{NT} = 10 \text{ yuan}$, and $S = \frac{\$1}{10 \text{ yuan}}$.
- Law of one price holds; one T goods (say, an apple) is 10 yuan and \$1.
- 10 unit labor for one T goods and 10 unit labor for one NT goods.

$$RER_{CHN} = \left(\frac{10 \text{ yuan}^{NT}}{10 \text{ yuan}^T} \right)^{1-\alpha} \cdot \left(\frac{\$1}{10 \text{ yuan}} \right) \left(\frac{10 \text{ yuan}^T}{1 \$^T} \right) \cdot \bar{C}$$

- Now a technological progress in T sector.
- 5 unit labor for one T goods and 10 unit labor for one NT goods.

$$RER_{CHN} = \left(\frac{10 \text{ yuan}^{NT}}{5 \text{ yuan}^T} \right)^{1-\alpha} \cdot \left(\frac{\$1}{5 \text{ yuan}} \right) \left(\frac{5 \text{ yuan}^T}{1 \$^T} \right) \cdot \bar{C}$$

Reserve Accumulation : Balance Sheet Decomposition

We can decompose Net Foreign Asset (NFA)

$$\begin{aligned} &= \text{Total Foreign Assets} - \text{Total Foreign Liabilities} \\ &= (\text{FDIA} + \text{EQA} + \text{DEBTA} + \text{Reserve}) - (\text{FDIL} + \text{EQL} + \text{DEBTL}) \\ &= \text{Foreign Asset net of Reserve} - \text{Foreign Liabilities} + \text{RES} \\ &= \text{NFA}_{\text{X}} + \text{RES}. \end{aligned}$$

Reserve Accumulation : Balance Sheet Decomposition

We can decompose Net Foreign Asset (NFA)

$$\begin{aligned} &= \text{Total Foreign Assets} - \text{Total Foreign Liabilities} \\ &= (\text{FDIA} + \text{EQA} + \text{DEBTA} + \text{Reserve}) - (\text{FDIL} + \text{EQL} + \text{DEBTL}) \\ &= \text{Foreign Asset net of Reserve} - \text{Foreign Liabilities} + \text{RES} \\ &= \text{NFA} \times \text{R} + \text{RES}. \end{aligned}$$

As of 2011, in developing countries reserve accumulation is

- 22.2% of GDP, 39.8% of Total Foreign Assets, and 143% of DEBTA.

In Advanced countries reserve accumulation is

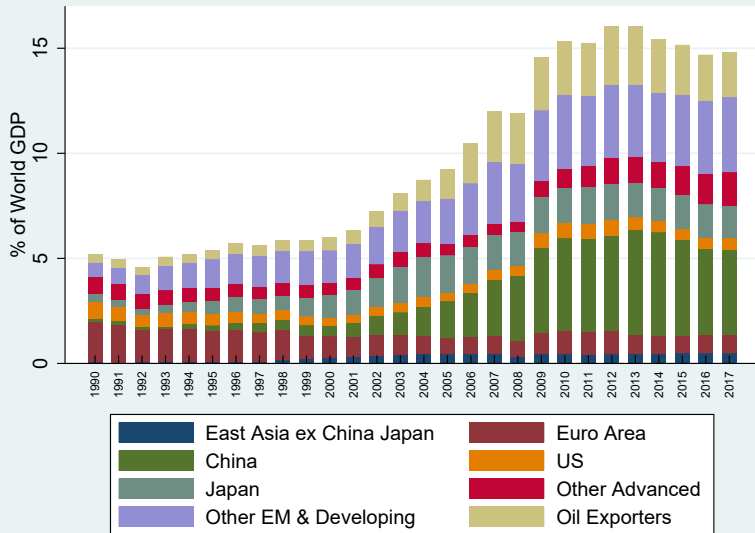
- 8.9% of GDP, 4.2% of Total Foreign Assets, and 10.7% of DEBTA.

Reserve Accumulation : Cross Country Evidence

As of Year 2011

| Rank | Country | Res (Bil.\$) | Percentage of | | | |
|------|----------------|--------------|---------------|-----------------|-------------|------------|
| | | | GDP | Total Liability | Total Asset | Debt Asset |
| 1 | China | 3202.8 | 42.7 | 99.8 | 67.5 | 331.0 |
| 2 | Japan | 1258.2 | 21.3 | 30.9 | 16.9 | 27.9 |
| 3 | Saudi Arabia | 540.7 | 80.8 | 176.5 | 51.8 | 197.5 |
| 4 | Russia | 453.9 | 22.3 | 41.3 | 38.0 | 123.1 |
| 5 | Brazil | 350.4 | 13.4 | 23.6 | 46.1 | 188.0 |
| 6 | Korea | 304.3 | 25.3 | 36.3 | 40.5 | 171.6 |
| 7 | Hong Kong | 285.3 | 114.8 | 12.0 | 9.2 | 24.8 |
| 8 | Switzerland | 279.4 | 40.1 | 10.5 | 8.0 | 18.5 |
| 9 | India | 271.3 | 14.9 | 37.0 | 66.8 | 1171.6 |
| 10 | Singapore | 237.5 | 86.3 | 13.0 | 10.1 | 18.8 |
| 11 | Algeria | 182.8 | 91.4 | 630.7 | 95.5 | 2865.6 |
| 12 | Thailand | 167.4 | 45.2 | 53.0 | 60.6 | 300.8 |
| 13 | Mexico | 144.0 | 12.3 | 17.8 | 34.1 | 90.0 |
| 14 | United States | 136.9 | 0.9 | 0.5 | 0.6 | 1.9 |
| 15 | Malaysia | 131.8 | 44.2 | 40.4 | 39.1 | 188.0 |
| 16 | Indonesia | 106.5 | 11.9 | 21.7 | 57.2 | 298.9 |
| 17 | Libya | 104.8 | 302.0 | 388.2 | 45.5 | 158.5 |
| 18 | Poland | 92.6 | 17.5 | 18.9 | 45.9 | 270.2 |
| 19 | Denmark | 81.7 | 23.9 | 11.6 | 10.4 | 22.7 |
| 20 | United Kingdom | 79.3 | 3.1 | 0.5 | 0.5 | 0.9 |
| 21 | Turkey | 78.3 | 10.1 | 15.7 | 46.2 | 124.4 |

Reserve Accumulation : Overall Stock to GDP



Empirical Analysis : Summary Statistics

Table 1: Summary Statistics: Average Values for Reserve Accumulation and Capital Control Variables

| | Period1 (1975–1985) | Period2 (1986–1996) | Period3 (1997–2007) | Period4 (2008–2011) |
|-----------------------------------------|------------------------|------------------------|------------------------|------------------------|
| (a) Advanced Countries | | | | |
| <i>RSRV</i> (%of GDP) | 5.15% | 6.71% | 5.91% | 7.69% |
| <i>KAControl</i> (standardized) | −0.51 | −1.44 | −2.26 | −2.17 |
| (b) Developing Countries | | | | |
| <i>RSRV</i> (%of GDP) | 8.90% | 8.80% | 16.44% | 25.45% |
| <i>KAControl</i> (standardized) | 0.58 | 0.56 | −0.11 | −0.25 |
| (c) Financially Open Economies | | | | |
| <i>RSRV</i> (%of GDP) | 8.49% | 8.67% | 11.14% | 15.26% |
| <i>KAControl</i> (standardized) | −0.47 | −0.99 | −1.97 | −1.96 |
| (d) Financially Closed Economies | | | | |
| <i>RSRV</i> (%of GDP) | 7.09% | 7.69% | 15.63% | 25.35% |
| <i>KAControl</i> (standardized) | 1.04 | 0.97 | 0.53 | 0.37 |

Empirics: Econometric Specification

Cross sectional analysis,

$$\Delta \log(REER_{i,T_1 T_2}) = \alpha + D_T + \beta^{NFA \times R} \Delta NFA \times R_{i,T_1 T_2} + \beta^{RSRV} \Delta RSRV_{i,T_1 T_2} + \beta^{R \& KAClosed} \Delta RSRV_{i,T_1 T_2} \times KAClosed_{i,T_1 T_2} \quad (1)$$

$$+ \beta^{YD} \Delta \log(YD_{i,T_1 T_2}) + \beta^{TT} \Delta \log(TT_{i,T_1 T_2}) + \epsilon_i, \quad (2)$$

where $T_1 T_2$ is period 12 and period 23, D_T denotes a period fixed effect for period 12 and period 23 sample.

Annual panel analysis,

$$\log(REER_{it}) = \alpha_i + D_t + \beta^{NFA \times R} NFA \times R_{it} + \beta^{RSRV} RSRV_{it} + \beta^{YD} \log(YD_{it}) + \beta^{TT} \log(TT_{it}) + \epsilon_{it}, \quad (3)$$

where D_t denotes a year fixed effect, and t denotes years rather than the period T .

Empirics: REER / Annual Panel / Period 123

Table 6: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects

| Dependent variable: $\Delta \log(\text{REER})$ | Period 123 (1975–2007) | | | | |
|----------------------------------------------------------|------------------------|--------------------|----------------------|------------------|---------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.17*** (2.74) | -0.03 (-0.63) | 0.19** (2.55) | 0.12 (1.56) | 0.21** (2.47) |
| RSRV | -0.98*** (-3.39) | 0.20 (0.63) | -0.89*** (-2.78) | -0.24 (-0.84) | -1.28*** (-3.88) |
| ln YD | 0.16** (2.10) | 0.05 (0.39) | 0.10 (1.28) | 0.22 (0.91) | 0.11* (1.86) |
| ln TT | -0.03 (-0.56) | 0.12 (1.54) | -0.06 (-0.90) | 0.06 (1.07) | -0.08 (-0.90) |
| Observations | 2,475 | 726 | 1,749 | 1,254 | 1,221 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R^2 | 0.188 | 0.23 | 0.273 | 0.092 | 0.31 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV}}$ | 0.000 | 0.506 | 0.003 | 0.257 | 0.000 |

Empirics: REER / Annual Panel / Period 12

Table 7: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects

| Dependent variable: $\Delta \log(\text{REER})$ | Period 12 (1975–1996) | | | | |
|----------------------------------------------------------|-----------------------|--------------------|----------------------|-------------------|---------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.32*** (2.83) | 0.22* (1.74) | 0.30** (2.40) | 0.14 (1.39) | 0.42** (2.65) |
| RSRV | -0.48* (-1.75) | 0.38 (0.88) | -0.57** (-2.04) | -0.33 (-1.13) | -1.06*** (-2.95) |
| ln YD | 0.04 (0.31) | -0.10 (-0.37) | -0.05 (-0.35) | 0.42*** (2.85) | -0.21 (-1.51) |
| ln TT | 0.02 (0.36) | 0.13 (1.50) | -0.02 (-0.20) | 0.11 (1.42) | -0.06 (-0.55) |
| Observations | 1,650 | 484 | 1,166 | 836 | 814 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R^2 | 0.158 | 0.26 | 0.25 | 0.24 | 0.209 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV}}$ | 0.020 | 0.725 | 0.016 | 0.164 | 0.001 |

Empirics: REER / Annual Panel / Period 23

Table 8: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects

| Dependent variable: $\Delta \log(\text{REER})$ | Period 23 (1986–2007) | | | | |
|----------------------------------------------------------|-----------------------|--------------------|----------------------|-------------------|---------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.13** (2.21) | -0.07 (-1.57) | 0.17** (2.19) | 0.11** (2.06) | 0.23** (2.65) |
| RSRV | -0.90*** (-3.07) | -0.06 (-0.24) | -0.91** (-2.59) | -0.41* (-1.77) | -1.19*** (-3.33) |
| ln YD | 0.14* (1.69) | 0.05 (0.43) | 0.14 (1.50) | -0.10 (-0.57) | 0.19** (2.08) |
| ln TT | -0.18** (-2.38) | 0.11 (1.05) | -0.19** (-2.37) | -0.04 (-0.36) | -0.26*** (-3.00) |
| Observations | 1,650 | 484 | 1,166 | 836 | 814 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R^2 | 0.174 | 0.17 | 0.21 | 0.067 | 0.267 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV}}$ | 0.001 | 0.986 | 0.003 | 0.033 | 0.000 |

Empirics: REER / X-Sections / Cts. KAControl

Table A1: Determinants of the Real Effective Exchange Rate: Cross-Sectional Analysis, Continuous Capital Control Measures

| Dependent variable: $\Delta \log(\text{REER})$ | Periods 12 (Average 86–96 minus Average 75–85) Periods 23 (Average 97–07 minus Average 86–96), Pooled Sample | | | | | |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------|--------------------|-------------------|----------------------|---------------------|
| | Full Sample | | Advanced Countries | | Developing Countries | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ΔNFAxR | 0.18* (1.67) | 0.25** (2.41) | -0.11 (-1.47) | -0.11 (-1.44) | 0.20 (1.65) | 0.31** (2.60) |
| ΔRSRV | -0.66* (-1.92) | -0.70*** (-2.82) | -0.09 (-0.22) | 0.05 (0.09) | -0.96** (-2.45) | -0.79*** (-3.24) |
| $\Delta \text{RSRV} \times \text{KAControl}$ | | -0.57*** (-2.82) | | 0.09 (0.21) | | -0.84*** (-3.90) |
| KAControl | -0.04** (-2.21) | -0.02 (-1.23) | 0.01 (0.35) | 0.01 (0.27) | -0.00 (-0.16) | 0.03 (1.35) |
| $\Delta \ln \text{YD}$ | 0.05 (0.49) | 0.07 (0.68) | 0.02 (0.09) | -0.00 (-0.01) | 0.03 (0.24) | 0.01 (0.07) |
| $\Delta \ln \text{TT}$ | 0.09 (0.82) | 0.10 (1.01) | 0.35*** (3.02) | 0.35*** (2.93) | 0.04 (0.36) | 0.04 (0.40) |
| Time Dummy | 0.07 (1.55) | 0.08* (1.74) | -0.03 (-0.54) | -0.03 (-0.53) | 0.19*** (3.21) | 0.19*** (3.23) |
| Observations | 150 | 150 | 44 | 44 | 106 | 106 |
| Countries | 75 | 75 | 22 | 22 | 53 | 53 |
| R^2 | 0.13 | 0.17 | 0.20 | 0.20 | 0.13 | 0.20 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV}}$ | 0.03 | 0.00 | 0.96 | 0.77 | 0.01 | 0.00 |
| p-value: $\beta^{\text{NFAxR}} \neq \beta^{\text{RSRV} \times \text{KAControl}}$ | | 0.00 | | 0.62 | | 0.00 |

Empirics: REER / Annual Panel / Cts. KAControl

Table 11: Determinants of Real Effective Exchange Rate: Annual Panel with - Continuous Capital Controls

| Dependent variable: log(REER) | Period 123 (1975–2007) | | | | | |
|---------------------------------------------------|------------------------|--------------------|----------------------|-----------------------------|--------------------|----------------------|
| | Full Sample | | | w/o Oil Exporting Countries | | |
| | Full Sample | Advanced Countries | Developing Countries | Full Sample | Advanced Countries | Developing Countries |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| NFAxR | 0.15*** (2.81) | -0.05 (-0.92) | 0.20*** (2.87) | 0.22*** (3.90) | 0.02 (0.37) | 0.33*** (6.52) |
| RSRV | -0.85*** (-3.82) | 0.39 (0.78) | -0.86*** (-3.77) | -0.61*** (-2.91) | 0.30 (1.00) | -0.75*** (-3.17) |
| RSRV × KAcontrol | -0.22** (-2.16) | 0.32 (1.25) | -0.26** (-2.35) | -0.10 (-0.99) | 0.09 (0.45) | -0.37*** (-3.30) |
| KAControl | -0.00 (-0.08) | -0.04 (-1.60) | 0.01 (0.28) | -0.04** (-2.27) | -0.05** (-2.71) | 0.03 (1.35) |
| ln YD | 0.14* (1.89) | -0.04 (-0.40) | 0.16* (1.92) | 0.08 (0.90) | -0.08 (-0.48) | 0.16* (1.73) |
| ln TT | -0.17** (-2.20) | 0.11 (0.89) | -0.17** (-2.13) | 0.01 (0.13) | 0.18 (1.41) | -0.03 (-0.52) |
| Obs. | 1650 | 484 | 1166 | 1987 | 687 | 1300 |
| Num. of Cty. | 75 | 22 | 53 | 61 | 21 | 40 |
| R ² | 0.19 | 0.08 | 0.21 | 0.19 | 0.19 | 0.20 |
| p-value: $\beta_{NFAxR} \neq \beta_{RSRV_KAcon}$ | 0.00 | 0.16 | 0.00 | 0.02 | 0.72 | 0.00 |

Empirics: REER / Annual Panel / Other KAClosed

Table 12: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects, Other Capital Control Measures

| Dependent variable: | Edwards Period123 | | Quinn and Toyoda Period123 | | Fernando et. al. Period 23 | |
|--------------------------------------------|----------------------|-----------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|
| | Financially Open | Financially Closed | Financially Open | Financially Closed | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| log(REER) | | | | | | |
| NFAxR | 0.17** (2.29) | 0.17* (1.76) | 0.22** (2.22) | 0.13 (1.12) | 0.04 (0.88) | 0.20** (2.63) |
| RSRV | -0.34 (-1.08) | -1.16*** (-3.40) | -0.18 (-0.39) | -1.37*** (-4.65) | -1.04** (-2.21) | -0.54*** (-2.88) |
| lnYD | 0.36** (2.06) | 0.09 (1.06) | -0.09 (-0.25) | 0.08 (0.90) | -0.47* (-1.78) | 0.00 (0.01) |
| lnTT | 0.08** (2.23) | -0.11 (-1.10) | 0.02 (0.28) | -0.10 (-0.93) | -0.18** (-2.50) | -0.42*** (-3.78) |
| Obs. | 1,188 | 1,188 | 1,089 | 1,056 | 660 | 660 |
| Num. of Cty. | 36 | 36 | 33 | 32 | 30 | 30 |
| R ² | 0.21 | 0.22 | 0.09 | 0.26 | 0.17 | 0.23 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.14 | 0.00 | 0.09 | 0.00 | 0.03 | 0.00 |

Empirics: REER / Annual Panel / Crisis Period

Table 13: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects With Crisis Period

| Dependent variable: log(REER) | Full | | Advanced | | Developing | |
|--------------------------------------------|---------------------|---------------------|------------------|------------------|---------------------|---------------------|
| | Period1234 | Period34 | Period1234 | Period34 | Period1234 | Period34 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| NFAxR | 0.08* (1.91) | 0.02 (1.31) | 0.03 (1.33) | 0.04* (2.02) | 0.17*** (2.73) | 0.06 (1.11) |
| RSRV | -0.73*** (-6.03) | -0.45*** (-5.25) | -0.09 (-0.51) | -0.34 (-1.56) | -0.72*** (-4.69) | -0.44*** (-4.11) |
| ln YD | 0.16** (2.32) | 0.14 (1.29) | -0.03 (-0.31) | 0.32 (1.54) | 0.09 (1.49) | 0.11 (0.88) |
| ln TT | -0.02 (-0.37) | -0.15* (-1.67) | 0.12 (1.27) | 0.21** (2.60) | -0.05 (-0.80) | -0.18* (-1.90) |
| Obs. | 2,775 | 1,125 | 814 | 330 | 1,961 | 795 |
| Num. of Cty. | 75 | 75 | 22 | 22 | 53 | 53 |
| R ² | 0.179 | 0.199 | 0.243 | 0.399 | 0.267 | 0.235 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.00 | 0.00 | 0.49 | 0.08 | 0.00 | 0.00 |

Empirics: REER / Annual Panel / w/o Oil

Table 14: Determinants of Real Effective Exchange Rate: Annual Panel with Fixed Effects Without Oil Exporting Countries

| Dependent variable: log(REER) | Period 123 (1975–2007) | | | | |
|--------------------------------------------|------------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.22*** (4.11) | -0.017 (-0.29) | 0.27*** (4.19) | 0.10 (1.32) | 0.28*** (3.84) |
| RSRV | -0.66*** (-2.84) | 0.31 (1.04) | -0.33 (-1.24) | -0.48 (-1.34) | -0.57** (-2.10) |
| ln YD | 0.080 (0.95) | 0.068 (0.53) | 0.0027 (0.032) | -0.047 (-0.14) | 0.056 (0.92) |
| ln TT | -0.0048 (-0.083) | 0.16 (1.70) | -0.045 (-0.78) | 0.11 (1.42) | -0.068 (-0.88) |
| Obs. | 2013 | 693 | 1320 | 990 | 1023 |
| Num. of Cty. | 63 | 21 | 40 | 30 | 31 |
| R ² | 0.16 | 0.24 | 0.30 | 0.08 | 0.36 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.00 | 0.33 | 0.04 | 0.12 | 0.01 |

Empirics: REER / Annual Panel / IMF REER

Table 15: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects, IMF REER Index

| Dependent variable: log(REER) | 1980–2007 (IMF REER available from 1980 onwards) | | | | |
|--------------------------------------------|--------------------------------------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.16*** (2.82) | -0.07 (-1.53) | 0.25*** (2.95) | 0.04 (0.56) | 0.22** (2.29) |
| RSRV | -0.73*** (-3.23) | 0.27 (1.63) | -0.68** (-2.72) | -0.22 (-0.72) | -0.91*** (-3.58) |
| ln YD | 0.24* (1.94) | 0.10 (0.68) | 0.10 (1.01) | 0.39** (2.21) | 0.07 (0.76) |
| ln TT | -0.06 (-0.96) | 0.20* (1.85) | -0.09 (-1.51) | 0.08 (0.99) | -0.15** (-2.25) |
| Obs. | 1,534 | 631 | 903 | 942 | 592 |
| Num. of Cty. | 54 | 22 | 32 | 33 | 21 |
| R ² | 0.33 | 0.15 | 0.51 | 0.21 | 0.53 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.00 | 0.09 | 0.00 | 0.44 | 0.00 |

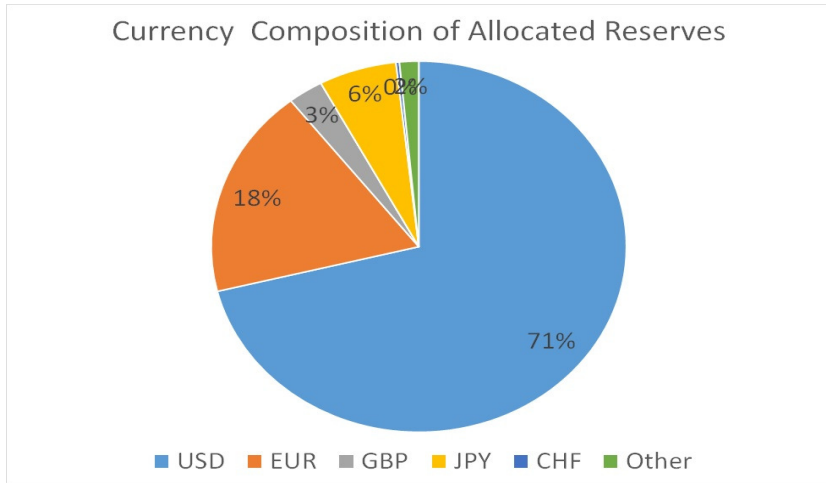
Empirics: REER / Annual Panel / BIS REER

Table 16: Determinants of the Real Effective Exchange Rate: Annual Panel with Fixed Effects, BIS REER Index

| Dependent variable: log(REER) | 1994–2007 (BIS REER available from 1994 onwards) | | | | |
|--------------------------------------------|--------------------------------------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.04 (0.67) | -0.09** (-2.32) | 0.21* (2.06) | -0.01 (-0.09) | 0.17 (1.69) |
| RSRV | -0.40*** (-3.60) | -0.11 (-0.40) | -0.28** (-2.13) | -0.47*** (-3.81) | -0.29* (-1.95) |
| ln YD | 0.27** (2.24) | 0.32** (2.08) | 0.21 (1.53) | 0.36* (1.97) | 0.19 (1.32) |
| ln TT | -0.21** (-2.63) | 0.24** (2.60) | -0.30*** (-4.52) | -0.03 (-0.33) | -0.31*** (-4.51) |
| Observations | 574 | 308 | 266 | 392 | 182 |
| Countries | 41 | 21 | 19 | 28 | 13 |
| R ² | 0.23 | 0.39 | 0.38 | 0.24 | 0.37 |
| p-value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.00 | 0.94 | 0.01 | 0.00 | 0.01 |

Currency Composition : Year 2000

Out of allocated reserves (78.4% of total reserves)



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Trade Balance : Econometric Specification

Cross Sectional Analysis

$$\Delta TradeSurplus_{i,T_1T_2} = \alpha + D_T + \beta^{NFAxR} \Delta NFAxR_{i,T_1T_2} + \beta^{RSRV} \Delta RSRV_{i,T_1T_2} + \Delta \beta^{R\&KAClosed} RSRV_{i,T_1T_2} \times KAClosed_{i,T_1T_2} + \epsilon_i \quad (4)$$

where $T_1 T_2$ is period 12 and period 23, D_T denotes a period fixed effect for period 12 and period 23 sample.

Annual Panel Analysis

$$\log(REER_{it}) = \alpha_i + D_t + \beta^{NFAxR} NFAxR_{it} + \beta^{RSRV} RSRV_{it} + \epsilon_{it} \quad (5)$$

where D_t denotes a year fixed effect, and t denotes years rather than the period T .

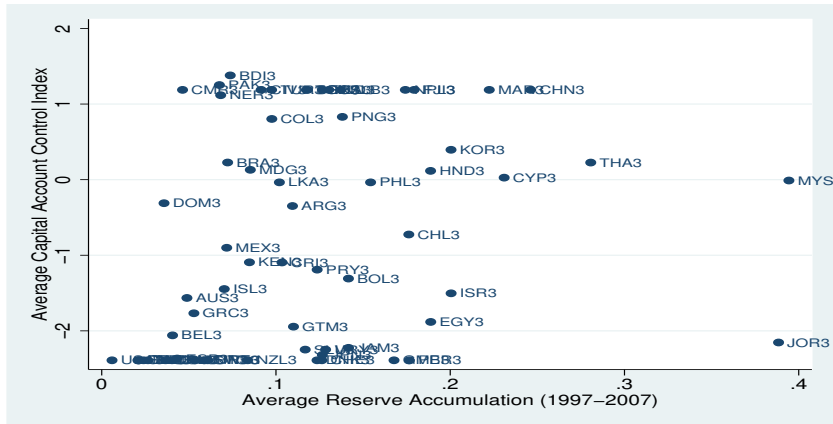
Empirical Results : Capital Account Policy and Trade Balance

Table 10: Trade Balances and Reserve Accumulations: Annual Panel with Fixed Effects

| Dependent variable: Net Exports | Period 123 (1975–2007) | | | | |
|-----------------------------------------------|------------------------|-----------------------|-------------------------|---------------------|-----------------------|
| | Full Sample | Advanced Countries | Developing Countries | Financially Open | Financially Closed |
| | (1) | (2) | (3) | (4) | (5) |
| NFAxR | 0.00 (0.22) | 0.06* (2.01) | -0.01 (-0.42) | 0.01 (0.30) | -0.00 (-0.12) |
| RSRV | 0.16** (2.16) | -0.25 (-1.40) | 0.20** (2.61) | 0.11 (1.03) | 0.24** (2.21) |
| Observations | 2379 | 705 | 1674 | 1211 | 1168 |
| Countries | 75 | 22 | 53 | 38 | 37 |
| R^2 | 0.08 | 0.30 | 0.09 | 0.08 | 0.10 |
| p -value: $\beta^{NFAxR} \neq \beta^{RSRV}$ | 0.06 | 0.12 | 0.02 | 0.41 | 0.05 |

Capital Account Policy - RSRV and KAControl

Scatter-plot : Period3 1997-2007



Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Feasible consumption sets (where hats denote the crisis state)

$$\begin{aligned}c_0^T &= (1 + \omega)y^T - (rsrv^* - d^*), \\c_1^T &= (1 + \bar{g} + g(ex_0, \nu))y^T + (1 + r^*)(rsrv^* - d^*),\end{aligned}$$

$$\begin{aligned}\hat{c}_0^T &= (1 + \omega - \xi^T)y^T - \eta(rsrv^*, y^T) - (-d^*), \\ \hat{c}_1^T &= (1 + \bar{g})y^T + (1 + r^*)(-d^*),\end{aligned}$$

$$\begin{aligned}c_0^N &= y^N, \\c_1^N &= y^N,\end{aligned}$$

$$\begin{aligned}\hat{c}_0^N &= (1 - \xi^N)y^N, \\ \hat{c}_1^N &= y^N.\end{aligned}$$

Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Aggregate export,

$$ex_0 = (1 + \omega)y^T - c_0^T = rsrv^* - d^*.$$

Growth rate,

$$g(ex_0, \nu)y^T = \nu(rsrv^* - d^*).$$

First order conditions for consumption with Lagrange Multipliers,

$$\lambda_0 = \frac{1 + r^* + \nu}{1 + r^*} \lambda_1,$$
$$\hat{\lambda}_0 = \frac{1 + r^*}{1 + r^*} \hat{\lambda}_1.$$

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Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Seek closed form solutions for $rsrv$ and κ (and implied d and rer).

For tractability now assume also: log utility ($\gamma = 1$), unit elasticity between T & NT ($\sigma = 1$), and fixed cost for liquidation ($\bar{\eta}$). Then, at the social optimum:

$$\begin{aligned}-d_1^{*opt} &= \frac{1}{2+r^*} \left(-(1+\bar{g}) + (1+\omega) + (-\xi^T - \bar{\eta}) \right) \cdot y^T, \\ rsrv_1^{*opt} &= \frac{1}{2+r^*} \left(\frac{\nu(1+\bar{g})}{1+r^*+\nu} - (-\xi^T - \bar{\eta}) \right) \cdot y^T, \\ rer_0^{opt} &= \frac{\theta^N}{\theta^T} \cdot \frac{1+r^*}{2+r^*} \cdot \left(1+\omega + \frac{1+\bar{g}}{1+r^*+\nu} \right) \cdot \frac{y^T}{y^N}.\end{aligned}$$

ω : current productivity

ξ^T : crisis loss

ν : growth externality

$\bar{\eta}$: liquidation penalty

Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Proposition 1

Fixing all other parameters, if an economy has a higher output loss in a crisis (ξ^T), optimal reserve accumulation increases while the real exchange rate is not affected.

$$\begin{aligned}\frac{\partial rsrv_1^{*opt}}{\partial \xi^T} &= \frac{\partial d_1^{*opt}}{\partial \xi^T} > 0, \\ \frac{\partial rer_0^{opt}}{\partial \xi^T} &= 0.\end{aligned}$$

Full Model: Endogenous Capital Account Policies

Constrained Social Planner's Problem

Proposition 2

Fixing all other parameters, if an economy has a higher growth externality (ν), optimal reserve accumulation increases while the real exchange rate is depreciated.

$$\begin{aligned}\frac{\partial rsv_1^{*opt}}{\partial \nu} &> 0, & \frac{\partial d_1^{*opt}}{\partial \nu} &= 0, \\ \frac{\partial rer_0^{opt}}{\partial \nu} &< 0.\end{aligned}$$

Full Model: Endogenous Capital Account Policies

Optimal Capital Account Policy

The **Optimal Capital Account Policy** is to set $rsrv^* = rsrv_1^{*opt}$, and optimal capital control κ satisfying

$$1 - \tau_1(d_1^{*opt}, \kappa) = \frac{(1 - \pi)\lambda_1^{*opt} + \pi\hat{\lambda}_1^{*opt}}{(1 - \pi)\lambda_0^{*opt} + \pi\hat{\lambda}_0^{*opt}}.$$

Theorem 1 (Precaution Versus Mercantilism)

All else equal, if an economy has a higher output loss in a crisis (ξ^T), the optimal degree of capital control decreases. And if an economy has a higher growth externality (ν), the optimal degree of capital control increases. That is,

$$\frac{\partial \kappa^{opt}}{\partial \xi^T} \leq 0, \quad \text{and} \quad \frac{\partial \kappa^{opt}}{\partial \nu} \geq 0.$$

Growth : Econometric Specification

Cross Sectional Analysis

$$\begin{aligned}\Delta \log(y_i) = & \alpha + \beta^{RSRV} \Delta RSRV_i + \beta^{R\&KAClosed} \Delta RSRV_i \times KAClosed_i \\ & + \beta^{InitialGDP} \log(y_{i,0}) + \gamma' Z_i + \epsilon_i,\end{aligned}\tag{6}$$

where y is the average real GDP per capita or TFP for period 2 or 3. The initial value of real GDP per capita or TFP comes from the the last year of the period 1. Z stands for all other controls.

Annual Panel Analysis

$$\begin{aligned}\log(y_{i,t}) - \log(y_{i,t-1}) = & \alpha_i + D_t + \beta^{RSRV} (RSRV_{i,t-1} - RSRV_{i,t-2}) \\ & + \beta^{Initial} \log(y_{i,t-1}) + \gamma' Z_{i,t} + \epsilon_{i,t}.\end{aligned}\tag{7}$$

Empirical Results : Capital Account Policy and rGDP Growth

Table 17a: Annual Panel: Capital Account Policy and Growth of Real GDP per Capita

| Dependent variable: | Period 2 & Period 3 (1986-2007) | | | | | |
|----------------------------------------|---------------------------------|---------------------|--------------------------------|---------------------|--------------------------------|--------------------|
| | All Sample | | | | | |
| | All | Fin.Opn. | Fin.Cl. | Adv. | EM | Dev. |
| rGDP Growth | (1) | (2) | (3) | (4) | (5) | (6) |
| Lagged Δ RSRV | 0.07 (1.18) | 0.04 (0.56) | 0.23** (2.56) | 0.01 (0.06) | 0.19** (2.60) | 0.02 (0.31) |
| Initial rGDP | -0.05** (-2.54) | -0.09*** (-4.62) | -0.02 (-0.69) | -0.08*** (-3.10) | -0.10*** (-3.62) | -0.02 (-0.91) |
| Schooling | 0.01 (1.65) | 0.01* (2.00) | 0.00 (0.03) | 0.00 (1.19) | 0.04** (2.90) | 0.01 (1.02) |
| Inst. Quality | 0.01*** (2.93) | 0.01*** (3.90) | 0.00 (0.81) | 0.00* (1.82) | 0.01** (2.60) | 0.01* (1.90) |
| Trade Openness | 0.03* (1.69) | 0.03*** (3.51) | 0.04 (1.28) | 0.02*** (3.51) | -0.04 (-1.31) | 0.05 (1.62) |
| Credit to GDP | -0.00*** (-3.80) | -0.00*** (-3.08) | -0.00** (-2.16) | -0.00 (-1.09) | 0.00 (0.03) | -0.00** (-2.26) |
| Terms of Trade | -0.01 (-0.42) | 0.04 (1.36) | -0.04* (-2.05) | 0.03 (0.55) | -0.11*** (-10.11) | 0.04* (1.85) |
| Obs. | 1231 | 724 | 507 | 424 | 248 | 559 |
| Num. of Cty. | 64 | 38 | 26 | 22 | 13 | 29 |
| R ² | 0.18 | 0.26 | 0.22 | 0.44 | 0.63 | 0.20 |

Empirical Results : Capital Account Policy and rGDP Growth w/o Oil

Table 17b: Annual Panel: Capital Account Policy and Growth of Real GDP per Capita

| Dependent variable: | Period 2 & Period 3 (1986-2007) | | | | | |
|----------------------------------------|---------------------------------|---------------------|--------------------------------|---------------------|---------------------------------|---------------------|
| | w/o Oil Exporting Countries | | | | | |
| rGDP Growth | All | Fin.Opn. | Fin.Cl. | Adv. | EM | Dev. |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Lagged Δ RSRV | 0.03 (0.38) | -0.05 (-0.49) | 0.23** (2.51) | -0.06 (-0.57) | 0.27*** (3.18) | -0.03 (-0.26) |
| Initial rGDP | -0.09*** (-6.72) | -0.11*** (-4.86) | -0.08*** (-5.28) | -0.09*** (-3.41) | -0.10*** (-3.39) | -0.08*** (-3.69) |
| Schooling | 0.01** (2.30) | 0.01** (2.11) | 0.02* (1.84) | 0.00 (0.89) | 0.04** (2.54) | 0.01 (1.33) |
| Inst. Quality | 0.01*** (3.30) | 0.00*** (2.81) | 0.01** (2.52) | 0.00* (1.99) | 0.00 (1.38) | 0.01* (1.98) |
| Trade Openness | 0.01* (1.75) | 0.03*** (3.08) | -0.03 (-0.91) | 0.02*** (2.88) | -0.06* (-1.85) | -0.02 (-0.63) |
| Credit to GDP | -0.00*** (-3.20) | -0.00** (-2.49) | -0.00 (-1.60) | -0.00 (-0.57) | -0.00 (-0.11) | -0.00 (-1.35) |
| Terms of Trade | -0.04 (-1.67) | -0.02 (-0.67) | -0.05* (-1.90) | -0.03 (-0.99) | -0.11*** (-10.45) | 0.01 (0.51) |
| Obs. | 1037 | 609 | 428 | 405 | 208 | 424 |
| Num. of Cty. | 54 | 32 | 22 | 21 | 11 | 22 |
| R ² | 0.24 | 0.27 | 0.32 | 0.48 | 0.66 | 0.23 |

Empirical Results : Capital Account Policy and TFP Growth

Table 18a: Annual Panel: Capital Account Policy and Growth of TFP

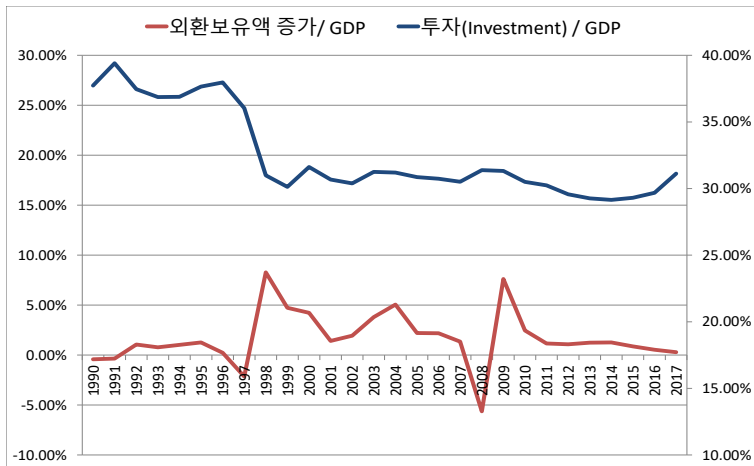
| Dependent variable: | Period 2 & Period 3 (1986-2007) | | | | | |
|----------------------|---------------------------------|--------------------|---------------------|---------------------|---------------------|---------------------|
| | All Sample | | | | | |
| TFP Growth | All | Fin.Opn. | Fin.Cl. | Adv. | EM | Dev. |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Lagged Δ RSRV | 0.03 (0.47) | -0.02 (-0.31) | 0.20*** (3.19) | 0.06 (0.96) | 0.14*** (2.60) | -0.01 (-0.14) |
| Initial TFP | -0.11*** (-3.95) | -0.11** (-2.63) | -0.09*** (-3.41) | -0.06*** (-3.77) | -0.17*** (-3.19) | -0.10*** (-2.31) |
| Schooling | -0.00 (-0.50) | -0.00 (-0.61) | 0.00 (0.41) | -0.00 (-1.35) | -0.00 (-0.40) | -0.00 (-0.07) |
| Inst. Quality | 0.00*** (3.40) | 0.00*** (2.74) | 0.00*** (3.10) | 0.00 (0.98) | 0.00 (1.56) | 0.00** (2.25) |
| Trade Openness | 0.02*** (6.13) | 0.02*** (3.37) | 0.02*** (7.78) | 0.01*** (4.05) | -0.01 (-0.41) | 0.02*** (4.10) |
| Credit to GDP | -0.00* (-1.95) | -0.00 (-1.43) | -0.00* (-1.75) | -0.00 (-0.99) | -0.00 (-0.55) | -0.00 (-1.08) |
| Terms of Trade | -0.03*** (-2.37) | -0.01 (-0.74) | -0.05** (-2.75) | -0.02 (-1.30) | -0.10*** (-7.62) | -0.00 (-0.03) |
| Obs. | 1187 | 720 | 467 | 424 | 248 | 515 |
| Num. of Cty. | 61 | 37 | 24 | 22 | 13 | 26 |
| R ² | 0.18 | 0.15 | 0.30 | 0.18 | 0.56 | 0.19 |

Empirical Results : Capital Account Policy and TFP Growth w/o Oil

Table 18b: Annual Panel: Capital Account Policy and Growth of TFP

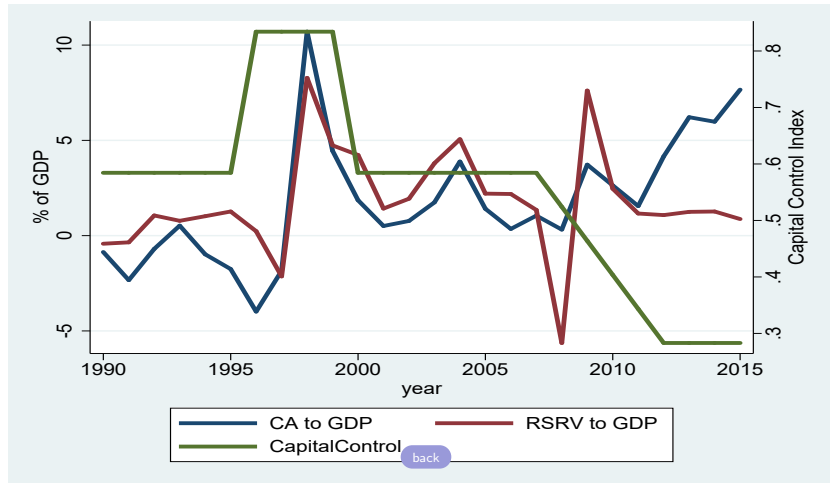
| Dependent variable: | Period 2 & Period 3 (1986-2007) | | | | | |
|----------------------|---------------------------------|---------------------|--------------------|---------------------|---------------------|---------------------|
| | w/o Oil Exporting Countries | | | | | |
| TFP Growth | All | Fin.Opn. | Fin.Cl. | Adv. | EM | Dev. |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Lagged Δ RSRV | 0.07* (1.79) | 0.03 (0.64) | 0.17*** (2.92) | 0.05 (0.71) | 0.20** (2.86) | 0.04 (0.92) |
| Initial TFP | -0.11*** (-4.57) | -0.15*** (-4.21) | -0.07** (-2.63) | -0.06*** (-3.28) | -0.20*** (-3.38) | -0.10*** (-3.01) |
| Schooling | -0.00 (-0.84) | -0.00 (-0.93) | -0.00 (-0.44) | -0.00 (-1.35) | -0.00 (-0.22) | -0.00 (-0.56) |
| Inst. Quality | 0.00*** (3.02) | 0.00** (2.68) | 0.00*** (2.92) | 0.00 (0.59) | 0.00 (0.53) | 0.00** (2.43) |
| Trade Openness | 0.01*** (4.17) | 0.02*** (3.27) | 0.03 (1.17) | 0.01*** (4.15) | -0.00 (-0.27) | 0.02 (0.86) |
| Credit to GDP | -0.00** (-2.20) | -0.00 (-1.46) | -0.00** (-2.17) | -0.00 (-1.07) | -0.00 (-1.28) | -0.00 (-1.14) |
| Terms of Trade | -0.03* (-1.93) | -0.01 (-0.67) | -0.05* (-2.07) | -0.02 (-1.52) | -0.10*** (-6.75) | 0.01 (0.67) |
| Obs. | 1013 | 605 | 408 | 405 | 208 | 400 |
| Num. of Cty. | 52 | 31 | 21 | 21 | 11 | 20 |
| R ² | 0.21 | 0.24 | 0.27 | 0.19 | 0.65 | 0.21 |

Reserve Accumulation and Gross Fixed Capital Formation



Notes: BOK ECOS, World Bank WDI

Current Account, Reserves, and Capital Controls : Korea



Reserves and Currency Crash Risk

Correlation between Reserves to GDP and Forward Premium

| | Reserves to GDP | Excess Return $\left(\frac{S_{t+1}-F_t}{F_t}\right)$ | Forward Carry $\left(\frac{S_t-F_t}{F_t}\right)$ |
|-------------------------|-----------------|------------------------------------------------------|--------------------------------------------------|
| Brazil | 13.40% | 0.10% | 0.63% |
| Hungary | 35.05% | 0.07% | 0.28% |
| Indonesia | 13.09% | 0.03% | 0.49% |
| Israel | 32.57% | 0.04% | 0.05% |
| Korea | 28.72% | 0.03% | 0.14% |
| Mexico | 11.63% | 0.06% | 0.22% |
| Poland | 18.91% | 0.08% | 0.19% |
| Russia | 29.08% | 0.05% | 0.25% |
| South Africa | 10.51% | 0.06% | 0.48% |
| Thailand | 52.53% | 0.02% | 0.04% |
| Turkey | 11.04% | 0.18% | 0.37% |
| CORR w. Reserves to GDP | 1 | -0.52 | -0.71 |

Weekly Data as of the end of 2010. The base currency is USD.

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