International capital flows and global imbalances

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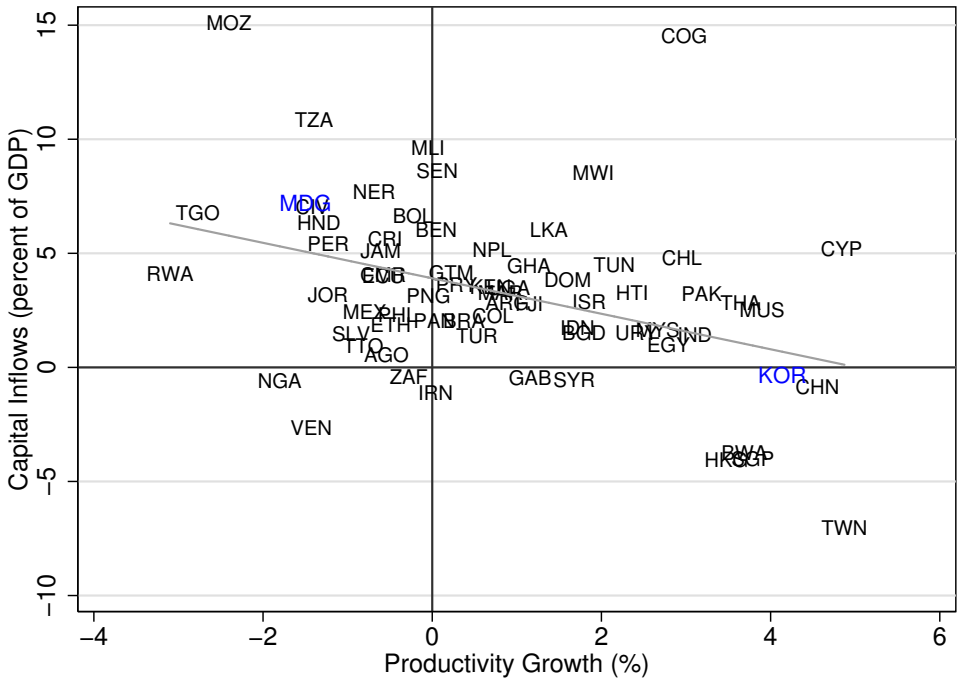
- Lucas (1990) - Why Doesn't Capital Flow from Rich to Poor Countries?
- Gourinchas and Jeanne (2011) - Capital Flows to Developing Countries: The Allocation Puzzle
- Mendoza, Quadrini, Rios-Rull (2009) - Financial Integration, Financial Development and Global Imbalances

Gourinchas and Jeanne (2011)

- The basic neoclassical growth model predicts that countries that enjoy higher productivity growth should receive more net capital inflows. This is not true in the data.



Model

- Small open economy that can borrow and lend at world interest rate R^*
- Time is discrete and there is no uncertainty
- Technology: $Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}$
- Labor supply is exogenous, equal to the population $L_t = N_t$
- Resource constraint:

$$\begin{aligned} C_t + I_t + R^* D &= Y_t + D_{t+1} \\ I_t &= K_{t+1} - (1-\delta)K_t \end{aligned}$$

- Country's external debt D_t

Model

- Capital inflows $D_{t+1} - D_t$ is equal to domestic investment I_t minus savings $S_t = Y_t - (R^* - 1)D_t - C_t$
- $R_t = \alpha(k_t/A_t)^{\alpha-1} + 1 - \delta$ where $k_t = K_t/N_t$
- Since $R_t = R^*$ in equilibrium,

$$\tilde{k}_t = \tilde{k}^* \equiv \left(\frac{\alpha}{R^* + \delta - 1} \right)^{1/(1-\alpha)}$$

where $\tilde{k} = k/A$ (capital stock per efficient unit of labor)

Model

- Exogenous, deterministic productivity path, $\{A_t\}_{t=0,..\infty}$,

$$A_t \leq A_t^* = A_0^* (g^*)^t$$

where $g^* - 1$ is the growth rate of the world technology frontier

- Gap between domestic productivity and the productivity with no "catch-up"

$$\pi_t \equiv \frac{A_t}{A_0 (g^*)^t} - 1$$

- Growth rate always converges to g^* , and $\pi \equiv \lim_{t \to \infty} \pi_t$ is well-defined.

Model

- Representative household solves

$$\begin{aligned} \max \quad & \sum_{s=0}^{\infty} \beta^s u(c_{t+s}) \\ \text{s.t.} \quad & C_t + K_{t+1} \leq R^* K_t + (D_{t+1} - R^* D_t) + w_t N_t \end{aligned}$$

where $u(c) = \log(c)$, $w_t = (1-\alpha) k_t^{\alpha} A_t^{1-\alpha}$

- Euler equation

$$\frac{1}{c_t} = \beta R^* \frac{1}{c_{t+1}}$$

- Assume $R^* = \frac{g^*}{\beta}$, which holds if ROW is composed of developed economies that have the same preferences and are in steady

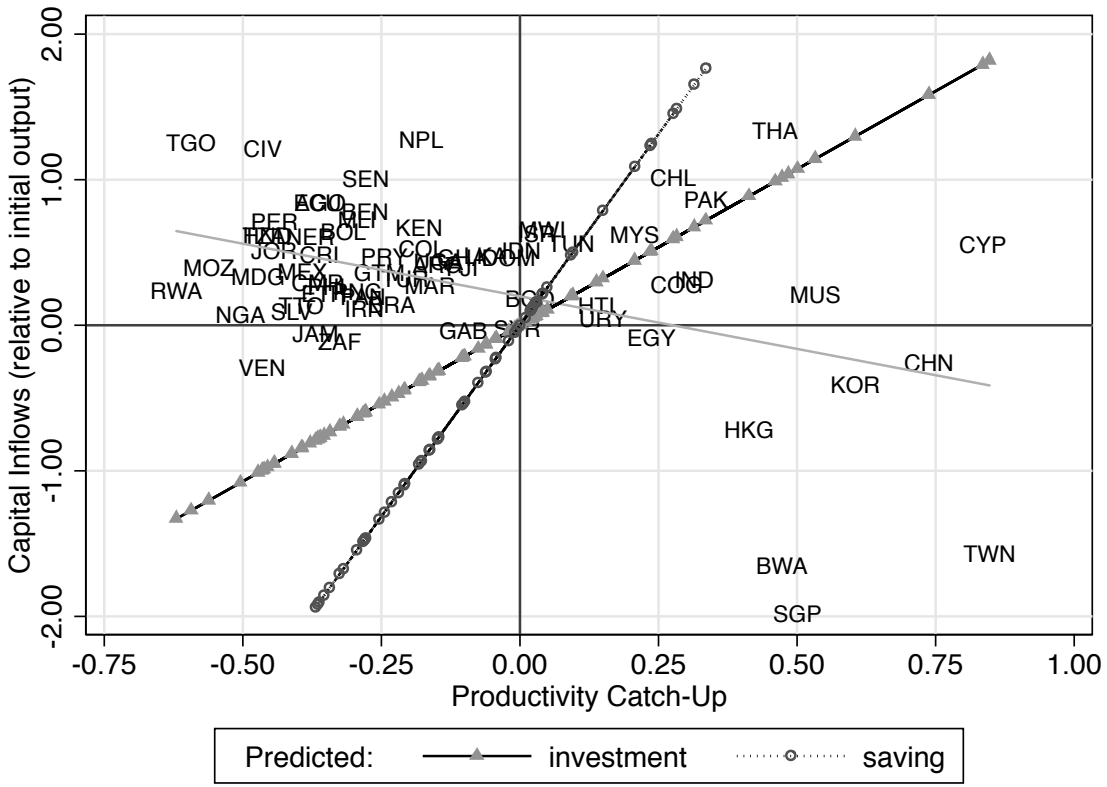
Capital Flows and Productivity Catch-Up

1. *If $\tilde{k}_0 = \tilde{k}^*$ (optimal initial capital) and $\tilde{d}_0 = 0$ (no initial debt), then the country receives positive net capital inflows iff $\pi > 0$.*
   Capital flows *into* the developing countries whose TFP catches up relative to the world frontier, and flows *out* of the countries whose TFP falls behind.
2. *If identical except for long-run productivity catch-up, then country A receives more capital inflows iff it catches up more than country B, i.e. $\pi^A > \pi^B$.*
   Other things equal, countries that grow faster should receive more capital flows.

The opposite is true in the data, hence the puzzle.

Capital Flows and Productivity Catch-Up

Data: 65 non-OECD countries + Korea, Mexico, Turkey (1980-2000)



Capital Flows and Productivity Catch-Up

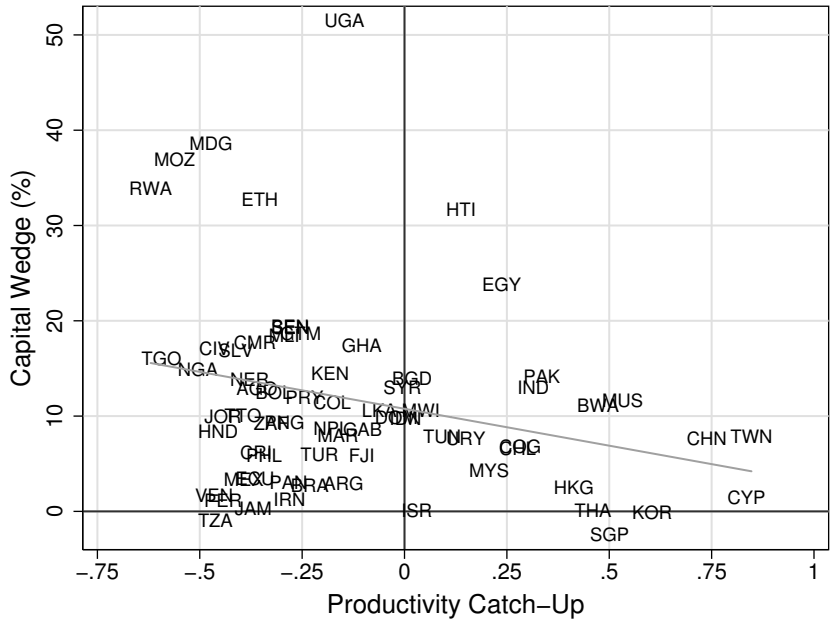
Variable: $\Delta D/Y_0$	(1)
	(Std. Err.)
Productivity catch-up (π)	-0.586***
	(0.217)
Initial capital abundance (k_0/y_0)	-0.161
	(0.115)
Initial debt (d_0/y_0)	0.006*
	(0.003)
Population growth (n)	-0.058
	(0.104)

Wedge Analysis

- Business Cycle Accounting (Chari, Kehoe, and Macgrattan 2007): large class of DSGE models are observationally equivalent to a benchmark RBC model with "wedges" in the FOCs.
- Capital wedge: tax τ_k on gross return to capital R_t (e.g. taxes, credit market imperfections, bureaucracy, bribery/corruption)
- Savings wedge: tax τ_s on capital income (e.g. domestic financial repression)
- $C_t + K_{t+1} = (1-\tau_s)(R_t(1-\tau_k)K_t - R^*D_t) + D_{t+1} + w_t + T_t$ where $T_t = \tau_k R_t K_t + \tau_s R^*(K_t - D_t)$ lump-sum transfer
- Euler equation $\frac{1}{c_t} = \beta R^*(1-\tau_s)\frac{1}{c_{t+1}}$

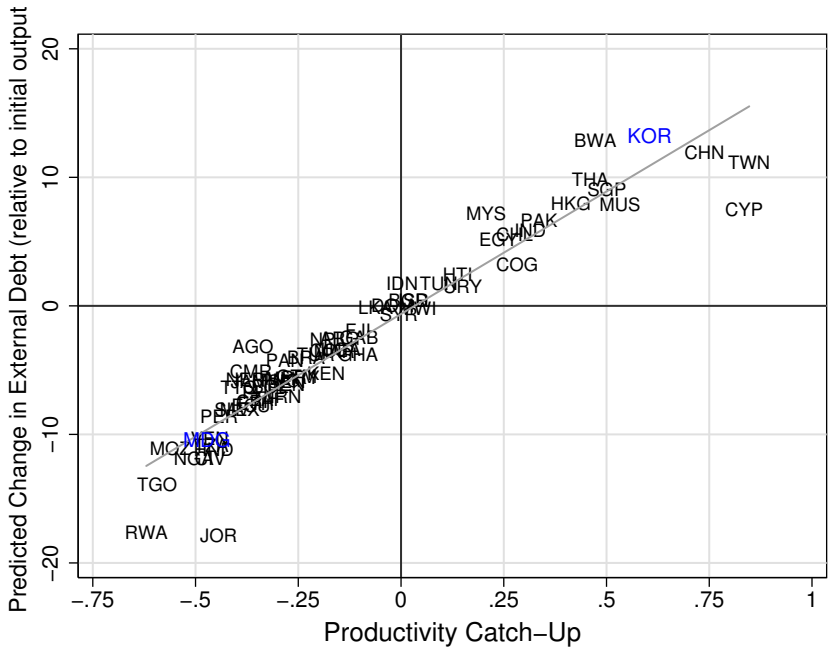
Capital Wedge

- Capital and savings wedges can be calculated to match investment and savings rates
- Capital wedge lower in high productivity growth economies (better institutions and lower distortions)



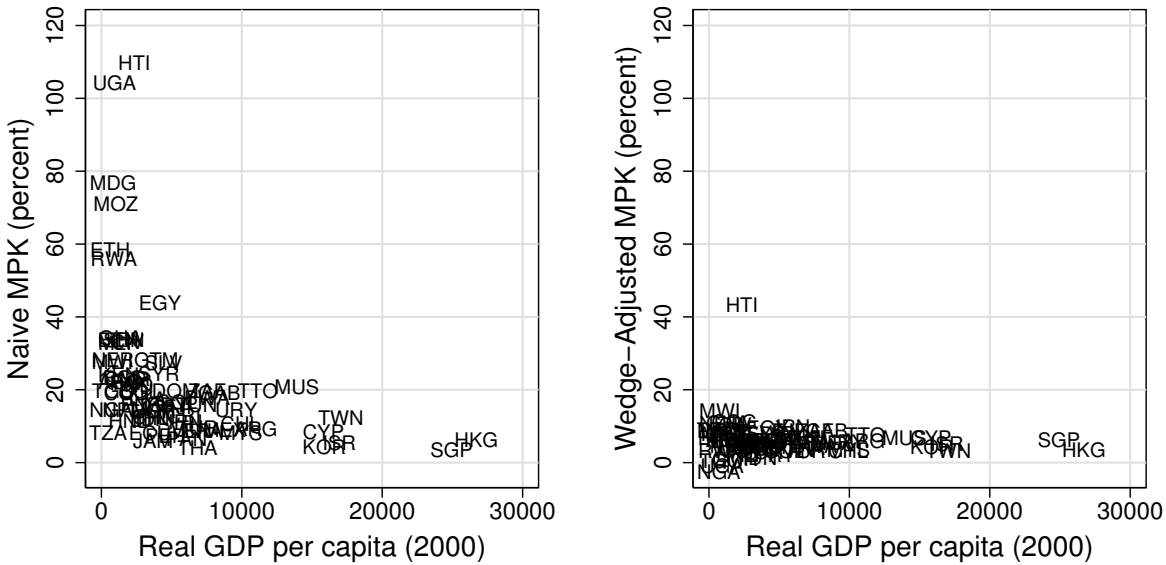
Capital Wedge

- This worsens the allocation puzzle
- Plot of productivity catch-up and capital inflows predicted by the model with capital wedges



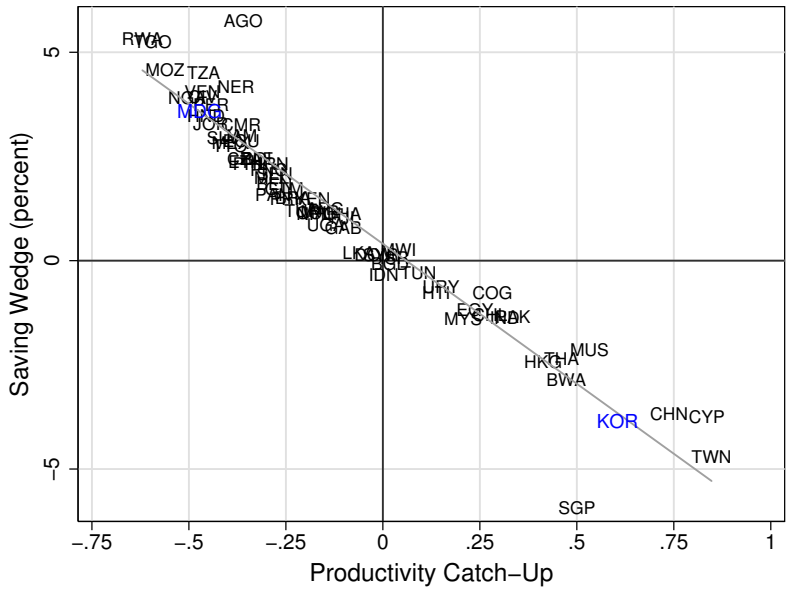
Private Returns Equalization

- Naive private returns $R_n \equiv \alpha Y/K - \delta$
- Wedge-adjusted returns $(1 - \tau_k)(1 + R_n) - 1$



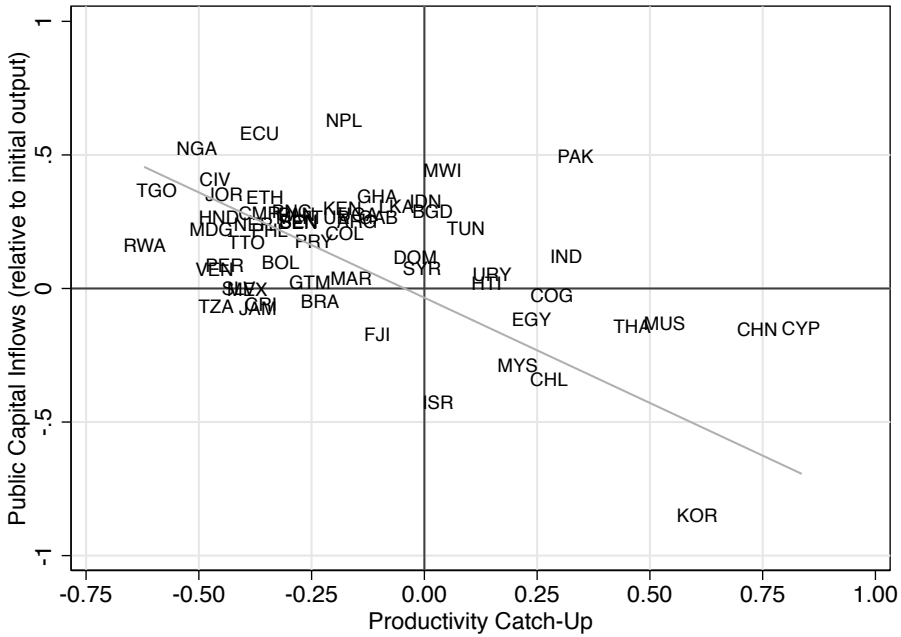
Savings Wedge

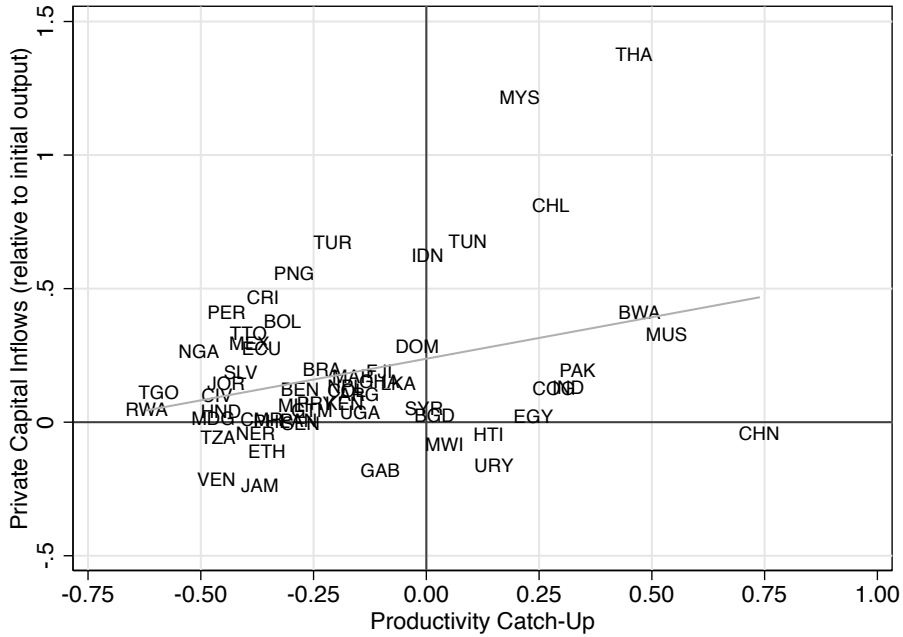
- Savings wedge lower in high productivity growth economies (subsidize vs tax)



Savings Puzzle

- The allocation puzzle is a saving puzzle
- In particular, it is public savings puzzle





Savings Puzzle

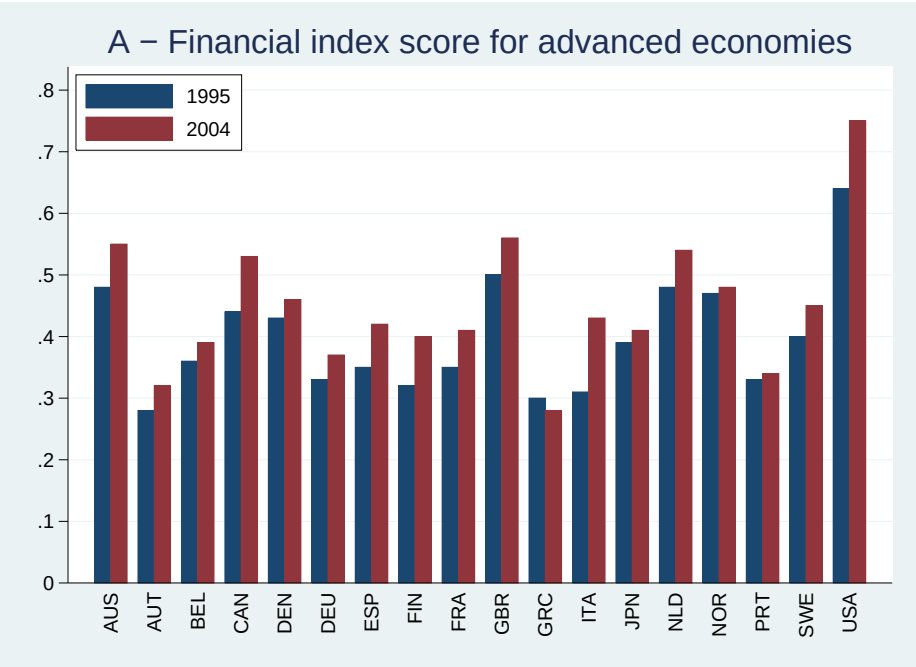
- Why are emerging economies accumulating so much foreign reserves (savings)?
- Recent papers on reserves accumulation
  - reserves to smooth consumption against exogenous crises: Alfaro and Kanczuk (2009), Bianchi et al. (2012), Caballero and Panageas (2007), Jeanne and Ranciere (2011)
  - NFA prevents crises: Durdu et al (2009), Mendoza (2010)
  - reserves prevent crises: Hur and Kondo (2013), Kim (2008)

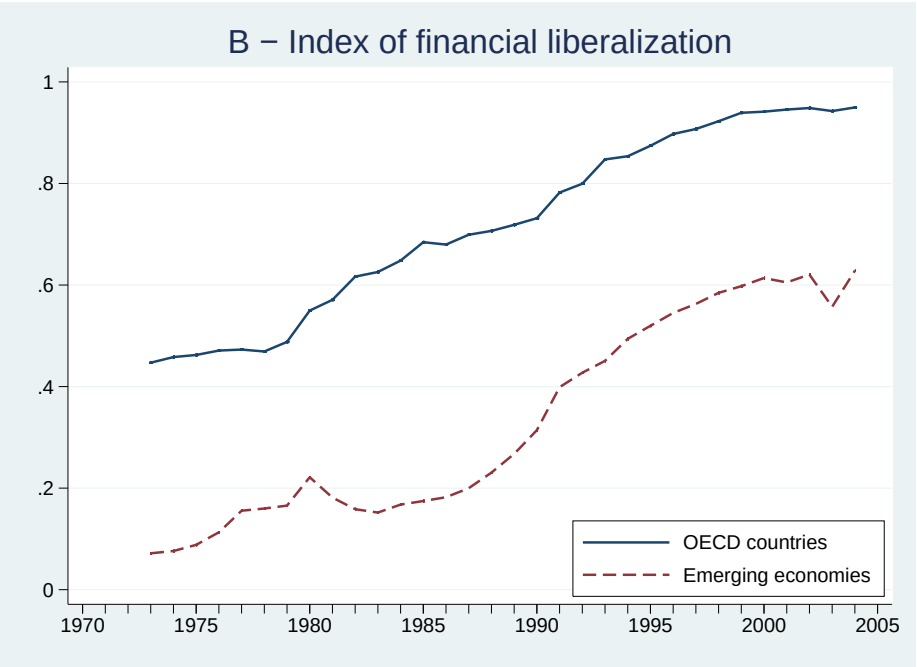
Mendoza, Quadrini, and Rios-Rull (2009)

- Global financial imbalances are the outcome of financial integration when countries differ in financial markets development
  - countries with more advanced financial markets accumulate foreign liabilities
  - they also hold positive net holdings of equity and FDI
- Theory is consistent with empirical observations
  - large differences in financial development across countries
  - decline in US NFA began in early 1980s
  - portfolio compostition of US NFA: positive position on risky assets, negative position in debt

Differences in Financial Development

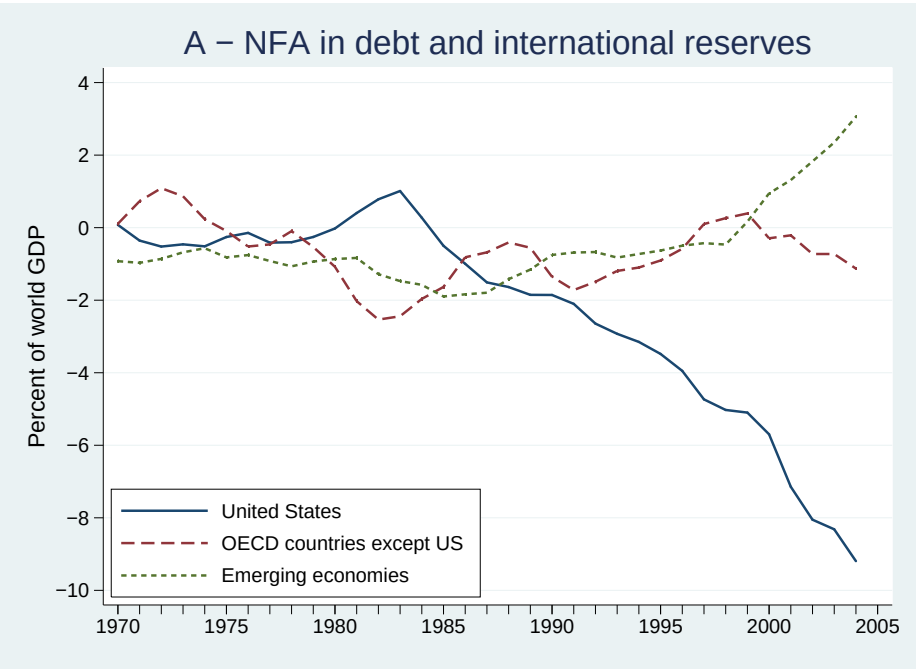
- Large differences even among advanced economies (IMF financial development index)
- Financial liberalization of emerging economies far behind

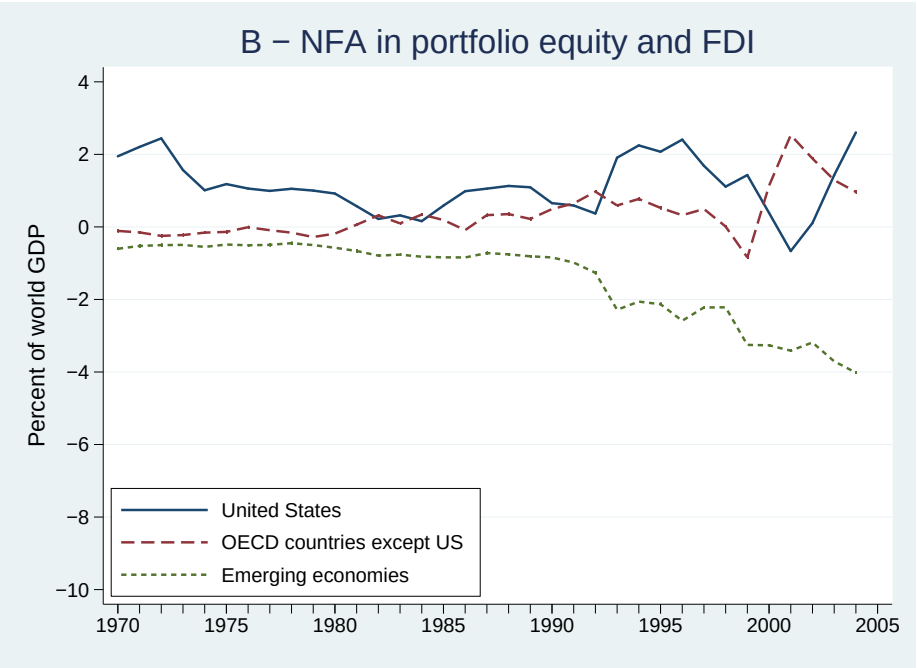




Composition of NFA

- US increased risky assets and reduced riskless assets (net)
- Emerging economies reduced risky assets and increased riskless assets (net)





Model

- Multi-country DSGE model with incomplete markets
- Idiosyncratic shocks to endowment and investment
- Two frictions: limited enforcement and limited liability

Simple Model

- Two countries, $i = 1, 2$, each populated by continuum of agents
- Each country endowed with unit supply of non-reproducible, international immobile asset, traded at price P_t^i
- This asset can be used to produce $y_{t+1} = z_{t+1} k_t^\nu$ where z_{t+1} is an idiosyncratic investment shock. Agents can invest domestically or abroad, but not diversify (relaxed later)
- Agents receive an idiosyncratic stochastic endowment w_t, which follows a Markov process
- Maximize $\sum_{t=0}^{\infty} \beta^t U(c_t)$
- No aggregate uncertainty

Simple Model

- Let $g(s_t, s_{t+1})$ be the conditional probability distribution where $s_t \equiv (w_t, z_t)$
- Agents can buy state-contingent claims $b(s_{t+1})$
- Price of claims is $q_t^i(s_t, s_{t+1}) = g(s_t, s_{t+1})/(1 + r_t^i)$ where r_t^i is the equilibrium interest rate
- Budget constraint

$$c_t + P_t^i k_t + \sum_{s_{t+1}} b(s_{t+1}) q_t^i(s_t, s_{t+1}) \leq a(s_t)$$

where a_t is end-of-period net worth before consumption

$$a(s_t) = w_t + k_{t-1} P_t^i + z_t k_{t-1}^{\nu} + b(s_t)$$

Financial Frictions

- If markets were complete, agents would perfectly insure against endowment and investment risks
- Agents can divert $1-\phi^i$ of income; ϕ^i represents degree of enforcement
- Two frictions: limited enforcement and limited liability

$$\begin{aligned} a(s_j) - a(s_1) &\geq (1-\phi^i)\left[w_j - w_1 + (z_j - z_1)k_t^{\nu}\right] \\ a(s_j) &\geq 0 \end{aligned}$$

where s_1 denotes the worst possible realization

- $\phi^i = 1$ implies constant consumption and $\phi^i = 0$ implies no insurance

Household problem

- With capital mobility, prices are equalized internationally. Thus we can write the optimization problem as if the agent only buys domestic k:

$$V_t^i(s,a) = \max_{c,k,b(s')} U(c) + \beta \sum_{s'} V_{t+1}^i\left(s', a(s')\right) g(s,s')$$

subject to

budget constraint

incentive compatibility

limited liability

Autarky Equilibrium

Given financial development ϕ^i and initial distributions $M_t^i(s,k,b)$ for $i=1,2$, an autarky equilibrium is policy functions, value functions, prices, and distributions such that

1. policy functions and value functions solve household problem
2. asset markets clear : $\int_{s,k,b} k_t^i M_t^i(s,k,b) = 1$,
   $\int_{s,k,b,s'} b_t^i(s,a,s') M_t^i(s,k,b) g(s,s') = 0$ for $i=1,2$
3. distributions are consistent with initial distributions, individual policies, and stochastic processes for idiosyncratic shocks

Integrated Equilibrium

The definition of integrated equilibrium is identical except additional conditions on prices ($q_t^1 = q_t^2,\ P_t^1 = P_t^2$) and market clearing conditions:

$$\sum_{i=1,2} \int_{s,k,b} k_t^i M_t^i(s,k,b) = 2$$

$$\sum_{i=1,2} \int_{s,k,b,s'} b_t^i(s,a,s') M_t^i(s,k,b) g(s,s') = 0$$

Net foreign asset position

NFA of country i is given by

$$NFA_t^i = \int_{s,k,b} b_t^i(s,a,s')M_t^i(s,k,b)g(s,s') + \int_{s,k,b} \left[k_t^i - 1\right] P_t M_t^i(s,k,b)$$

Characterization

- First consider the case with endowment shocks only.
- Financial autarky regime and $\phi = \bar{\phi}$ (such that IC not binding). Then $r = 1/\beta - 1$ since agents can perfectly insure against idiosyncratic risk, and there are no precautionary savings. Also $R_{t+1} = 1 + r_t$
- Financial autarky regime and $\phi = 0$ (no state-contingent claims). Then $r < 1/\beta - 1$ since agents cannot perfectly insure against idiosyncratic risk, and there are precautionary savings (since U' is convex). Also $R_{t+1} = 1 + r_t$
- All agents invest $k = 1$ since marginal return on productive asset is equal to the interest rate

Proposition 1

- Suppose that $\phi^1 = \bar{\phi}$ and $\phi^2 = 0$. In the integrated equilibrium, $r_t < 1/\beta - 1$ and country 1 accumulates a negative NFA but holds a zero net position in the productive asset
- $r_1^{aut} > r_{int} > r_2^{aut}$
- Demand for assets fall in country 1 and rise in country 2, hence the country with deeper financial markets ends up with a negative NFA

Characterization

- Now consider the case with investment shocks only.
- Financial autarky regime and $\phi = \bar{\phi}$ (such that IC not binding). Then $r = 1/\beta - 1$ since agents can perfectly insure against idiosyncratic risk. Now $ER_{t+1} = 1 + r_t$, but still all agents invest $k = 1$
- Financial autarky regime and $\phi = 0$ (no state-contingent claims). Then $r < 1/\beta - 1$ since agents cannot perfectly insure against idiosyncratic risk (precautionary savings). But now there is a marginal risk premium for the risky asset

$$ER_{t+1} - (1 + r_t) = -\frac{Cov(R_{t+1}, U'(c(z'))}{EU'(c(z'))} > 0$$

Proposition 2

- Suppose that $\phi^1 = \bar{\phi}$ and $\phi^2 = 0$. In the integrated equilibrium, $r_t < 1/\beta - 1$. Country 1 has a negative NFA but a positive position on the productive asset. Moreover, the average return of country 1's foreign assets is larger than the cost of its liabilities.
- The same proposition holds for the case with both endowment and investment shocks.

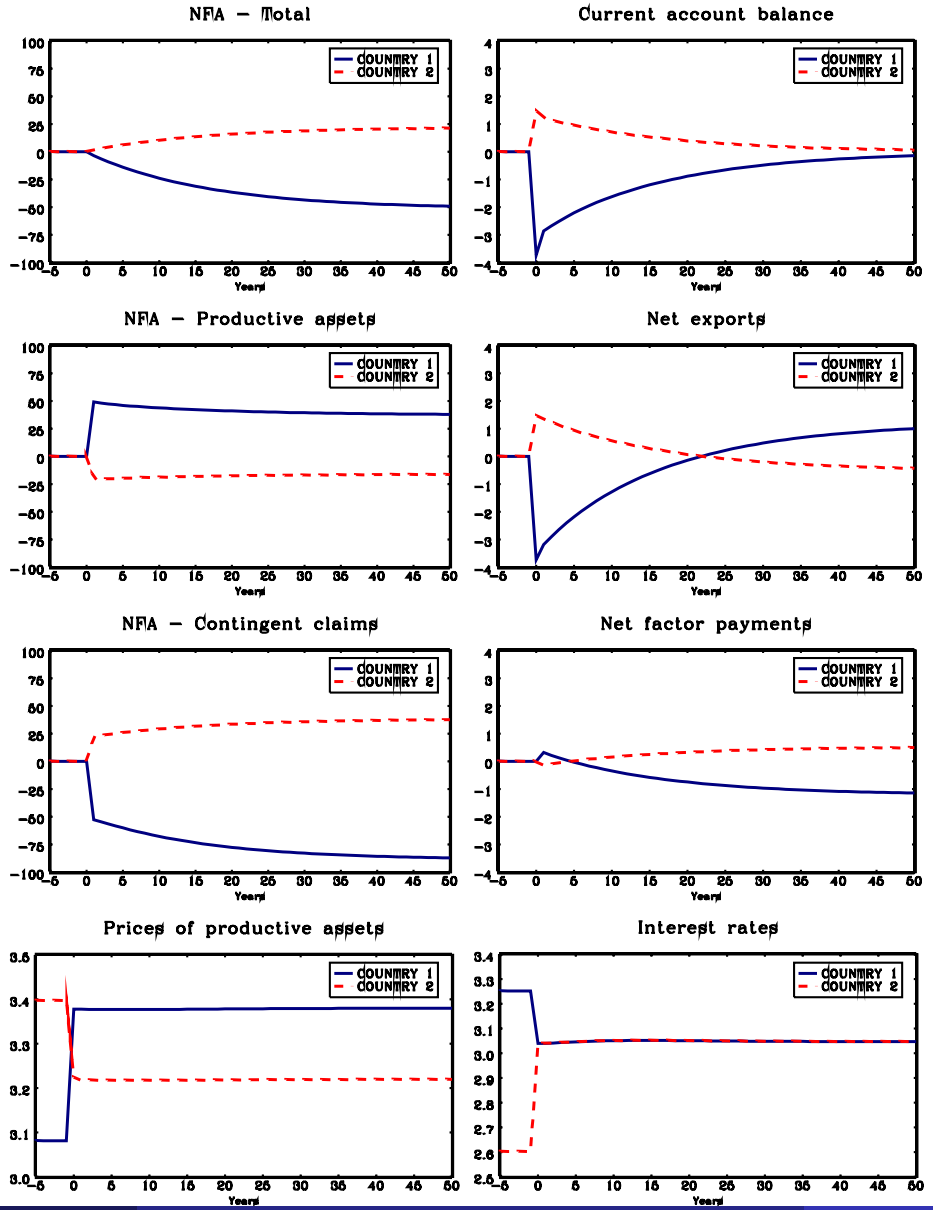
General Model

- Extend the simple model
  - N countries
  - diversifiable managerial capital $y_{t+1} = \sum_{i=1}^{N} z_{i,t+1} A_{it}^{1-\nu} k_{it}^{\nu}$ with $\sum_{i=1}^{N} A_{it} = 1$
  - second source of financial heterogeneity ($a(s_j) \geq \underline{a}^i$ limited liability) in addition to ϕ
  - differences in economic size of countries

US vs ROW

- $\mu_1 = 0.3$ to match US share of world GDP, 30 percent
- $\phi^1 = 0.3,\ \phi^2 = 0$ (contingent claims partly available in US)

US vs ROW: Transition



US vs ROW: steady state

Table 1: Steady state with and without capital mobility.

	Autarky		**Capital mobility**	
	C1	*C2*	*C1*	*C2*
A) Both shocks				
Prices of productive assets	3.08	3.40	3.38	3.22
Returns on productive assets	4.80	4.30	4.41	4.58
Interest rate	3.25	2.60	3.05	3.05
Net foreign asset positions	-	-	-51.39	22.12
Productive assets	-	-	37.41	-16.10
Bonds	-	-	-88.80	38.22
Gross holdings of productive assets				
Domestic	1.00	1.00	0.24	0.61
Foreign	-	-	0.91	0.33
Welfare gains from liberalization			2.63	-0.27

US vs ROW: welfare

- Two sources of welfare gains/losses
  - diversification of investment risk
  - cost of borrowing/lending
- In country 1, all agents gain from liberalization, and the gains are especially high for low wealth agents
- In country 2, agents also gain from diversification of risk, but the increase in interest rates relative to autarky hurt the poor. Overall, they suffer a welfare loss.

US, Advanced, and Emerging

- $\mu = (0.3, 0.5, 0.2)$ to match shares of world GDP
- $\phi = (0.5, 0.5, 0)$, $\underline{a} = (-1, 0, 0)$
- $\beta = (0.925, 0.925, 0.863)$ to capture differential growth effects

Table 6: Steady state in the three-country economy with heterogeneity in financial development, growth and income volatility.

	Autarky			**Capital mobility**		
	C1	C2	C3	C1	C2	C3
Prices of productive assets	2.65	2.95	3.84	2.85	2.82	2.87
Returns on productive assets	5.63	5.05	3.60	5.10	5.10	5.81
Interest rate	3.96	3.53	1.24	3.68	3.68	3.68
Net foreign asset positions	-	-	-	-76.89	-0.23	117.07
Productive assets	-	-	-	29.68	29.54	-120.70
Bonds	-	-	-	-106.57	-29.77	237.77
Gross holdings of productive assets						
Country 1	1.00	1.00	1.00	0.33	0.32	0.19
Country 2	-	-	-	0.57	0.57	0.21
Country 3	-	-	-	0.20	0.20	0.19

Notes: The heterogeneous parameters are $\phi = (0.5, 0.5, 0)$, $\underline{a} = (-1, 0, 0)$, $\beta = (0.925, 0.925, 0.863)$, $\Delta_w = (0.6, 0.6, 0.9)$, $\Delta_z = (2.5, 2.5, 3.75)$, $\mu = (0.3, 0.5, 0.2)$. See also Table 1.