External Adjustment, Global Imbalances and Global Safe Assets

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1-Stylized Facts, The Neoclassical Benchmark & Models of Global Imbalances

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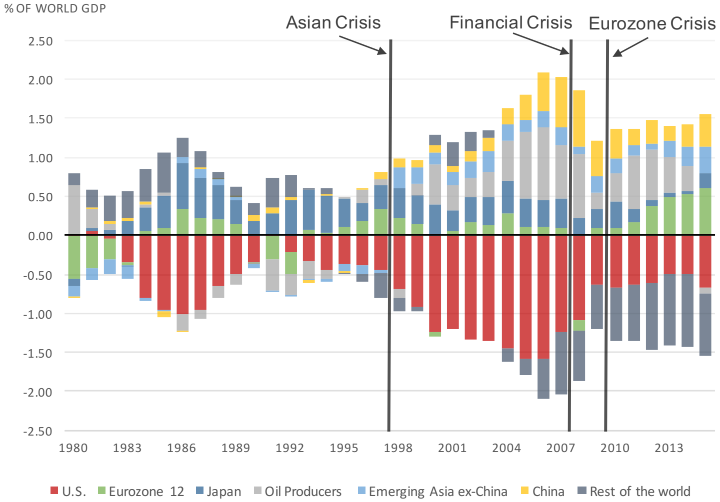
Outline

Stylized Facts

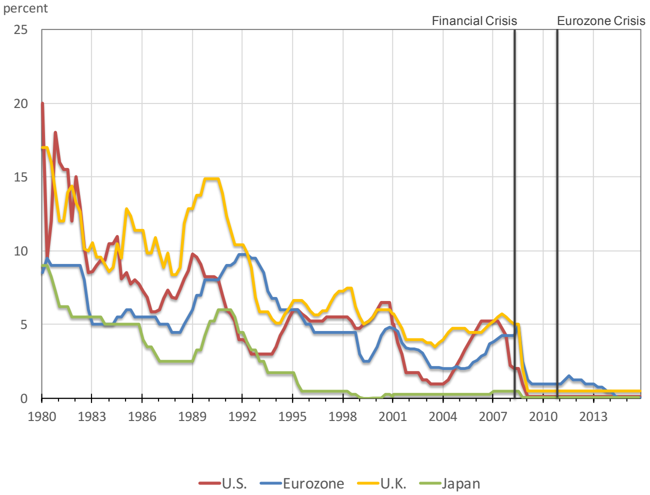
1. Global Imbalances
2. World Interest Rates
3. Allocation Puzzle
4. Cross-Border Gross Flows and Positions
5. Heterogeneity in Global External Portfolios
6. Valuation Effects
7. The Scarcity of Safe Assets

Stylized Fact 1: Global Imbalances



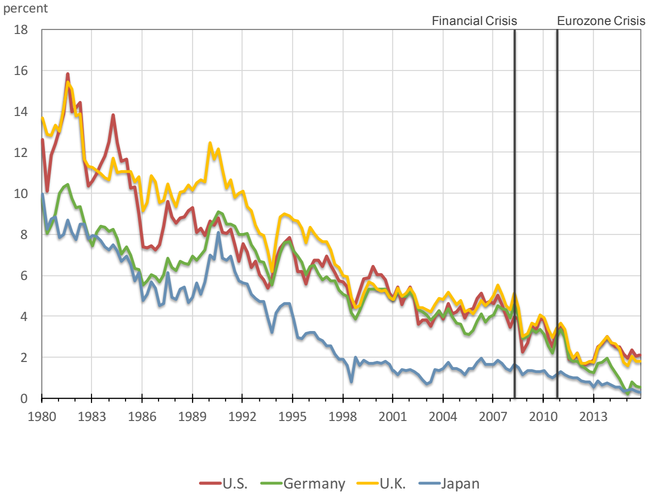
Oil Producers: Bahrain, Canada, Iran, Iraq, Kuwait, Libya, Mexico, Nigeria, Norway, Oman, Russia, Saudi Arabia, United Arab Emirates, Venezuela. Emerging Asia ex-China: India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Source: IMF WEO, Various Issues

Stylized Fact 2: Advanced World Policy Rates



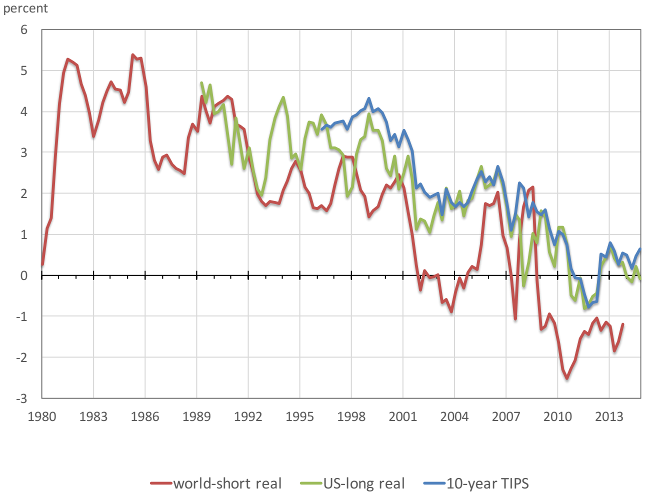
Source: Global Financial Database

Stylized Fact 2: Advanced World 10-Year Yields



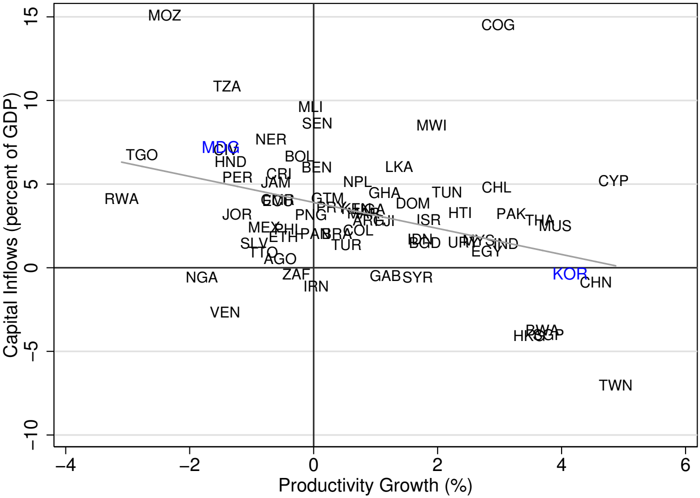
Source: Global Financial Database

Stylized Fact 2: World Real Rates



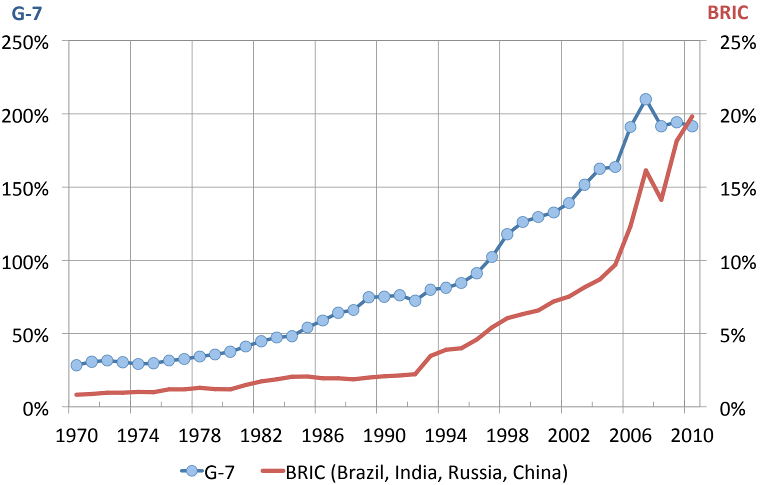
Source: Global Financial Database

Stylized Fact 3: Allocation Puzzle



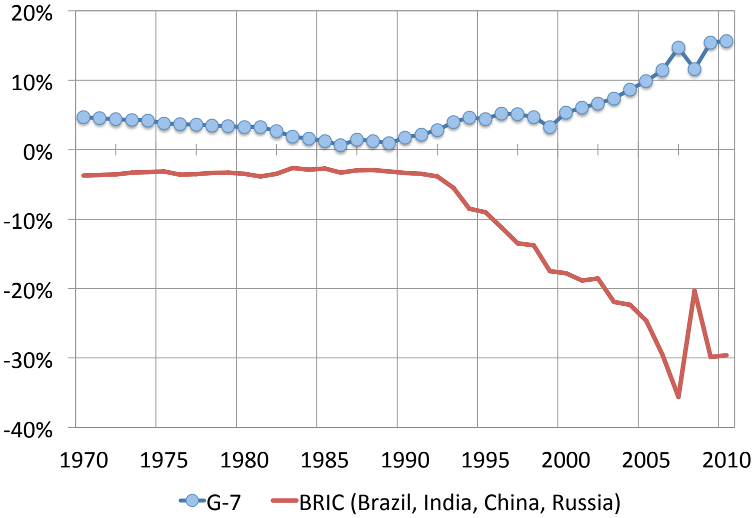
Average Productivity Growth and Capital Inflows Between 1980 and 2000. Note: Sample of 68 developing economies. Source: Gourinchas and Jeanne (2013)

Stylized Fact 4: Cross-Border Asset and Liabilities (% of World GDP)



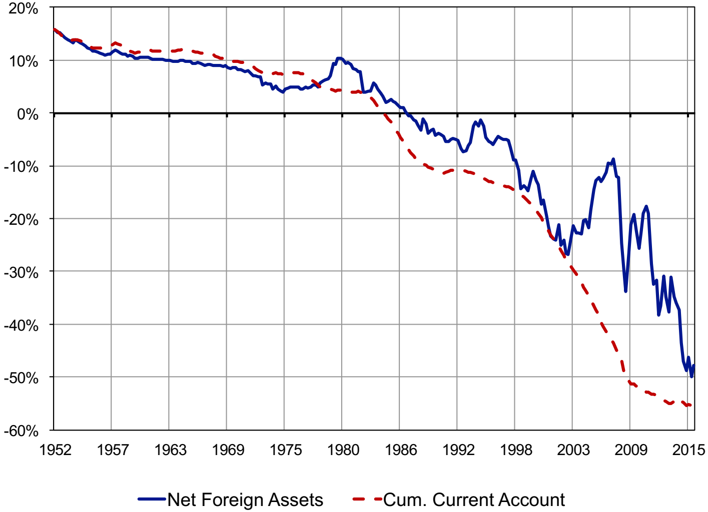
Cross-Border Assets and Liabilities Defined as the Sum of Gross External Assets and Liabilities.
Source: Lane and Milesi-Ferretti (2007a) updated to 2010

Stylized Fact 5: Heterogeneity. Net Risky Position



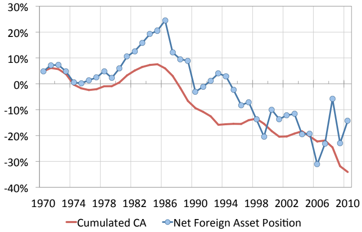
Net Risky Position Defined as Equity and Direct Investment Assets, Minus Equity and Direct Investment Liabilities. Source: Lane and Milesi-Ferretti (2007a) updated to 2010

Stylized Fact 6(a): Valuation Effects, U.S.

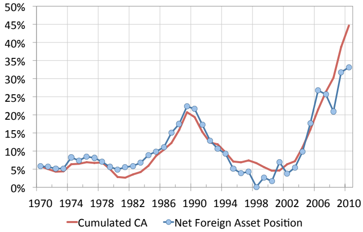


Source: Gourinchas & Rey (2016)

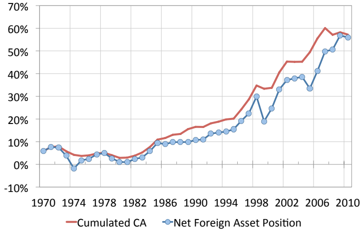
Stylized Fact 6(b): Valuation Effects, ADV, 1970-2010



(a) United Kingdom



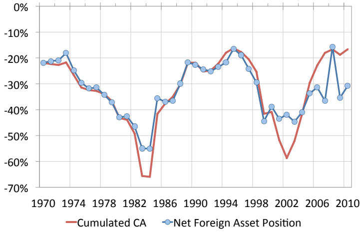
(b) Germany



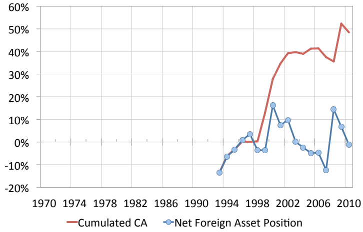
(c) Japan

Cumulated Current Account and Net Foreign Asset Position, US, UK, Germany and Japan, 1970-2010. Percent of GDP

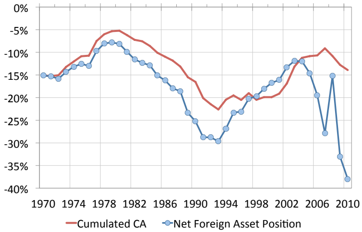
Stylized Fact 6(c): Valuation Effects BRIC, 1970-2010



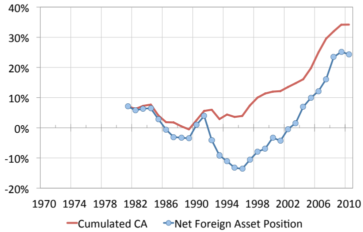
(d) Brazil



(e) Russia



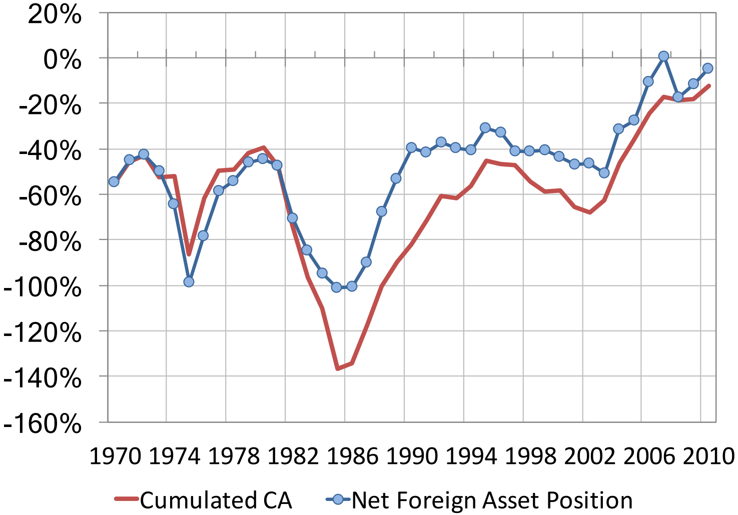
(f) India



(g) China

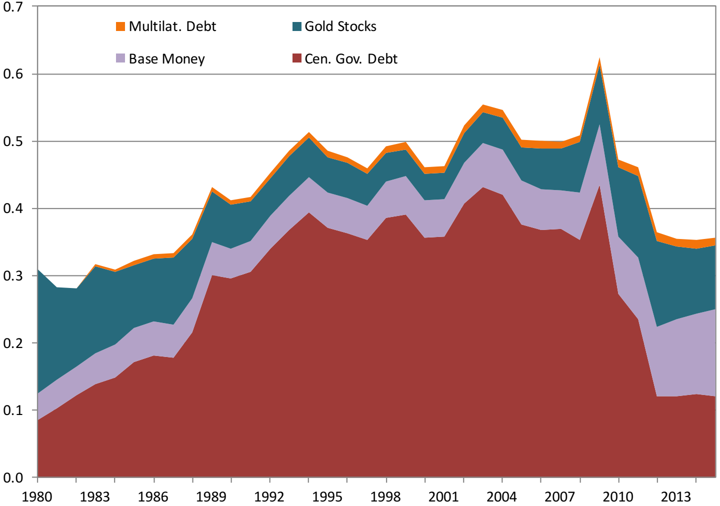
Cumulated Current Account and Net Foreign Asset Position, Brazil, Russia, India and China, 1970-2010. Percent of GDP

Stylized Fact 6(d): Chile



Cumulated Current Account and Net Foreign Asset Position, Chile. Percent of GDP. Source: Lane and Milesi-Ferretti (2007a) updated to 2010

Stylized Fact 7: Scarcity of Safe Assets



Global Financial Liquidity as a Share of World GDP by component, 1980-2015. Source: Eichengreen (2016)

Motivating Questions

1. What do standard growth models have to say about the determinants of international exchange of financial assets?
2. How should we alter the models to fit the evidence on global imbalances?
3. What are the consequences of increased cross-border financial integration on the process of external adjustment?
4. What is the effect of the scarcity of safe assets?
5. What are the implications for the International Monetary System?

Modeling choices

Aim is to provide a **unifying framework** to discuss capital flows and global imbalances in growing economies

- Neo-classical growth model and long term capital flows Special emphasis on determinants of **autarky rates**
- Models of global imbalances
  Asset shortage, precautionay savings, frictions and demographics: they **alter autarky rates**
- From the intertemporal approach of the current account to valuation effects
- Quantification of the **valuation channel of external adjustment** and imperfect asset substitutability: the revival of portfolio balance models
- 'Safe Assets' scarcity, safety traps and currency wars
- Implication of the 'safe asset view' for the workings of the International Monetary and Financial System

Neo-classical growth model and long term flows

- Time is continuous and there is no uncertainty.
- Consider a country with one homogeous good and a population N_t that grows at a constant rate n

$$U_t = \int_t^{\infty} e^{-\rho(s-t)} N_s u\left(c_s\right) ds,$$

where $\rho > 0$ is the rate of time preference, $u\left(c\right) = c^{1-\gamma} / \left(1-\gamma\right)$ is an isoelastic instantaneous utility function with constant relative risk aversion γ.

- Production function:

$$Y_t = K_t^{\alpha} \left(\xi_t N_t\right)^{1-\alpha},$$

ξ_t is some exogenous labor-augmenting measure of productivity that grows at a constant rate g. α is the capital share.

- Output can be consumed, or invested $Y_t = C_t + I_t$,

$$\dot{K}_t = I_t - \delta_k K_t$$

- Given some initial conditions $K_0,\ \xi_0,\ N_0 > 0$, the set-up is complete.

Autarky rates and capital flows

- *Financial autarky*: no cross border *financial* transactions.
- *Autarky real interest rate*: r_t^a equal to the net marginal return to capital:

$$r_t^a = MP_k - \delta_k = \alpha \tilde{k}_t^{\alpha-1} - \delta_k.$$

where $\tilde{x} = X/\xi N$ is expressed in efficiency units.

- The theory says that autarky rates are high if countries are *capital-scarce*: $\tilde{k}_0$ low. [initial conditions]

Relation to Lucas puzzle

- Lucas (1990) observed that *if* countries share the same technology (α, δ_k and ξ) then the marginal product of capital in countries i and j is in relation to the output per worker:

$$\frac{MP_k^i}{MP_k^j} = \frac{\alpha \tilde{k}^{i(\alpha-1)}}{\alpha \tilde{k}^{j(\alpha-1)}}$$

Relation to Lucas puzzle

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Relation to Lucas puzzle

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$$\frac{MP_k^i}{MP_k^j} = \left(\frac{y^i/\xi}{y^j/\xi}\right)^{(\alpha-1)/\alpha}$$

Relation to Lucas puzzle

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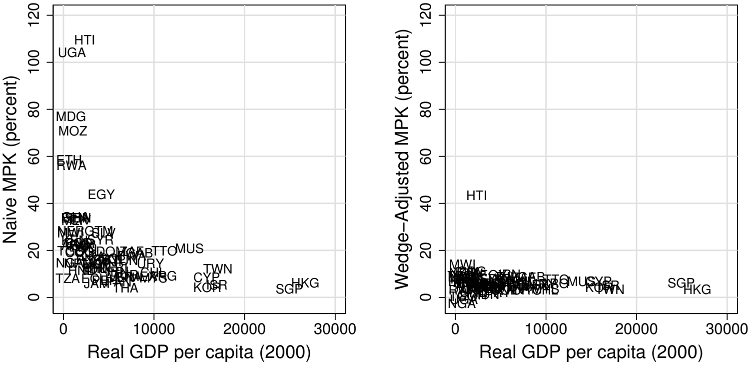
$$\frac{MP_k^i}{MP_k^j} = \left(\frac{y^i}{y^j}\right)^{1-1/\alpha}$$

- US-India: $y^i/y^{us} = 1/15$. With $\alpha = 0.4$, $MP_k^i/MP_k^{us} = (1/15)^{1-1/0.4} = 58$
- puzzle can be 'solved' if ξ differs across countries. Some evidence that labor productivity varies systematically but not enough
- puzzle can also be solved if we take into account variation in α (Caselli and Feyrer 2007). Two good candidates:
  - lower share of *reproducible* capital in less developed countries, so lower MP_k
  - higher price of investment goods relative to consumption, reduces also MP_k.
- another possibility: wedge between private and social return to capital. $r = (1-\tau)(MP_k - \delta_k)$

Returns to Capital, Developing Countries, 2000



Source: Gourinchas & Jeanne (2013) Capital wedge τ calibrated to match average investment rate, 1980-2000.

Relation to Lucas puzzle

- Conclusion: empirical evidence largely consistent with equalization of wedge-adjusted returns.

- International frictions unlikely to prevent financial arbitrage: the assumption of financial mobility is perhaps reasonably accurate

- Direct observation of realized rates of return provides little guidance as to the underlying autarky rates.

Autarky rates and capital flows

- Steady state:

$$r_{ss}^{a} = \rho + \gamma g$$

  increases with long run productivity growth g, rate of time preference ρ; decreases with elasticity of intertemporal substitution $1/\gamma$.
- With common preferences, once initial capital scarcities are eliminated, differences in autarky interest rates across countries are driven by differences in productivity growth: high autarky rate if high g. [productivity growth]

Two determinants: historical conditions (k_0) and long term productivity growth (g)

Small open economy

Consider now a small open economy facing a constant world real interest rate r. Along the optimal plan, consumption per capita grows at

$$\frac{d\ln c_t}{dt} \equiv g_c = \frac{1}{\gamma}\left(r-\rho\right) = g + \frac{1}{\gamma}\left(r - r_{ss}^a\right)$$

- consumption growth is higher/lower than output growth if the world interest rate is higher/lower than the autarky interest rate.
- if world interest rate is determined in similar fashion: $r = \rho + \gamma\bar{g}$, then $g_c = \bar{g}$ regardless of g. (caveat: if $g > \bar{g}$, then at some point the country does not remain small).
- external financial wealth $(\tilde{b})$ and the current account $(c\tilde{a})$ evolve according to:

$$\begin{aligned}
\tilde{b}_t &= \left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g}\right) e^{\left(r-r_{ss}^a\right)t/\gamma} - \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g} - \tilde{k}\,(r) \\
c\tilde{a}_t &= (n+\bar{g})\left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g}\right) e^{\left(r-r_{ss}^a\right)t/\gamma} - (n+g)\left(\frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g} + \tilde{k}\,(r)\right)
\end{aligned}$$

Small open economy

Need to consider three cases:

- **Case 1**: $r^a_{ss} < r = \rho + \gamma\bar{g}$. This occurs when $g < \bar{g}$.

$$\begin{aligned} \tilde{b}_t &= \left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g}\right) e^{(r-r^a_{ss})\frac{t}{\gamma}} - \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g} - \tilde{k}\,(r) \\ c\tilde{a}_t &= (n+\bar{g})\left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g}\right) e^{(r-r^a_{ss})\frac{t}{\gamma}} \\ &\quad -(n+g)\left(\frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g} + \tilde{k}\,(r)\right) \end{aligned}$$

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$$c\tilde{a}_t = (n+\bar{g}) \left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}(r)}{r-n-g} \right) e^{\left(r - r_{ss}^{a}\right)\frac{t}{\gamma}} - (n+g) \left(\frac{(1-\alpha)\,\tilde{y}(r)}{r-n-g} + \tilde{k}(r) \right)$$

- Eventually the country runs a current account surplus and holds a positive net foreign position. Because optimal consumption grows at a higher rate than output, the country needs to accumulate growing claims against the rest of the world.

Small open economy

Need to consider three cases:

- **Case 2**: $r_{ss}^{a} = r$. In that case $g = \bar{g}$

$$
\begin{aligned}
\tilde{b}_t &= \left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g}\right) e^{\left(r-r_{ss}^{a}\right)\frac{t}{\gamma}} - \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g} - \tilde{k}\,(r) \\
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\end{aligned}
$$

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&\quad - (n+g)\left(\frac{(1-\alpha)\,\tilde{y}(r)}{r-n-g} + \tilde{k}(r)\right)
\end{aligned}
$$

Small open economy

Need to consider three cases:

- **Case 2**: $r^a_{ss} = r$. In that case $g = \bar{g}$

$$\begin{aligned} \tilde{b}_t &= \tilde{w}_0 - \tilde{k}\,(r) \\ c\tilde{a}_t &= (n+g)\left(\tilde{w}_0 - \tilde{k}\,(r)\right) \end{aligned}$$

- The current account and net foreign asset positions are driven by initial capital scarcity and external claims.

Small open economy

Need to consider three cases:

- **Case 3**: $r < r_{ss}^a$. This corresponds to $g > \bar{g}$.

$$\begin{aligned}
\tilde{b}_t &= \left(\tilde{w}_0 + \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g}\right) e^{(r-r_{ss}^a)\frac{t}{\gamma}} - \frac{(1-\alpha)\,\tilde{y}\,(r)}{r-n-g} - \tilde{k}\,(r) \\
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- Asymptotically the economy becomes a *net borrower* and runs a *current account deficit*. Since the country's output grows faster than the rest of the world, foreigners want to invest domestically.

Endogenous world interest rate

If home has a higher growth rate of productivity than foreign ($g > g^*$) then

$$\rho + \gamma g^* = r_{ss}^{a*} \leq r \leq r_{ss}^{a} = \rho + \gamma g$$

Comparative advantage [generalization of Obstfeld Rogoff (1996)]:

Countries export (resp. import) capital when the autarky interest rate is below (resp. above) the world interest rate.

Countries export goods that are relatively abundant (i.e. with low autarky prices), countries export capital when capital is relatively abundant, i.e. when autarky real interest rates are relatively low.

Empirical implications: if emerging economies are more capital scarce and if their productivity growth is higher than advanced economies, capital should flow towards them.

Current Account and Productivity Differentials

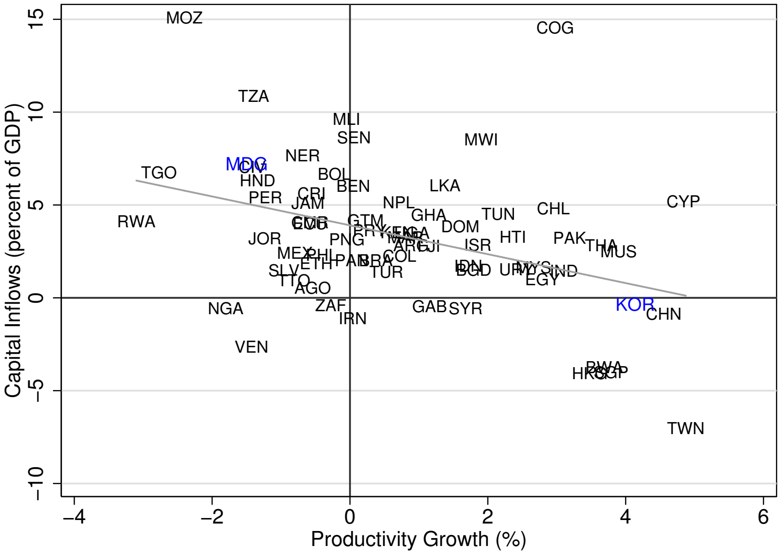
- Standard theory can explain current account balances if:
  - capital scarcities are not too large for developing world ($\tilde{k} \approx \tilde{k}_{ss}$)
  - productivity growth larger in advanced world: $g^{ADV} > g^{DEV}$.

- If true, broad pattern of economic divergence. Contrary to what we've seen in the last twenty years: Countries with faster productivity growth are the ones with CA surpluses.

- Simple financial frictions cannot account for this pattern.
  - recall that autarky rate is determined as $r_{ss}^a = \rho + \gamma g$. Independent from financial frictions τ.
  - long run effect of financial frictions entirely on MP_k and capital-output ratio:

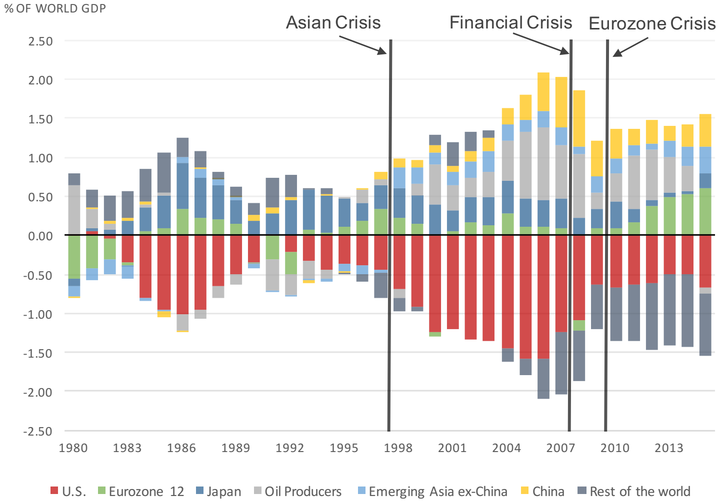
$$MP_k = \left(r_{ss}^a + \delta_k\right)/(1-\tau) = \left(\rho + \gamma g + \delta_k\right)/(1-\tau)$$

Reality check



Source: Gourinchas & Jeanne (2013)

The elephant in the room



Oil Producers: Bahrain, Canada, Iran, Iraq, Kuwait, Libya, Mexico, Nigeria, Norway, Oman, Russia, Saudi Arabia, United Arab Emirates, Venezuela. Emerging Asia ex-China: India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Source: IMF WEO, Various Issues

Models of Global Imbalances

- What is needed : different models of the autarky interest rates.
- Specifically, models in which "frictions" drive *down* the autarky interest rates of emerging economies and drive *up* their marginal product of capital
- Different flavours:
  - asset shortage [Caballero, Farhi and Gourinchas]
  - demographics interacted with credit constraint [Coeurdacier, Guibaud and Jin]
  - precautionary savings [Mendoza, Quadrini and Rios-Rull; Angeletos and Panousi]
  - financial friction and international trade [Antras and Caballero, Jin]

Lowering the autarky rate through asset shortages

- Generalization of Caballero et al. (2008); perpetual youth model (Blanchard, 1985)
- Agents unable to invest in claims on ressources of unborn generations: shortage of stores of values
- *Non-Ricardian Model*

Assumptions

- Each agent faces an i.i.d instantaneous probability θ of dying (Poisson). A fraction θ of the population is also born every instant, so that population is constant. The only risk faced by households is mortality risk.
- Denote by $c(s,t)$, $w(s,t)$, $z(s,t)$ the consumption, financial assets and nonfinancial income at time t of an individual born at time $s \leq t$. As of time t, the household maximizes

$$U_t = \int_t^{\infty} e^{-(\rho+\theta)(u-t)} u(c(s,u))\, du$$

- The budget constraint -while alive- is

$$\frac{dw(s,t)}{dt} = (r_t + \theta)\, w(s,t) - c(s,t) + z(s,t)$$

- Production structure: $Y_t = K_t^{\alpha} \left(\xi_t N_t\right)^{1-\alpha}$

Solution to household problem

- Optimal consumption path satisfies Euler equation:

$$\gamma \frac{d \ln c(s,t)}{dt} = r_t - \rho$$

Note: mortality risk θ makes households more impatient, but this is exactly compensated by higher return on savings (competitive annuity market).

- With logarithmic preferences ($\gamma = 1$), the consumption function takes the simple form:

$$c(s,t) = (\rho + \theta)\left[w(s,t) + h(s,t)\right]$$

where $h(s,t) = \int_t^{\infty} z(s,y)\, e^{-\int_t^u (r_v + \theta) dv} du$ is the PDV of future non financial income over the expected lifetime of the household.

Solution to household problem

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$$\gamma \frac{d \ln c(s,t)}{dt} = (r_t + \theta) - (\rho + \theta)$$

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Aggregation

Aggregate value summed over existing cohorts:

$$X_t = \int_{-\infty}^{t} x\left(s,t\right)\theta e^{-\theta(t-s)} ds$$

Aggregate consumption:

$$C_t = (\rho+\theta)\left[W_t + H_t\right].$$

where H_t is the present discounted value of non financial income of all *currently alive* cohorts:

$$H_t = \int_{-\infty}^{t} h\left(s,t\right)\theta e^{-\theta(t-s)} ds$$

H_t differs from $\bar{H}_t$, non financial wealth of current and future generations:

$$\bar{H}_t = \int_{t}^{\infty} Z_u e^{-\int_t^u r_v dv} du$$

$H_t \leq \bar{H}_t$ and equality when $\theta = 0$.

Non-Ricardian feature of the model.

Demographics

The model allows for some interesting demographic features. In particular, one can parametrize the shape of the cross-section income profile as follows:

$$z(s,t) = \frac{\phi + \theta}{\theta} Z_t e^{-\phi(t-s)},$$

where $\phi \geq 0$ is the slope of income in the cross section.

- $\phi \to \infty$, all nonfinancial income is received by the newborn generation: $z(t,t) = Z_t$. Maximizes asynchronicity between income and expenditures.
- $\phi = 0$, all households receive the same income, regardless of age, which mitigates the need for saving.

Closing the model

We make three assumptions:

1. there is no depreciation of capital: $\delta_k = 0$.
2. the ratio of non-financial wealth of currently alive cohorts to the economy's nonfinancial wealth is constant: $H_t = \beta \bar{H}_t$ with $0 \leq \beta \leq 1$. (true in steady state with β a decreasing function of ϕ)
3. the share of non-financial income is $1 - \delta$:

$$Z_t = (1 - \delta)\, Y_t.$$

δ is a **key parameter** (captures explicit taxation, the lack of enforcement of property rights, corruption or rent-seeking...)
It parameterizes the supply of stores of value. Payments to capital rK equal δY so $K/Y = \delta/r$. For a given interest rate r, the market value of the capital stock (the supply of stores of value under financial autarky) varies one-to-one with δ.
Note: $\delta = \alpha\,(1 - \tau)$.

Steady state autarky rates

The autarky interest rate satisfies:

$$\left(r_{ss}^a - g\right)\left(r_{ss}^a - \delta\left(g + \rho + \theta\right)\right) = \beta\left(\rho + \theta\right)\left(1 - \delta\right) r_{ss}^a.$$

Special cases:

- when $\beta = 1$, (corresponds to the case $\theta = \phi = 0$), the model collapses to the neoclassical ricardian benchmark and $r_{ss}^a = g + \rho$ (recall that $\gamma = 1$ with log preferences)
- when $\beta = 0$ (corresponding to $\phi \to \infty$, newborn get all financial income), we obtain $r_{ss}^a = \delta\left(g + \rho + \theta\right)$.

  Compared to the neoclassical model, two parameters influence the autarky rate:

  - mortality risk $\theta \geq 0$. Agents are more impatient which reduces the demand for stores of value.
  - asset supply $\delta \leq 1$. lowers the interest rate because only a share δ of income is paid out as financial income.
- in the general case, r_{ss}^a increases with β and:

$$\delta\left(g + \rho + \theta\right) \leq r_{ss}^a \leq g + \rho$$

Interpretation

- Mortality risk pushes up interest rate (impatience)
- The second effect is related to the *lack of supply of stores of value* in the non-Ricardian economy. If dominant, autarky interest rate falls below the autarky rate of the benchmark model.
- In general, a decrease in δ:
  - lowers the autarky interest rate r_{ss}^{a}
  - increases the autarky $MP_k = \alpha Y/K = \alpha r_{ss}^{a}/\delta$
- in the limit case $\beta = 0$, in fact the MP_k remains constant, regardless of δ:

  $$MP_k = \alpha (g + \rho + \theta)$$

  The interpretation is that variations in δ are fully absorbed by variations in r so as to leave the effective supply of stores of value K/Y constant.

The model provides simultaneously a rationale for high marginal product of capital and low autarky rates in countries with low levels of financial development, despite high g_a.

Open Economy and the direction of capital flows

Consider now a small open economy and assume $\beta = 0$

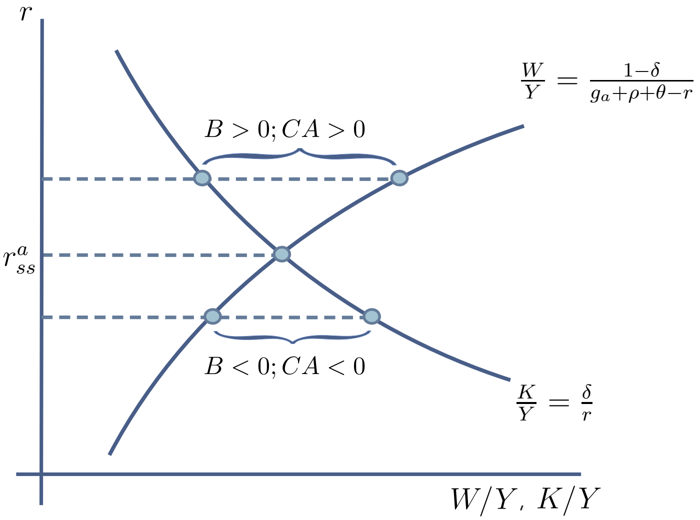
$$\frac{W_t}{Y_t} = \frac{1-\delta}{g+\rho+\theta-r} \qquad ; \qquad \frac{K_t}{Y_t} = \frac{\delta}{r}.$$

1. domestic *demand for stores of value* per unit of output, W/Y. A higher interest rate increases the demand for stores of value since wealth accumulates at a higher rate.
2. *domestic supply of stores of value* K/Y (here capital). A higher interest rate depresses the present discounted value of the payments to capital δY, which lowers the equilibrium capital-output ratio.

From this, we can derive the current account as:

$$\frac{CA_t}{Y_t} = \frac{g\delta}{r\left(r^a_{ss} - \delta r\right)} \left[r - r^a_{ss}\right]$$

The Metzler Diagram



World economy

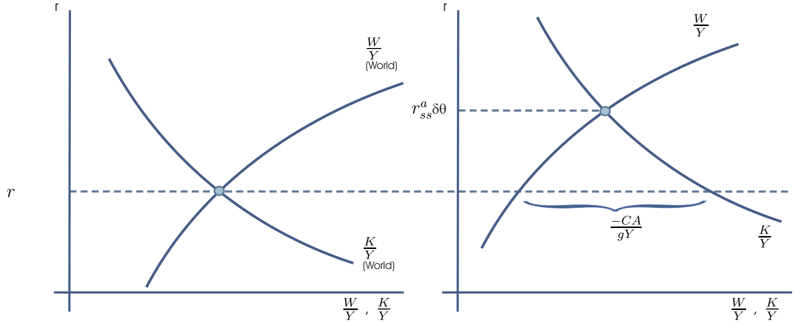
World economy composed of two countries, U and R. The two countries are identical, except in their level of financial development, captured by δ. Assume that $\delta^U > \delta^R$

$$\begin{aligned}
\frac{CA^U}{Y^U} &\rightarrow -g\frac{\delta^U(1-\omega^u)}{\bar{\delta}\left(r_{ss}^a - \delta^U r_{ss}\right)}\left[\delta^U - \delta^R\right] < 0 \\
r_{ss} &= \omega^u r_{ss}^U + (1-\omega^u) r_{ss}^R = \bar{\delta}(g+\rho+\theta)
\end{aligned}$$

where $\omega^u = Y^U / \left(Y^U + Y^R\right)$ is the share of U in the world economy and $\bar{\delta} = \omega^u \delta^U + (1-\omega^u)\delta^R$.

The country which has a smaller shortage of assets runs a deficit.

A Shortage of Stores of Value



The World Equilibrium when $\bar{\delta} < \delta^U$

What asset shortages?

Prices. By definition, we don't observe autarky interest rates. In a world with limited financial integration, there should be a wedge between interest rates in different regions and $|r^u - r^r| < \tau_i$ where τ_i measures *international* financial frictions. If $r^u_{ss} > r^r_{ss}$ then we should also expect $r^u_{ss} > r^u > r^r > r^r_{ss}$ so one could look directly at local interest rates to validate the theory. This is in principle consistent with evidence of financial repression in many countries. However, directly looking at interest rates is not an easy task:

- The evidence on convergence in MP_k and r suggests that τ_i must be quite small. So differences in rates of return could be easily determined by other factors
- Chief among them, the fact that interest rates are not typically risk-adjusted, so we're talking about different financial assets.
- Also market interest rates can be non-allocative (especially in environments with financial repression)

What asset shortages?

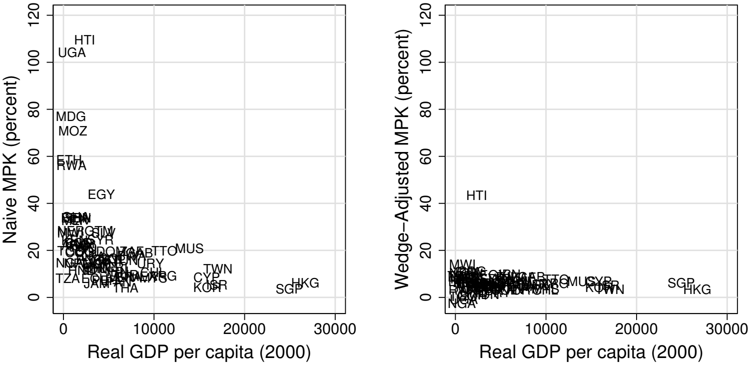
Quantities. It is potentially a more promising approach.

- Another possibility consists in measuring the marginal product of capital $MP_k = \alpha Y/K$ and the domestic wedge τ to match observed levels of investment, then infer domestic returns as $r = (1-\tau)(MP_k - \delta_k)$. This is what Gourinchas & Jeanne (2013) do and find very little variation in observed r. As before, this could be simply because observed returns have largely converged.

- Another possibility would be to infer the autarky rate from current account themselves, but this is a bit tautological since the pattern of current accounts is what is to be explained

- Yet another possibility is to focus on the supply of 'stores of value' and measure its evolution over time, relative to the size of the world economy. This creates other problems:
    - What is a store of value?
    - How to adjust for risk. Some assets are safe, others less so.
    - How about non-liquid assets (private equity)?

Returns to Capital, Developing Countries, 2000



Source: Gourinchas & Jeanne (2013) Capital wedge τ calibrated to match average investment rate, 1980-2000.

What asset shortages?

Indicators of financial development. A final approach is to test directly for indicators of financial development. One such paper is Gruber and Kamin (2005), estimating a panel regression of CA_t/Y_t on various determinants (fiscal, demography, growth...) and indicators of financial development (credit/GDP, market cap....). Results are not encouraging but:

- indicators are quite crude. What one wants is a measure of the *safety* of local stores of value. This is not going to be captured by aggregate measures such as credit/GDP or market cap/GDP.
- theory is about relative relative strength of economic growth and financial development. For some countries, financial development may go hand in hand with economic growth (i.e. no shortage of assets). For others, economic growth may run ahead of financial development (i.e. asset shortage)
- Forbes (2010) finds strong evidence of portfolio investment in the US from countries with weaker financial development.

The effect of δ^R on foreign investment in the U.S.

Table 4
Regression Results: Foreign Investment in U.S. Equities

	Full Sample (1)	Full Sample (2)	IMF Data (3)	Full Sample (4)	Middle & Low Income[1] (5)	High Income[1] (6)	Largest Holdings[2] (7)	GDP weighted (8)	Foreign Bias (9)	US Bias (10)
Capital Controls	-0.217**	-0.195**	-0.208**	-0.143**	-0.283**	-0.102**	0.024	-0.115**	-0.038*	-0.200**
	(0.049)	(0.048)	(0.044)	(0.042)	(0.037)	(0.033)	(0.044)	(0.030)	(0.020)	(0.045)
Financial Development	-0.354**	-0.291**	-0.407**	-11.292**	-1.177**	-0.172**	-0.155*	-14.720**	-0.159**	-0.169**
	(0.085)	(0.086)	(0.090)	(1.363)	(0.179)	(0.073)	(0.091)	(1.517)	(0.031)	(0.067)
Corporate Governance	0.363**	0.514**	0.242**	0.350**	-0.071	0.791**	0.673**	0.542**	0.435**	0.067
	(0.041)	(0.073)	(0.054)	(0.070)	(0.057)	(0.055)	(0.097)	(0.051)	(0.022)	(0.044)
Returns	-0.022**	-0.022**	-0.039**	-0.008	-0.010	-0.032*	-0.071**	-0.030**	-0.020**	-0.020**
	(0.007)	(0.007)	(0.009)	(0.006)	(0.007)	(0.019)	(0.030)	(0.008)	(0.006)	(0.008)
Correlation	0.098*	0.105**	0.165**	0.135**	0.190**	-0.106	-0.435**	0.053	0.078*	-0.065
	(0.053)	(0.052)	(0.076)	(0.049)	(0.068)	(0.088)	(0.165)	(0.053)	(0.043)	(0.047)
Closeness	-0.053	0.037	0.031	-0.107	0.043	-0.011	-0.199**	0.018	0.124**	-0.040
	(0.059)	(0.068)	(0.058)	(0.071)	(0.057)	(0.050)	(0.039)	(0.045)	(0.024)	(0.039)
Trade	3.261**	2.548**	2.151**	4.477**	3.190**	1.477**	2.835**	1.140**	0.037	4.180**
	(0.699)	(0.813)	(0.473)	(0.816)	(0.775)	(0.677)	(0.561)	(0.539)	(0.286)	(0.483)
GDP per Capita		-0.458**	2.519**	-0.424**			3.070**	-0.545**	0.578**	-0.905**
		(0.143)	(0.154)	(0.141)			(0.865)	(0.129)	(0.039)	(0.111)
*Financial Development * GDP per capita*				1.112**				1.441**		
				(0.137)				(0.149)		
Countries	*65*	*65*	*46*	*65*	*41*	*24*	*8*	*65*	*62*	*62*
Observations	*319*	*319*	*221*	*319*	*199*	*120*	*36*	*319*	*340*	*298*
Wald χ^2	*479.1*	*463.7*	*1161.3*	*576.2*	*437.0*	*542.4*	*1606.1*	*1615.0*	*2223.4*	*713.0*

Notes: Explanatory variable is the log of the deviation in each country's holdings of U.S. equity liabilities from the world market portfolio based on USG data except in columns 9 and 10. In these columns the dependent variable is the *Foreign Bias* and *Home Bias* as defined in Section IV. C. * and ** are significant at the 10% and 5% levels, respectively. Standard errors in parentheses. See appendix for variable definitions. Estimates are FGLS and are adjusted for heteroscedasticity and autocorrelation within each country. Regressions include period dummy variables. (1) Based on World Bank definitions. (2) Only includes observations for which country holds over $50 billion in U.S. equities.

from K. Forbes 'Why do foreigners invest in the U.S.?' Journal of International Economics 2010

The effect of δ^R on foreign investment in the U.S.

Table 6
Regression Results: Foreign Investment in U.S. Bonds

	Base (1)	Base[1] (2)	Base (3)	Middle & Low Income[2] (4)	High Income[2] (5)	Largest Holdings[3] (6)	GDP-weighted (7)	Financial Development measured by: Credit[1] (8)	Financial Development measured by: Index[4] (9)	Excludes Financial Centers[5] (10)
Capital Controls	0.014	-0.200**	-0.055	0.026	-0.039	0.089	-0.108**	-0.083**	0.050	0.052
	(0.042)	(0.045)	(0.042)	(0.080)	(0.041)	(0.057)	(0.041)	(0.034)	(0.042)	(0.044)
Financial Development	-0.714*	-0.493**	-21.379**	-1.704**	-0.912**	-203.476**	-31.172**	-15.570**	-5.252**	-18.398**
	(0.375)	(0.150)	(5.611)	(0.641)	(0.445)	(22.981)	(3.435)	(1.958)	(0.773)	(5.750)
Corporate Governance	0.198**	0.106**	0.075	-0.004	0.384**	0.125	0.263**	0.286**	0.094	0.130
	(0.077)	(0.038)	(0.087)	(0.087)	(0.118)	(0.167)	(0.082)	(0.053)	(0.072)	(0.101)
Returns	0.002		0.003	0.002	0.003	0.009	0.006*	0.004	0.000	0.000
	(0.003)		(0.003)	(0.006)	(0.009)	(0.011)	(0.004)	(0.003)	(0.003)	(0.004)
Correlation	0.045		0.054	-0.014	0.091	0.465**	0.055	-0.017	0.025	0.135*
	(0.057)		(0.057)	(0.183)	(0.114)	(0.143)	(0.076)	(0.059)	(0.056)	(0.072)
Closeness	-0.102**	-0.304**	-0.245**	0.034	-0.479**	-0.058	-0.342**	-0.322**	-0.313**	0.070
	(0.049)	(0.065)	(0.067)	(0.031)	(0.071)	(0.066)	(0.038)	(0.044)	(0.040)	(0.067)
Trade	2.470**	4.833**	4.334**	3.719**	6.208**	0.473	5.313**	4.654**	5.230**	1.981**
	(0.575)	(0.630)	(0.651)	(0.701)	(0.984)	(1.197)	(0.378)	(0.387)	(0.389)	(0.743)
GDP per Capita	-0.473**	-0.593**	-0.708**			-1.468**	-1.111**	-1.577**	0.560**	-1.140**
	(0.223)	(0.109)	(0.273)			(0.481)	(0.247)	(0.226)	(0.228)	(0.315)
*Fin. Dev. * GDP cap*			2.138**			19.624**	2.965**	1.517**	0.505**	1.887**
			(0.563)			(2.196)	(0.362)	(0.199)	(0.081)	(0.589)
Countries	*32*	*53*	*32*	*12*	*19*	*10*	*32*	*40*	*32*	*27*
Observations	*152*	*248*	*152*	*55*	*93*	*38*	*152*	*184*	*152*	*129*
Wald χ^2	*175.1*	*288.2*	*217.3*	*93.8*	*132.2*	*1828.9*	*492.9*	*382.2*	*696.2*	*107.8*

Notes: Explanatory variable is the log deviation in each country's holdings of U.S. debt liabilities from the world market portfolio based on USG data. * and ** are significant at the 10% and 5% level, respectively. Standard errors in parentheses. See appendix for variable definitions. Estimates are FGLS and are adjusted for heteroscedasticity and autocorrelation within each country. Period dummies included. (1) Financial Development is measured by private credit by deposit money banks and other financial institutions to GDP. (2) Based on World Bank definitions. (3) Only includes observations for which country holds over $50 billion in U.S. bonds. (4) Financial development index constructed as first standardized principle component of: private bond market capitalization to GDP, public bond market capitalization to GDP and private credit by deposit money banks and other financial institutions to GDP. (5) Excludes major financial centers: Hong Kong, Ireland, Japan, Singapore, Switzerland, and the United Kingdom.

from K. Forbes 'Why do foreigners invest in the U.S.?' Journal of International Economics 2010

Lowering the autarky rate through demographics and financial frictions (Coeurdacier, Guibaud and Jin, 2012)

- If countries have the same δ (supply of stores of value), but differ in terms of ϕ (the slope of the income profile in the cross-section), a country with a higher ϕ (like China, front loading more income on younger cohorts) will have a lower autarky interest rate because of the higher saving of the young. Hence in equilibrium, it will export savings to the rest of the world

- in CGJ, the young are less productive (hence have a lower wage) than middle-age workers and would like to borrow for life-cycle reasons, but they face more severe borrowing constraints, which prevents them from borrowing, in less financially developed economies. This increases national saving, depressing the world interest rate. This is equivalent to a higher ϕ (when looking at the saving profile)

Demographics and Financial Frictions

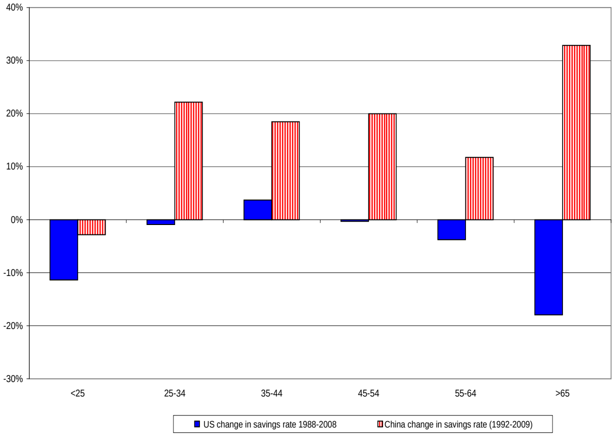


Figure 4.9: Change in Saving Rate by Age Group in the U.S. and China.
Notes: Changes in saving rates for China are estimated over the period 1992-2009 with Chesher method (controlling for household characteristics), and over the period 1988-2008 with Method 3 for the U.S. (sectoral-specific adjustment factors and correcting for health expenditures).

from Coeurdacier, Guibaud and Jin, 'Credit Constraints and Growth in a Global Economy' 2012

Lowering the autarky rate through precautionary savings (Angeletos and Panousi; Mendoza, Quadrini and Rios Rull)

We introduce tractable idiosyncratic income risk in the neoclassical model

- Country populated with a continuum of infinitely-lived households uniformly distributed over $[0, 1]$.

$$U_{it} = \int_t^{\infty} e^{-\rho(s-t)} u(c_{is})\, ds,$$

- Each household supplies one unit of labor inelastically to a competitive labor market
- Each household also runs a 'privately-held' firm:

$$y_{it} = F(k_{it}, \xi_{it} n_{it}) = k_{it}^{\alpha} (\xi_t n_{it})^{1-\alpha}$$

- Households can trade a riskless bond in zero net supply. The budget constraint is:

$$dw_{it} = d\pi_{it} + [r_t b_{it} + z_t - c_{it}]\, dt$$

  where $w = k + b$ is the household financial wealth (common to all households), b the bond holdings, z non financial income, r is the equilibrium riskfree rate and and $d\pi$ the household's capital income

- No aggregate risk, but *idiosyncratic risk* on capital income:

$$\begin{aligned} d\pi_{it} &= [y_{it} - z_t n_{it} - \delta_k k_{it}]\, dt + \sigma k_{it} d\omega_{it} \\ &= \bar{r}_t k_{it} dt + \sigma k_{it} d\omega_{it} \end{aligned}$$

- The idiosyncratic risk $d\omega_{it}$ is a standard Wiener process, iid across agents and time (obsolescence shock).

- σ captures the amount of *residual* risk faced by households after all available risk-sharing opportunities have been exhausted. Complete market would be $\sigma = 0$.

- $\bar{r}_t$ is the (common) expected return to capital equal to $\bar{r}_t = \alpha \bar{n}_t^{1-\alpha} - \delta_k$ where $\bar{n}_t = ((1-\alpha)\xi_t / z_t)^{1/\alpha}$

Because the budget constraint is linear in capital, the problem is a variant of the standard Samuelson-Merton problem. Define $x = w + h$ (total wealth) where $h = \int_t^{\infty} e^{-\int_t^s r_v dv} ds$ is human wealth, then:

$$\begin{aligned}
c_{it} &= m_t x_{it} \\
k_{it} &= \phi_t x_{it} \\
b_{it} &= (1-\phi_t)\, x_{it} - h_t \\
\phi_t &= \frac{\bar{r}_t - r_t}{\gamma\sigma^2} \\
\frac{\dot{m}_t}{m_t} &= m_t + \frac{(1-\gamma)\,\hat{\rho}_t - \rho}{\gamma}
\end{aligned}$$

where ϕ is the share of wealth invested in capital (common to all households), m is the marginal propensity to consume out of total wealth (common to all households) and $\hat{\rho}_t = [\phi_t \bar{r}_t + (1-\phi_t) r_t] - \gamma\phi_t^2\sigma^2/2$ is the risk-adjusted return on the portfolio.

Special case: $\gamma = 1$. Then, $m = \rho$.

Financial Autarky

Aggregation is straightforward since MPC and portfolio shares are identical across households, and risk is idiosyncratic (so that $\int d\omega_{it} di = 0$). Under financial autarky ($B = 0$ and $W = K$), we obtain:

$$
\begin{aligned}
\tilde{h} &= \frac{(1-\alpha)\,\tilde{k}^{\alpha}}{r_{ss}^{a} - g} \\
\phi &= \frac{\tilde{k}}{\tilde{k} + \tilde{h}} = \frac{\bar{r} - r_{ss}^{a}}{\gamma\sigma^{2}} \\
g &= \frac{\hat{\rho} - \rho}{\gamma} + \frac{1}{2}\gamma\phi^{2}\sigma^{2} \\
\hat{\rho} &= r_{ss}^{a} + \left(\bar{r} - r_{ss}^{a}\right)^{2} / \left(2\gamma\sigma^{2}\right) \\
\bar{r} &= \alpha\tilde{k}^{\alpha-1} - \delta_{k}
\end{aligned}
$$

Steady state autarky rate

$$r_{ss}^a \leq \hat{\rho} = \rho + \gamma g - \frac{1}{2}\gamma^2\phi^2\sigma^2 \leq \rho + \gamma g.$$

The precautionary motive depresses the autarky rate below the benchmark return in the riskless economy, equal to $\rho + \gamma g$. It increases the demand for riskless bonds, which pushes down the riskless rate up to the point where households decide not to hold riskless bonds in equilibrium.

Capital has to offer a premium in equilibrium:

$$\bar{r} = \alpha \tilde{k}^{\alpha-1} - \delta_k = r_{ss}^a + \sigma \left(\frac{2\gamma\left(\rho + \gamma g - r_{ss}^a\right)}{1+\gamma} \right)^{1/2}$$

Small open economy

Again, consider a small open economy facing world interest rate r.

- demand for stores of value:

$$\tilde{k}(r) = \left(\frac{r + \gamma\sigma^2\phi(r) + \delta_k}{\alpha} \right)^{1/(\alpha-1)}$$

- supply of stores of value:

$$\tilde{w}(r) = \left(\frac{2(\rho + \gamma g - r)}{\gamma\sigma^2(1+\gamma)} \right)^{1/2}$$

- net foreign position $\tilde{b}(r)/\tilde{k}(r) = \tilde{w}(r)/\tilde{k}(r) - 1$ is increasing in r. For $r > r_{ss}^a$, the country is a net creditor
- When $\alpha \approx 1$, Net creditor countries ($\tilde{b} > 0$) tend to run current account surpluses in response to positive income shocks (Kraay & Ventura (2000)):

$$\frac{\partial \tilde{k}}{\partial \tilde{x}} \approx \frac{\tilde{k}}{\tilde{k} + \tilde{b}}$$

World economy

World economy with two identical countries facing different levels of residual uninsurable risks with $0 < \sigma < \sigma^*$ where * denotes the less financially developed economy.

$$\begin{aligned} r^a_{ss} &\leq r \leq r^{a*}_{ss} < \rho + \gamma g \\ \tilde{k}(r^{a*}_{ss}) &< \tilde{k}^* < \tilde{k} < \tilde{k}(r^a_{ss}) \\ \tilde{b} &< 0 < \tilde{b}^* \end{aligned}$$

1. The capital stock in the riskier economy is lower than in the safer one (risk premium effect dominates).
2. The capital stock increases in the less developed economy upon financial integration: $\tilde{k}(r^a_{ss}) < \tilde{k}(r)$. The increase in interest rates makes the south richer and induces them to take more risk.
3. The marginal product of capital is higher and the capital-output ratio lower in less financially developed economies.
4. The more financially developped economy exports safe assets.

Mendoza, Quadrini and Rios Rull has similar results but is richer: it also allows for trade in risky assets.

Other models

- Models with trade and financial frictions : Antras and Caballero, Jin
- Models with active financial account management: Jeanne
- Models with a demand for liquidity complementary to investment: Bacchetta-Benhima