

Financial Integration and Growth in a Risky World

Nicolas Coeurdacier (SciencesPo and CEPR)

Hélène Rey (LBS, NBER and CEPR)

Pablo Winant (Bank of England)

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Motivation

Core question in international macroeconomics and finance

- Where do gains from international financial integration come from?
- Conventional view
 - ▶ efficient allocation of capital: capital flows to emerging countries
 - ▶ risk sharing: reduces volatility of aggregate consumption
- Other possibilities (not studied here)
 - ▶ effect on TFP (via financial markets development, institutional changes, macroeconomic policies...)

A simple experiment

Stochastic neoclassical framework with two production economies

- An emerging (risky) country (5% volatility of productivity shocks)
- A relatively safer developed country (2.5% volatility)
- Emerging country starts with 50% of the capital of developed country.

Questions

- What is the growth impact of financial integration?
- What is the dynamics of capital flows?
- How big are the gains from financial integration?
- Who benefits the most?

Modelling jointly the two types of gains in general equilibrium

- Two classes of models to quantify welfare gains
 - ▶ Allocative efficiency of financial integration without aggregate risk
 - ▶ International risk sharing without production
- Need for an integrated framework
 - ▶ Both types of gains are intertwined.
 - ▶ Are they substitute or complement?
- Convergence gains depend on distance from steady-state. Steady-state itself modified by integration in the presence of risk.
- Need for general equilibrium models. Emerging markets have integrated in waves.

- Assess the growth dynamics and the welfare gains from financial integration in a neoclassical growth model
 - ▶ with aggregate uncertainty
 - ▶ with heterogeneous countries
 - ▶ with incomplete/bond economy (or complete) markets
 - ▶ in general equilibrium
- Use a global approximation methods to study the transition path towards the long run world equilibrium.
- Emphasize relation between risk, growth and capital accumulation.
 - ▶ Tension between the buildup of precautionary assets by risky country and potential effect of capital scarcity in the short-run.

Related Literature (small subset)

■ Theory

- ▶ Allocative efficiency
 - Gourinchas and Jeanne (2006)
- ▶ Stochastic models with agg. uncertainty (without production side)
 - Lucas (1982), Cole and Obstfeld (1991), Van Wincoop (1999), Lewis (1999), Stepanchuk and Tsyrennikov (2012)
 - Colacito and Croce (2010), Lewis and Liu (2012)
- ▶ Growth models with idiosyncratic uncertainty
 - Angeletos and Panousi (2012), Corneli (2010), Mendoza, Quadrini and Rios Rull (2007, 08), Bai and Zhang (2010), Carroll and Jeanne (2013)
- ▶ Growth models with agg. uncertainty (local method): Kent (2013)

■ Empirics

- ▶ Effect on growth and on consumption volatility. Mixed results.
 - Surveys: Eichengreen (2002), Kose et al. (2006), Henry (2007), Obstfeld (2009), Jeanne et al. (2012).

Baseline model of financial integration

Technology

2 countries $i = D, E$ with a stochastic neoclassical structure. One good perfectly tradable.

Production

- Cobb-Douglas technology:

$$y_{i,t} = a_{i,t} k_{i,t}^{\theta} l_{i,t}^{1-\theta}$$

- Productivity shocks:

$$\log(a_{i,t}) = (1 - \rho) \log(a_{i,0}) + \rho \log(a_{i,t-1}) + \epsilon_{i,t}$$

- Investment with convex adjustment costs

$$k_{i,t+1} = (1 - \delta) k_{i,t} + k_{i,t} \phi \left(\frac{\dot{i}_{i,t}}{k_{i,t}} \right)$$

Baseline model of financial integration

Preferences

Epstein-Zin preferences

$$U_{i,t} = \left[(1 - \beta)c_{i,t}^{1-\psi} + \beta \left(E_t U_{i,t+1}^{1-\gamma} \right)^{\frac{1-\psi}{1-\gamma}} \right]^{\frac{1}{1-\psi}} .$$

- $1/\psi$ = the elasticity of intertemporal substitution (EIS)
- γ the risk aversion coefficient
- Nests the CRRA case when $1/\psi = \gamma$

Baseline model of financial integration

Asset market structure

Autarky

- Budget equation $c_{i,t} + i_{i,t} = y_{i,t}$
- Stochastic discount factor

$$m_{i,t+1} = \beta \left(\frac{c_{i,t+1}}{c_{i,t}} \right)^{-\psi} \left(\frac{U_{i,t+1}^{\psi-\gamma}}{\left[E_t \left(U_{i,t+1}^{1-\gamma} \right) \right]^{\frac{\psi-\gamma}{1-\gamma}}} \right)$$

- Euler equation for investment

$$E_t \left[m_{i,t+1} \left(r_{i,t+1} \phi'_{i,t} + \frac{\phi'_{i,t}}{\phi'_{i,t+1}} \left((1-\delta) + \phi_{i,t+1} - \frac{i_{i,t+1}}{k_{i,t+1}} \phi'_{i,t+1} \right) \right) \right] = 1$$

$\phi_{i,t} = \phi \left(\frac{i_{i,t}}{k_{i,t}} \right)$ and $\phi'_{i,t}$ the first derivative of $\phi(x)$.

Baseline model of financial integration

Asset market structure

Financial Integration (riskfree bond only)

- Budget equation with $p_t = \frac{1}{r_t}$ = price of the riskfree bond

$$c_{i,t} = y_{i,t} - i_{i,t} - b_{i,t}p_t + b_{i,t-1}$$

- Investment Euler equation
- Optimal bond holdings

$$p_t = E_t [m_{i,t+1}]$$

Baseline model of financial integration

Definition of an equilibrium

Under autarky

An equilibrium in a given country i is a sequence of consumption and capital stocks $(c_{i,t}; k_{i,t+1})$ such that individual Euler equations for investment decisions are verified and goods market clears at all dates.

Financial Integration

An equilibrium is a sequence of consumption, capital stocks and bond holdings in both countries $(c_{i,t}; k_{i,t+1}; b_{i,t})_{i=\{E,D\}}$ and a sequence of bond prices p_t such that Euler equations for investment decisions are verified in both countries, Euler equations for bonds are verified in both countries, bonds and goods market clear at all dates.

- Global solution: policy function iteration
 - ▶ Krueger and Kubler (2004), Judd, Kubler and Schmedders (2002)
 - ▶ Needs a compact set.
 - Bounds for debt b
 - Discretization method for productivity shocks (Rouwenhorst (1995))
- Why not standard perturbations methods?
 - ▶ Capital scarcity and incomplete markets moves dynamics away from deterministic steady-state
 - ▶ Non-linearities with high risk aversion
 - ▶ *Risky* steady state vs. deterministic steady state.
 - ▶ Compute welfare gains along the *transition* path. *Risky* path.

Calibration

Structural parameters

Discount rate	β	0.96
Capital share	θ	0.3
Depreciation rate	δ	0.08
Capital adjustment costs	ξ	0.2
EIS	$1/\psi$	1/4
Risk aversion	γ	4 to 40

- Capital adjustment costs such that σ^i close to $3\sigma^y$
- Low risk aversion $\gamma = 4$, CRRA case.
- High risk aversion γ up to 40 to generate meaningful risk premia.

Calibration

Productivity shocks

- Volatility matches the group of emerging markets E integrating to developed countries D since 1985.
- Emerging markets roughly twice as volatile.

▶ Graph

	Autocorrelation	Standard deviation
E=Risky economy	0.9	5%
D=Safe economy	0.9	2.5%

- Zero correlation of shocks in the baseline calibration (underestimation compared to the data, roughly 0.2)

Calibration

Size and capital scarcity

- 40 emerging markets liberalizing after 1985 (mostly 1988-1993).
- Roughly the same GDP size as developed countries at opening.
→ General Equilibrium effects cannot be neglected.
- On average, capital stocks (per efficiency units) of emerging countries $E = 50\%$ of developed countries D at time of integration.
 - ▶ Compute capital stocks for emerging countries E integrating to developed countries D since 1985 (perpetual inventory method).
 - ▶ Compare with capital stocks of already integrated countries.

▶ Graph

Financial integration experiments

- Baseline experiments
 - ▶ choose initial level of capital
 - ▶ simulate consumption in autarky $b_t = 0$
 - ▶ simulate consumption under financial integration (bond only economy)
- Compare the dynamics of the model
 - ▶ under various degrees of heterogeneity across countries,
 - ▶ various parametrization of structural parameters.
- Estimate welfare gains of financial integration.

Experiment 1: The riskless case in general equilibrium

- No shocks
- Capital starts 50% below steady-state in E
- Rest of the world D has the same population size than E and starts at autarky steady state

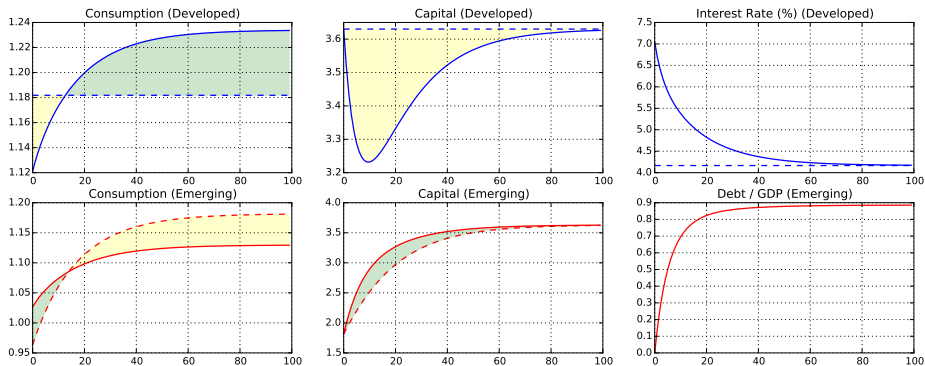


Figure 1: The riskless case: dynamics along the deterministic path.

Dotted lines (resp. solid lines) refer to autarky levels (resp. levels under integration).

Experiment without aggregate risk

Experiment 1: The riskless case in general equilibrium

Efficient reallocation of capital

- No precautionary savings in autarky. Only initial level of capital matters
- Capital goes where returns are higher (from developed to emerging)

But...

- Gains from financial integration are transitory
- Integration speeds up transition towards *unchanged* steady-state level of capital.
- Interest rates increases in ROW.

Experiment without aggregate risk

Experiment 1: The riskless case in general equilibrium

Welfare gains (% increase in permanent consumption)

	Country E	Rest of the world D
Partial	1.03%	-
General	0.35%	0.27%

- In partial equilibrium (small open economy), gains are small
 - ▶ Transitory nature (Gourinchas and Jeanne (2006)).
- In general equilibrium, welfare gains even smaller.
 - ▶ Must be shared between the two countries.
 - ▶ Adverse General Equilibrium movements of world interest rate.

Baseline experiments with *asymmetric* aggregate risk

- E is twice as volatile as D : $\sigma_E = 2\sigma_D = 5\%$.
- Both countries have the same population size and D starts at autarky steady state.
- Capital in E starts at steady-state or at 50% of capital stock in D .
- Low risk aversion $\gamma = 4$ (CRRA case) and high risk aversion $\gamma = 40$ to match market price of risk.

Risky steady states and risky path

- Risky steady state is where economy converges if shocks innovations are zero but agents expect uncertainty.
 - ▶ Different from deterministic and stochastic steady state.
 - ▶ Risky path is the convergence path towards risky steady state if shocks innovations are zero.
- Heterogeneity in risk across countries leads to different autarky risky steady states for capital.
 - ▶ Steady state capital output ratio higher in E than in D . Steady state interest rate lower in E than in D .
 - ▶ Leads to a reallocation of capital after integration. Happens even without initial capital scarcity.

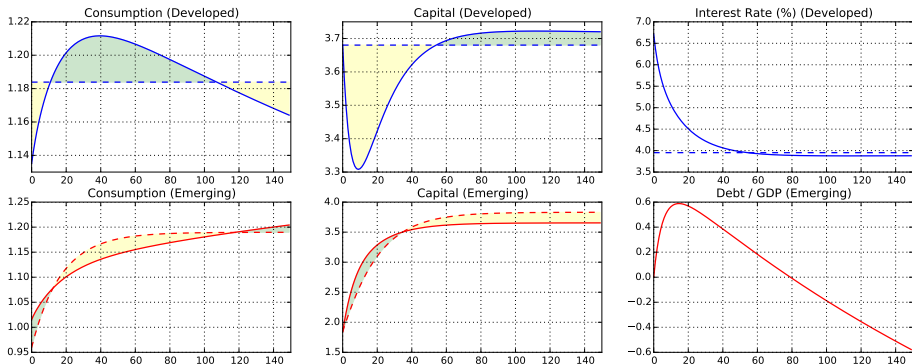


Figure 2: Baseline experiments: E capital scarce and $\gamma = 4$

Dotted lines (resp. solid lines) refer to autarky levels (resp. levels under integration).

Baseline Experiments

Asymmetric risk with initial capital scarcity & low risk aversion

- Capital reallocation for precautionary motives vs efficiency reasons
 - Capital flows and growth reversals
 - ▶ In the short-run, capital scarcity dominates: capital flows from D to E . Capital flows reversal in the medium-run.
 - ▶ Higher growth on impact in E compared to autarky initially, opposite in D . Reversal in the medium-run.
- Low welfare gains despite *efficiency & risk-sharing* gains.
 - ▶ Permanent increase in consumption is = 0.36% in D and 0.51% in E .
 - ▶ Gains from faster convergence in E are reduced as financial integration makes E closer to its steady-state.

But market price of risk is low in these experiments. Cannot match risk premia → crank up risk aversion

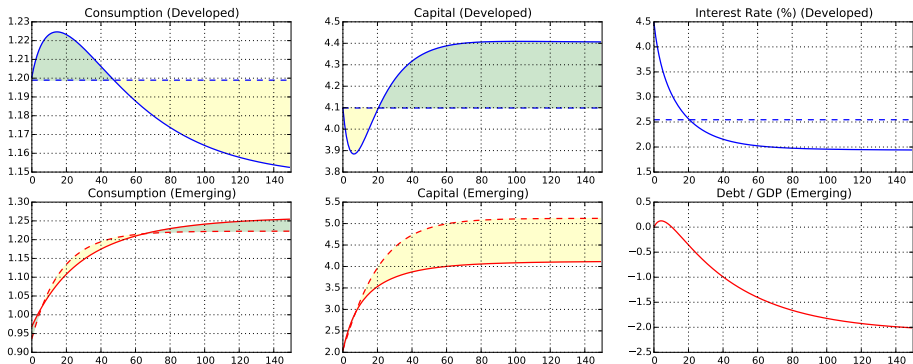


Figure 3: Baseline experiments: E capital scarce and $\gamma = 40$

Dotted lines (resp. solid lines) refer to autarky levels (resp. levels under integration).

Baseline Experiments

Asymmetric risk with initial capital scarcity & high risk aversion

- With high market price of risk, stronger reallocation of capital for precautionary motives.
 - ▶ Tend to dominate reallocation due to initial differences in capital although depends on degree of capital scarcity.
 - ▶ Capital more likely to flow from E to D , even if E has a lower initial capital stock.
 - ▶ Lower growth in E compared to autarky, opposite in D .
- Aggregate welfare gains fairly low and unevenly distributed.
 - ▶ Permanent increase in consumption is 0.3% in E .
 - ▶ Significantly increase in D , up to 0.8%.
 - ▶ E willing to forego a large amount of consumption for insurance. D issues the safe asset at a very high price.

- In our baseline experiment with low risk aversion, two forces: on one side, the capital scarcity effect generates short-run consumption gains (resp. losses) for capital scarce country. On the other side, the reallocation of precautionary savings towards the safer country generates short-run gains (resp. losses) for the capital abundant country.
- On average both effects tend to offset each other and both countries have fairly small consumption gains.
- Gains higher in endowment economies as production helps smoothing.

Welfare Analysis

		Country <i>D</i>	Country <i>E</i>
CRRA Utility Low risk aversion	Baseline (Exp. 2)	0.36	0.51
	No capital scarcity	0.25	0.23
	Symmetric	0.09	0.09
	Endowment	0.59	0.54
	Riskless world (Exp. 1)	0.27	0.35
Non-Expected Utility	Baseline (Exp. 3)	0.82	0.32

Table 1: Welfare gains of financial integration.

Notes: Gains are expressed in % equivalent of permanent consumption. For the benchmark and 'no capital scarcity' cases, $\sigma_f = 2\sigma_h = 5\%$. For the 'symmetric' case: $\sigma_h = \sigma_f = 2.5\%$ and both countries start at their autarky steady state capital stock. In the riskless world and in the benchmark case, country *f* is capital scarce (50% of the developed country capital stock) at date 0. In the endowment case, both countries have the same initial size and adjustment costs to capital are infinite.

- Overall welfare gains from financial integration are increasing in the degree risk aversion: risk sharing is more valued with higher risk aversion.
- Despite a much higher market price of risk (a 2.3% risk premium in autarky in the risky country for $\gamma = 40$), the welfare gains remain small: an average across countries significantly below 1%.
- The higher the degree of risk aversion, the more the safe country benefits from financial integration compared to the risky country.

- Intuition: The safe country has the technology that both countries prefer, i.e. a less risky production function.
- Comparative advantage: the safe country benefits more from trading. The higher the risk aversion the more agents will value the safest technology, increasing the wealth of the safe country.
- Risky country: it benefits more from risk sharing but insurance is expensive and the world interest rates is much lower upon integration

Welfare Analysis — Timing of the gains

- Gains front loaded by the safer country, for a given capital scarcity .
- The safer country enjoys a consumption boom following integration. The opposite holds for the riskier country: cuts consumption in the short-run.
- Holding risk constant across countries, welfare gains are front loaded by capital scarce economies.

- Sensitivity to risk aversion
 - ▶ Higher risk aversion shifts gains towards safer country.
 - ▶ Capital scarce *and* safe countries are the main beneficiaries of financial integration.
- Accuracy
 - ▶ Perturbation methods less accurate if high degree of capital scarcity. Also missing the asymmetry in absence of capital scarcity.
 - ▶ Global methods capture better non-linearities (high risk aversion).

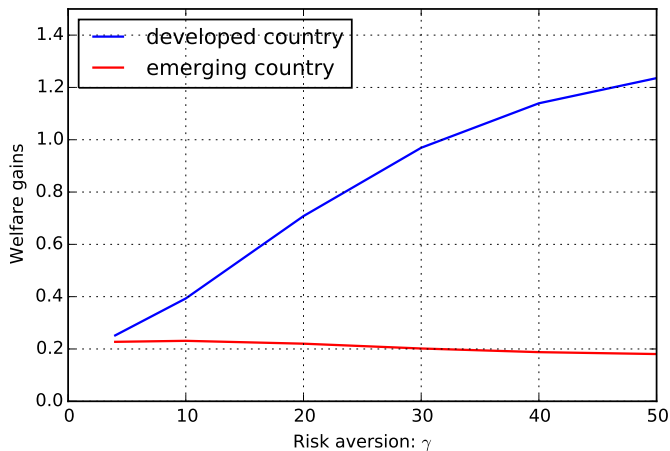


Figure 4: Welfare gains of financial integration with different degree of risk aversion γ .

Notes: Gains are expressed in % equivalent of permanent consumption. No capital scarcity $\frac{k_{E,0}}{k_{D,0}} = 1$

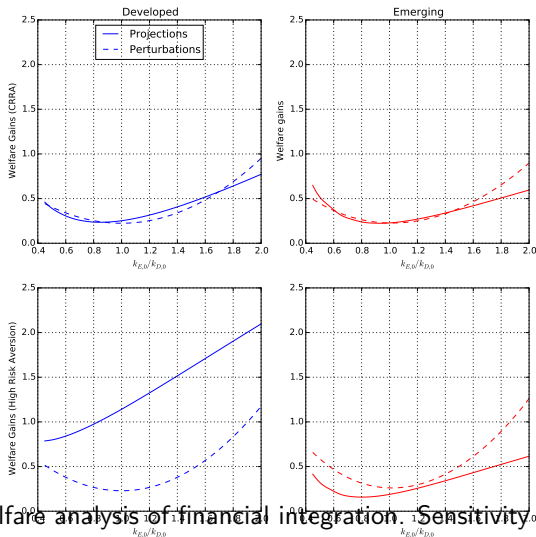


Figure 5: Welfare analysis of financial integration. Sensitivity and accuracy.

Notes: Gains are expressed in % equivalent of permanent consumption as a function of initial relative capital stock ($\frac{k_{E,0}}{k_{D,0}}$).

- Alternative specification of transitory shocks
- Long-run world productivity risk
- Asset market structure: incomplete vs complete markets
- Market sizes

Alternative specification of transitory shocks

- Increasing correlation of shocks significantly reduces welfare gains.
 - ▶ Roughly 30% lower with correlation of 0.25 similar to the date.
 - ▶ Up to 70% lower with correlation of 0.5 (upper-bound of our set of emerging countries).
- Increasing volatility of risky country increases overall gains from trade. More beneficial to safer country D if small differences in initial capital stock.

Alternative specification of transitory shocks

	No capital scarcity					
	$\zeta = 0$		$\zeta = 0.25$		$\zeta = 0.5$	
	<i>D</i>	<i>E</i>	<i>D</i>	<i>E</i>	<i>D</i>	<i>E</i>
(Symmetric risk) $\sigma_E = 2.5\%$ (Baseline)	0.09	0.09	0.06	0.07	0.04	0.06
$\sigma_E = 5\%$ (High risk in E)	0.25	0.23	0.15	0.15	0.07	0.07
$\sigma_E = 10\%$	1.16	0.87	0.62	0.50	0.18	0.16

Table 2: Welfare gains from financial integration with alternative stochastic structures for transitory shocks.

Notes: Welfare gains from financial integration are expressed in % equivalent of permanent consumption. Apart from σ_E and ζ , parameters of the model are set to their baseline values with risk aversion equal to its low value ($\gamma = 4$). In the 'No capital scarcity' experiment, both countries start with the same level of capital corresponding to the autarkic steady-state in *D*.

Long-run world productivity risk

- Stochastic total factor productivity $A_{i,t}$ is decomposed into a transitory country-specific component $a_{i,t}$ and a persistent world component $a_{W,t}$: $A_{i,t} = a_{W,t}a_{i,t}$, with $\log(a_{i,t})$ an AR(1) process.
- Long-run component $a_{W,t}$ = persistent world TFP growth shocks:

$$\log\left(\frac{a_{W,t+1}}{a_{W,t}}\right) = \rho_W \log\left(\frac{a_{W,t}}{a_{W,t-1}}\right) + \epsilon_{W,t}$$

- ▶ Calibration of LRR: $\rho_W = 0.999$; $\sigma_W = 4\% \sigma_D = 0.001$.
- ▶ Preferences: $1/\psi = 2$ and $\gamma = 10$.
- ▶ Similar to Colacito and Croce (2013) or Lewis and Liu (2012).

■ Implications for the dynamics

- ▶ Decreases the amount of leverage the safer country is willing to take (about 70% of GDP).
- ▶ More realistic asset prices and more realistic net foreign asset positions.
- ▶ Dynamics qualitatively unchanged but quantitative impact muted due to lower capital flows.

■ Welfare Implications

- ▶ Overall welfare gains even smaller: more limited ability to smooth shocks (0.17% in E).

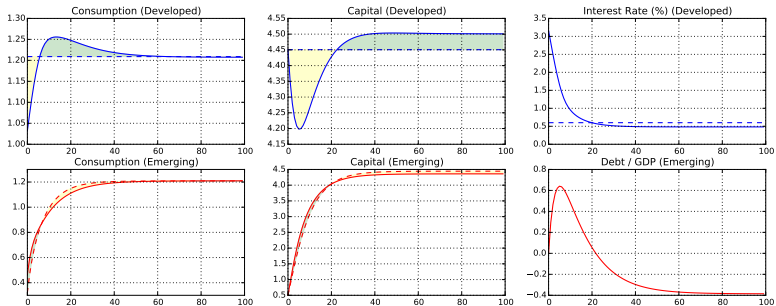


Figure 6: Dynamics with a long-run world productivity risk.

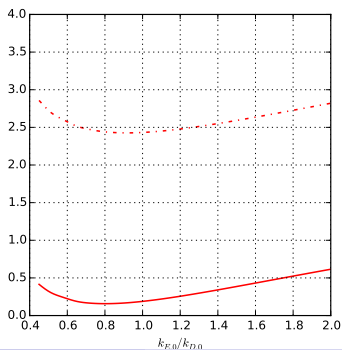
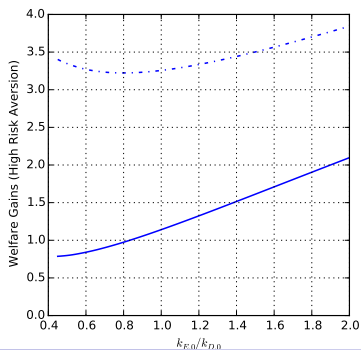
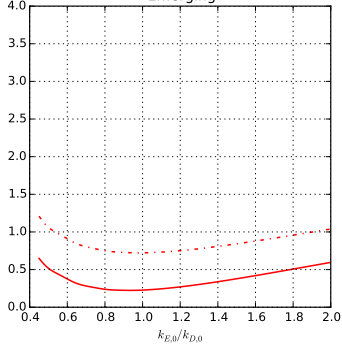
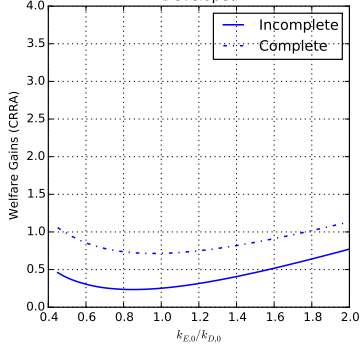
Complete markets

- One fictitious agent invests in both countries subject to the resource constraint and the law of capital accumulation
- Each country i is consuming a constant fraction λ_i of the world consumption at all dates, with $\lambda_h + \lambda_f = 1$:

$$c_{i,t}^{CM} = \lambda_i c_t^{CM}$$

- These fractions are allocated according to initial wealth at time of integration, which depends on initial state variables, the capital stock and the productivity level

- Results qualitatively unaffected.
- Provides loose upper-bound of the potential welfare gains
 - ▶ Baseline calibration: cross-country average up to 1% increase in permanent consumption with low risk aversion and 3% with risk aversion=50
 - ▶ With high risk aversion, still benefits more safer country but lower difference (about 1% in our baseline) due to lower precautionary demand for safe asset.



- Assume country E is 10 times smaller than country D
 - ▶ Country E benefits more from integration: the interest rate upon integration moves closer to autarky rate of the large economy (D)
 - ▶ Risky country E lends at a higher rate to country D
- Overall gain remains small: still reallocation of precautionary savings away from E.

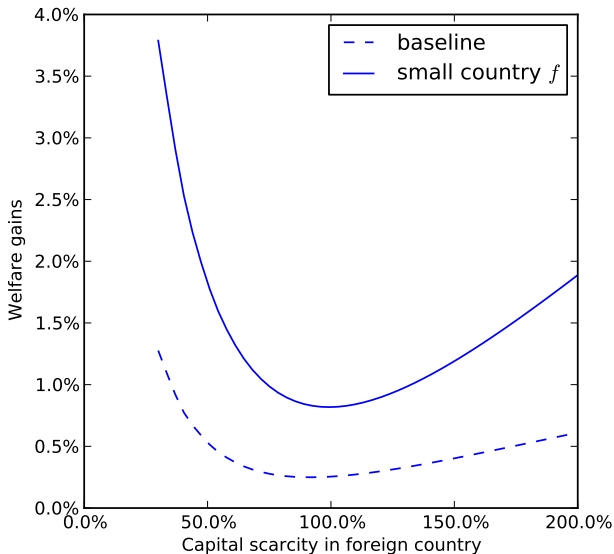


Figure 8: Welfare analysis of financial integration. Robustness with different country sizes.

Market sizes

- In our simulations, large GE effects: reasonable for the big liberalization wave of the late 80s-early 90s.
- With smaller risky countries, larger gains but at most around 1%.
- Quantitative simulations for early liberalizers or late liberalizers generate small gains.
- Early liberalizers (1986): Southern Europe has small gains due to (i) high correlation (0.6); (ii) small initial differences in capital stock (85%).
- Gains 0.08 %.
- Late liberalizers (1999): Middle-East has small gains despite being very capital scarce (35%) due to strong offsetting precautionary demand for safe assets. Volatile countries (8.1%).
- Gains of about 1%. [▶ Dynamics](#)

Conclusion

We use the most standard model of open economies to:

- i. account for the heterogeneity in the growth impact of financial integration.
 - ▶ Heterogeneity across countries and across time.
 - ▶ Opens the door for new empirical work regarding the growth benefits of financial integration.
- ii. account for the welfare gains from risk-sharing and from efficient capital allocation following integration.
 - ▶ For realistic calibrations, gains remain small for emerging markets integrating in the last 30 years.
 - ▶ Both gains tend to be *substitutes* for these countries.
 - ▶ Results hold in a world with high risk premia: in this case, safer (developed) countries extract most of the benefits.

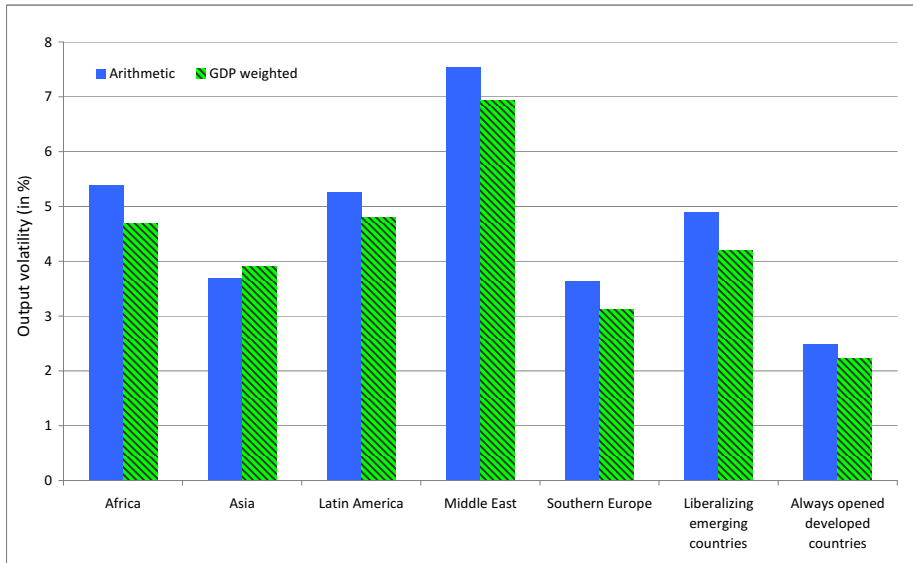


Figure 9: Volatility of real output growth per capita (in %, 1975-1995). [▶ back](#)

Source: PWT, Bekaert et al. (2005). 40 emerging markets liberalizing after 1985 (15 developed countries already integrated).

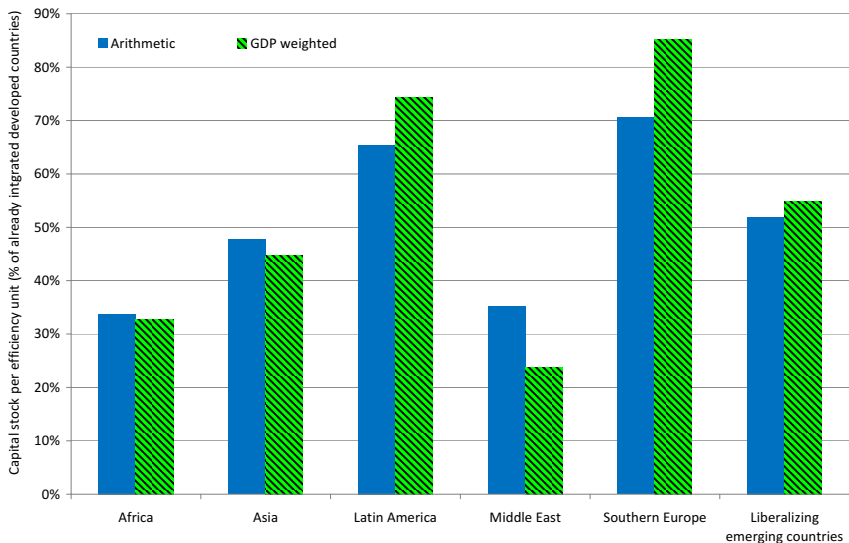


Figure 10: Capital stock at time of integration of emerging markets (ratio w.r.t developed countries). [▶ back](#)

Source: PWT, Bekaert et al. (2005). 40 emerging markets liberalizing after 1985 (15 developed countries already integrated).

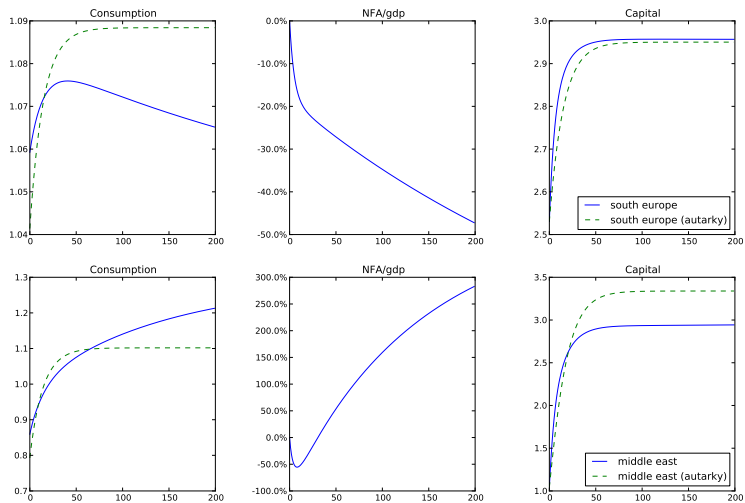


Figure 11: Dynamics along the risky path following integration the case of Early South Europe (top panel) and Late Middle-East (bottom panel). [▶ back](#)
 South Europe = Greece-Portugal-Spain; Middle-East=Oman-Saudi Arabia.