Financial Integration and Growth in a Risky World

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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.

Our contribution

- 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), Caroll 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

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

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

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

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.

Solution methods

- 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.
  $\rightarrow$ 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 without aggregate risk

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

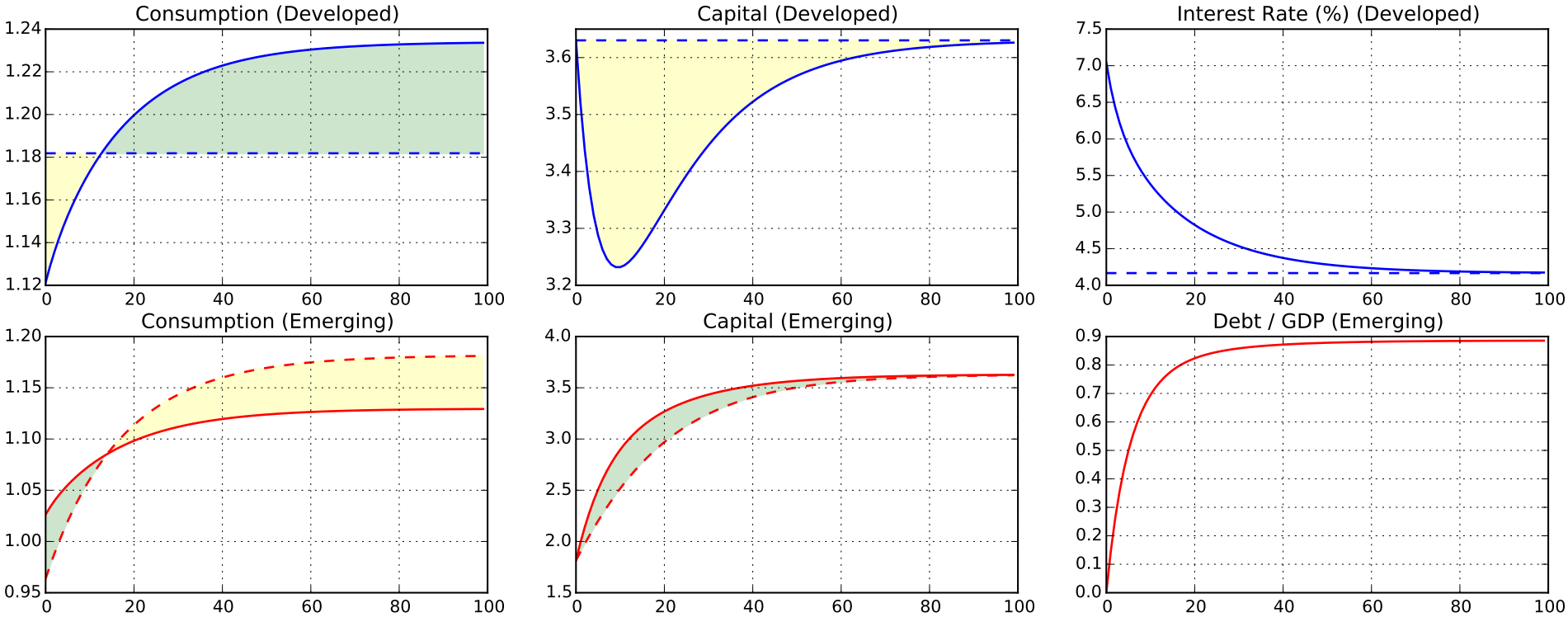


Figure 1: The riskless case: dynamics along the deterministic path.

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

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.

Baseline Experiments

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.

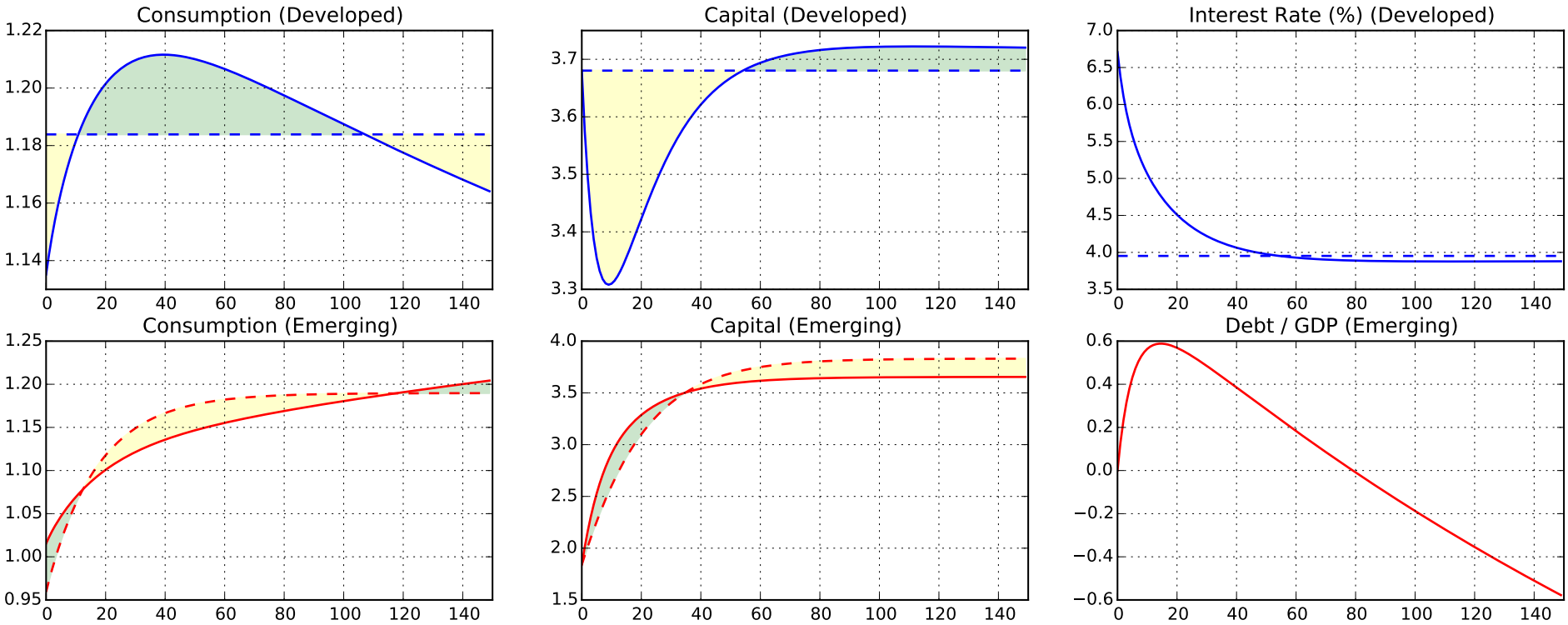


Figure 2: Baseline experiments: E capital scarce and $\gamma = 4$

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
  $\rightarrow$ 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 $\rightarrow$ crank up risk aversion

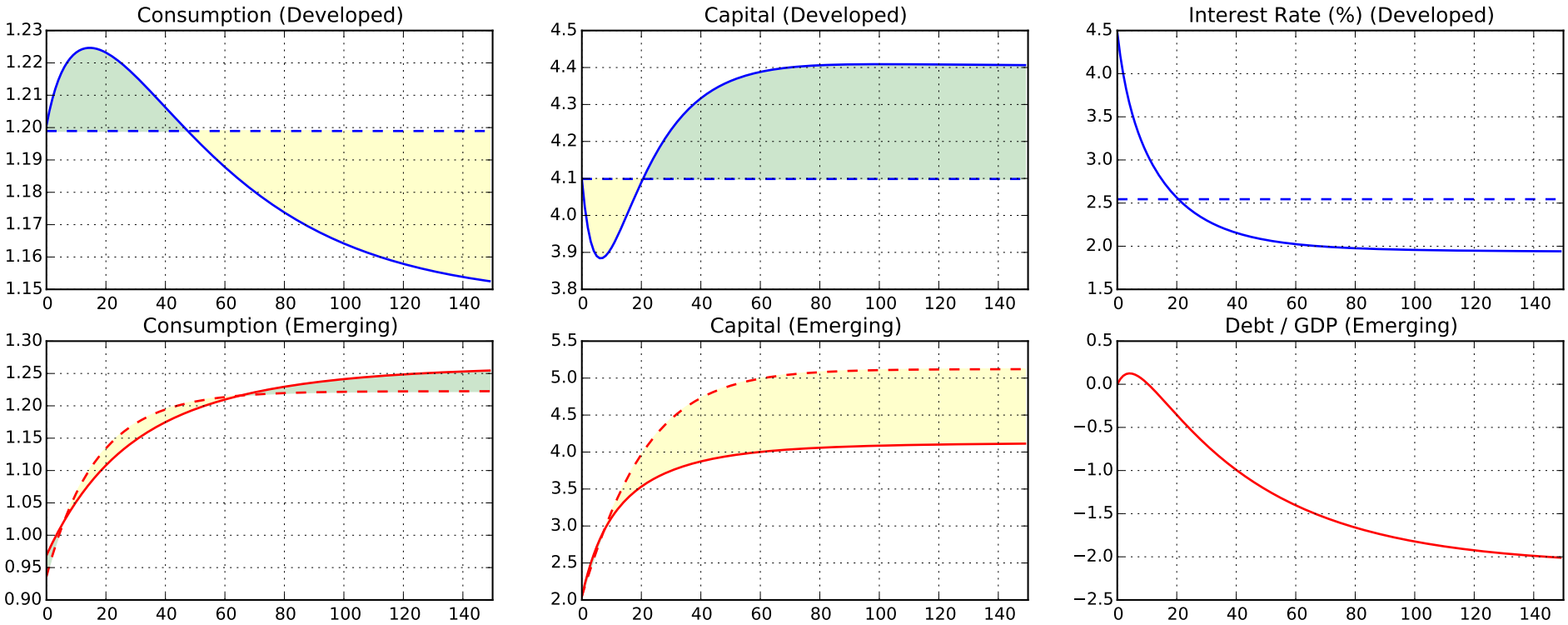


Figure 3: Baseline experiments: E capital scarce and $\gamma = 40$

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.

Welfare Analysis — CRRA case

- 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 D	Country E
CRRA Utility	Baseline (Exp. 2)	0.36	0.51
Low risk aversion	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.

Welfare Analysis — Epstein Zin case $\gamma = 40$

- 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.

Welfare Analysis — Epstein Zin case $\gamma = 40$

- 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 analysis and accuracy

- 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).

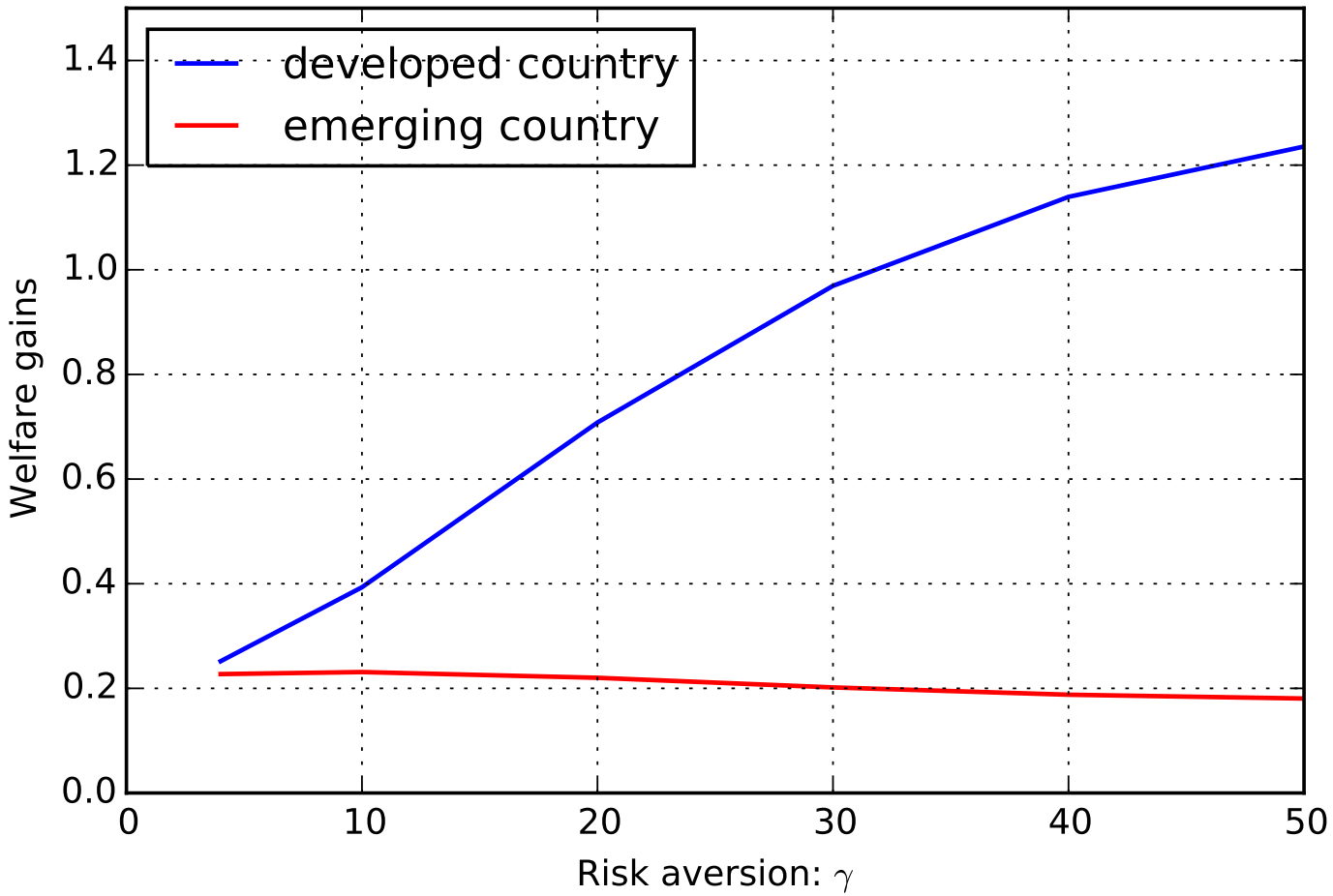


Figure 4: Welfare gains of financial integration with different degree of risk aversion γ.

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

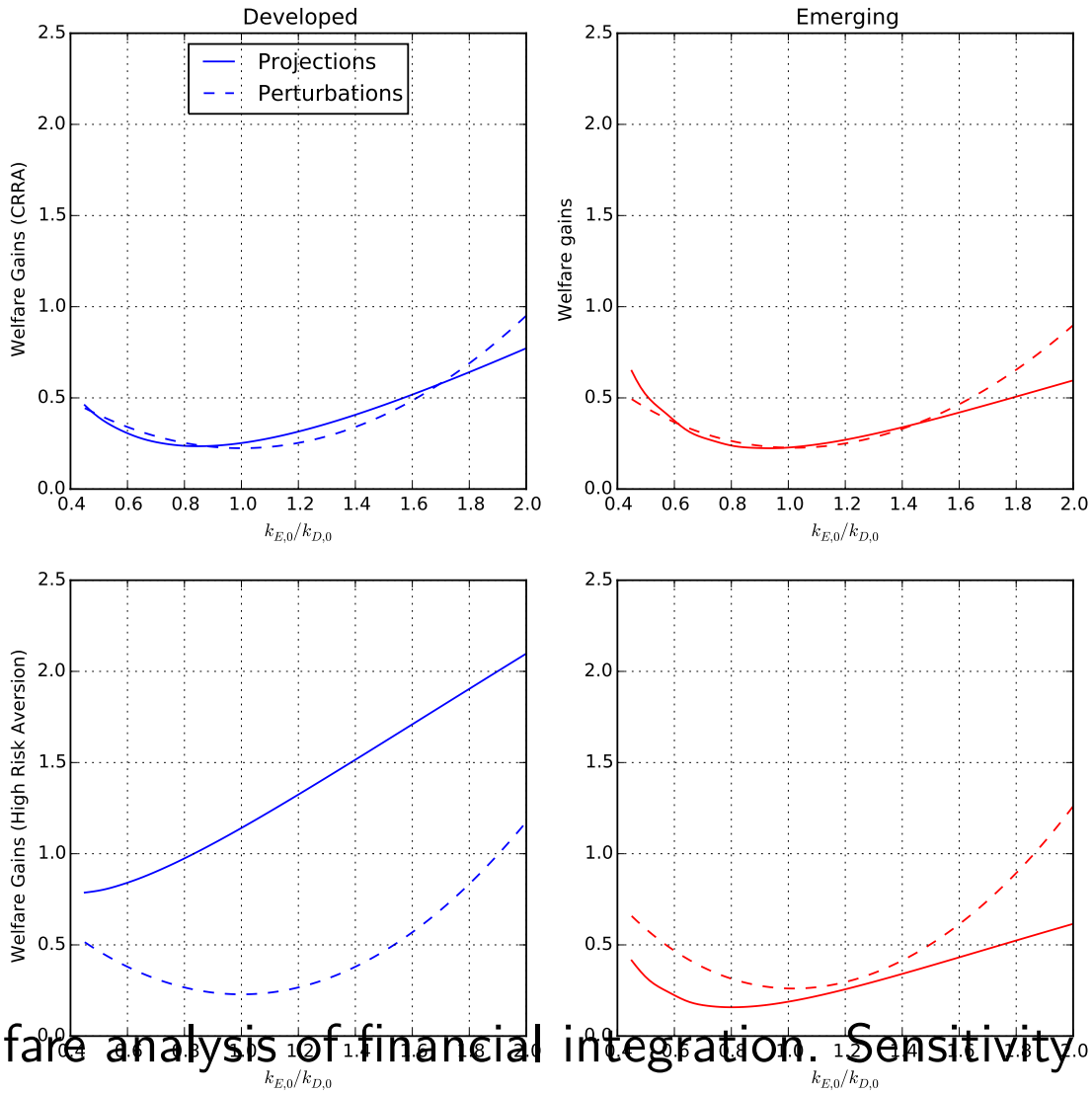


Figure 5: Welfare analysis of financial integration. Sensitivity and accuracy.

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

Robustness checks and extensions

- 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					
	$\zeta = 0$		$\zeta = 0.25$		$\zeta = 0.5$	
	D	E	D	E	D	E
(Symmetric risk) $\sigma_E = 2.5\%$	0.09	0.09	0.06	0.07	0.04	0.06
(Baseline) $\sigma_E = 5\%$	0.25	0.23	0.15	0.15	0.07	0.07
(High risk in E) $\sigma_E = 10\%$	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:

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

  - 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).

Long-run world productivity risk

- 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).

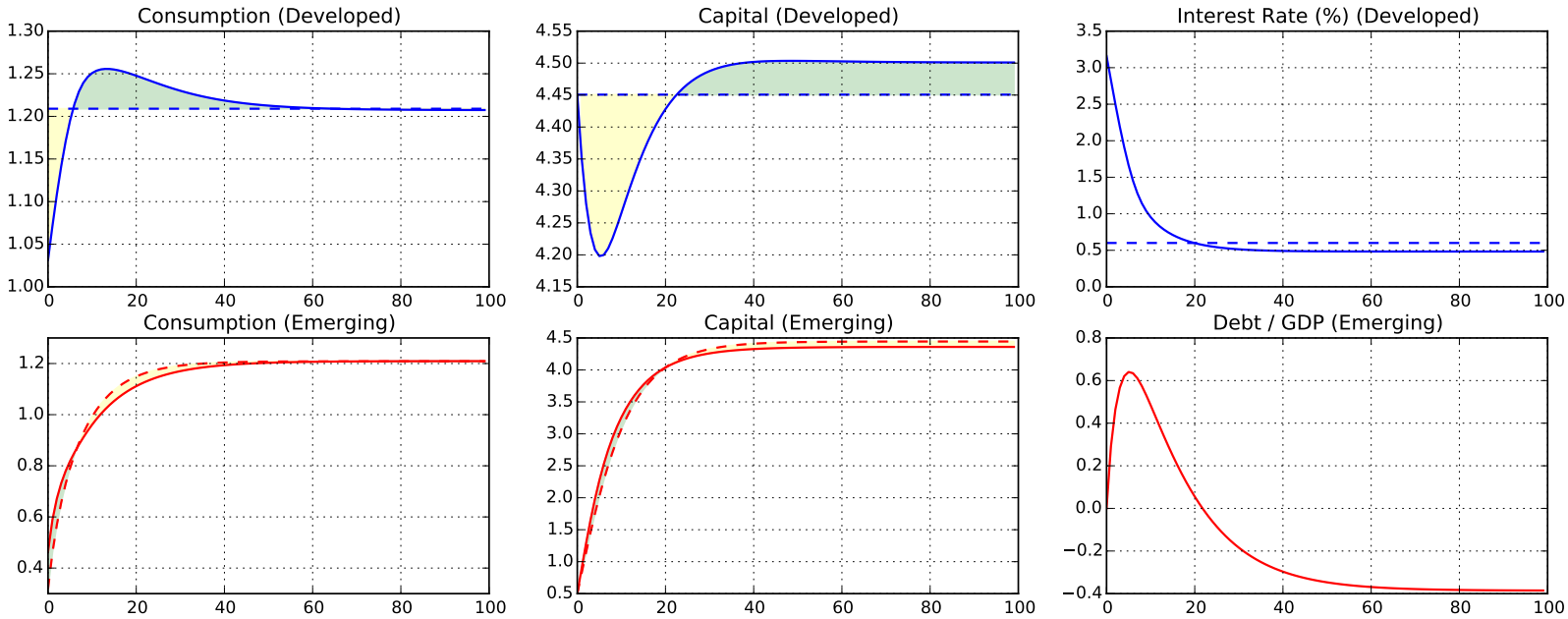


Figure 6: Dynamics with a long-run world productivity risk.

Complete markets

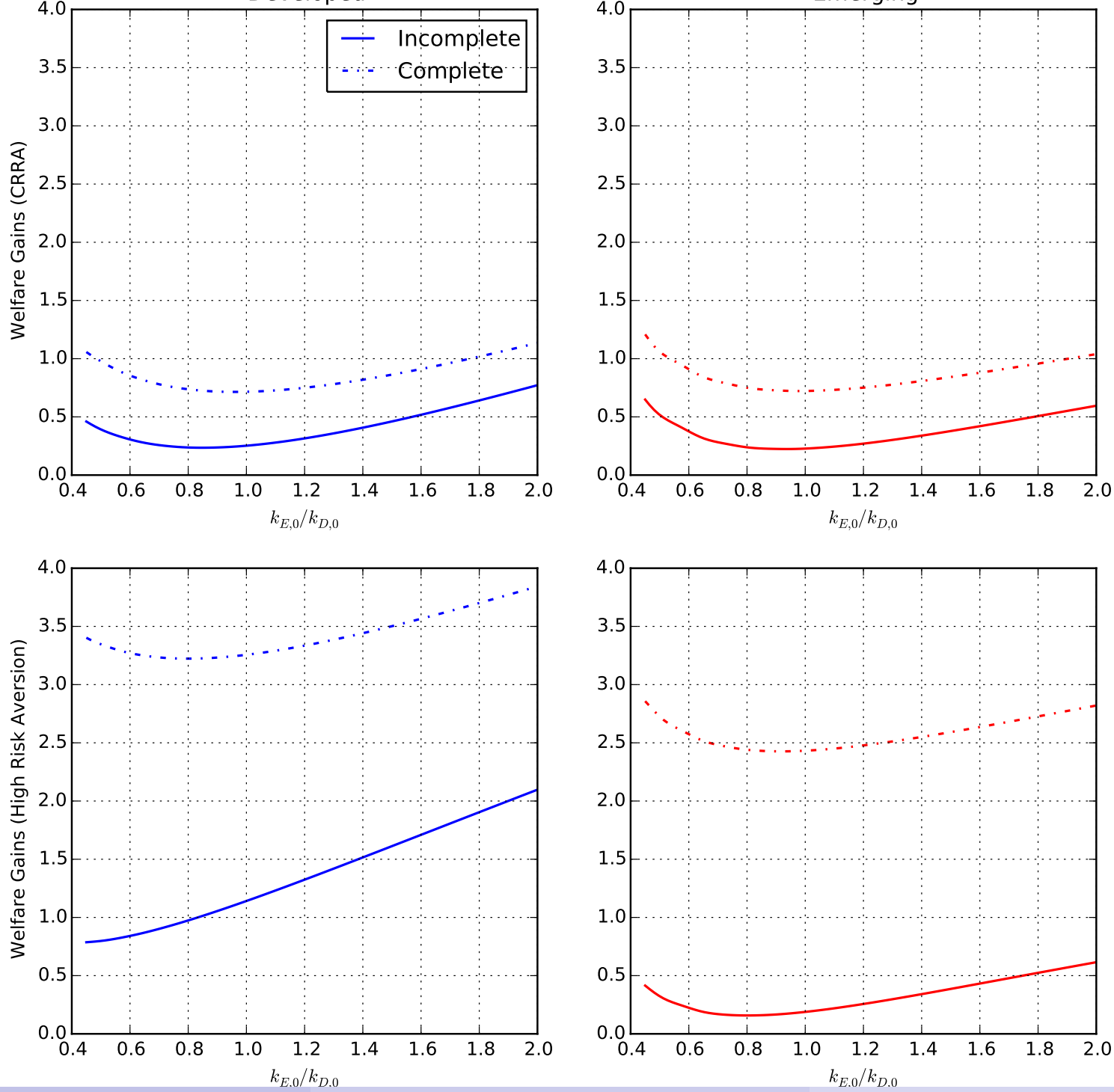
- One fictitious agent invests in both countries subject to the resource constraint and the law of capital accumulation
- Each country i is consuming a constant fraction λ_i of the world consumption at all dates, with $\lambda_h + \lambda_f = 1$:

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

- 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

Complete markets

- 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.


Incomplete
Complete
Welfare Gains (CRRA)
Welfare Gains (High Risk Aversion)
$k_{E,0}/k_{D,0}$
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0

Market sizes

- 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.

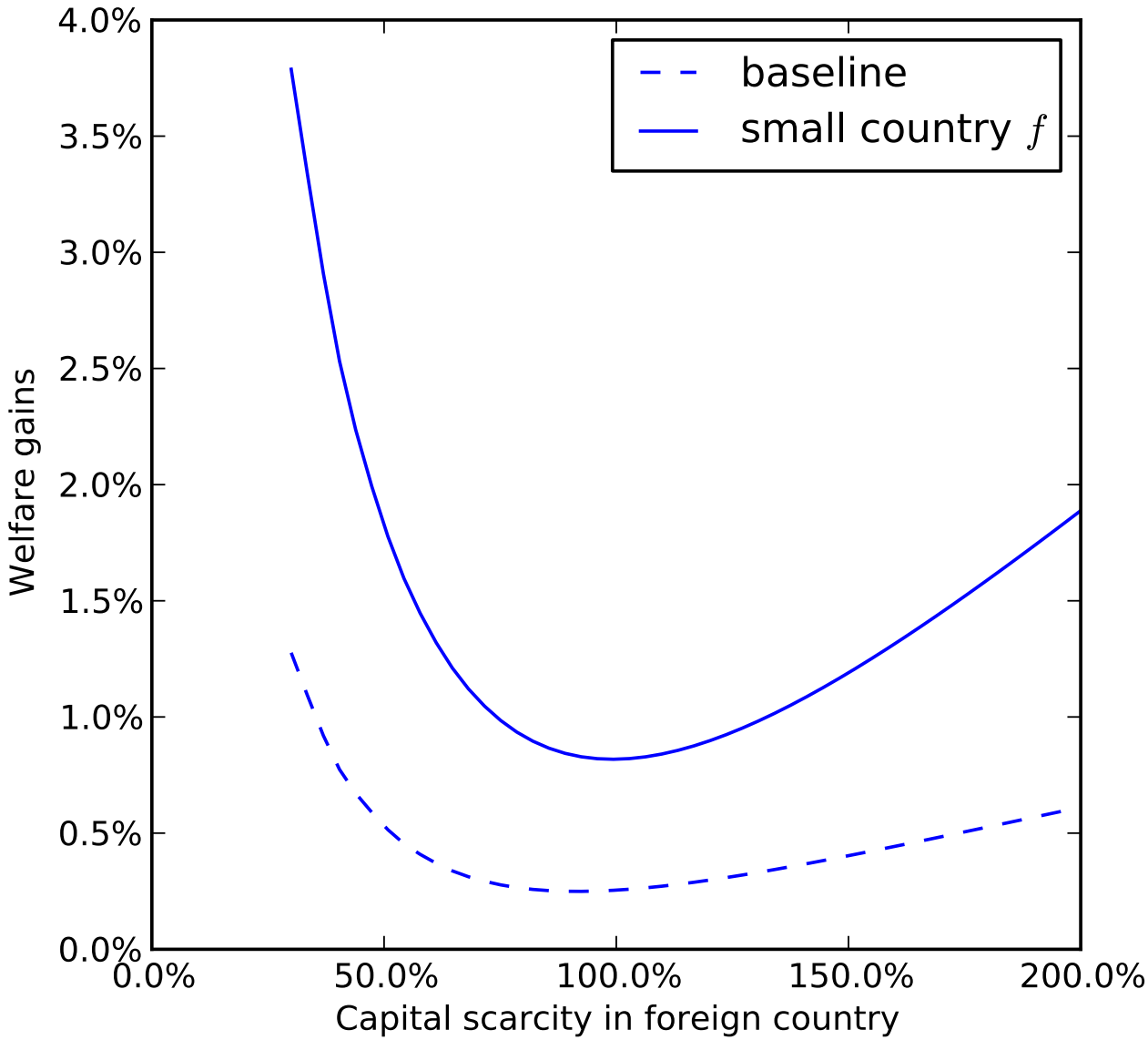


Figure 8: Welfare analysis of financial integration. Robustness with different country sizes.

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.

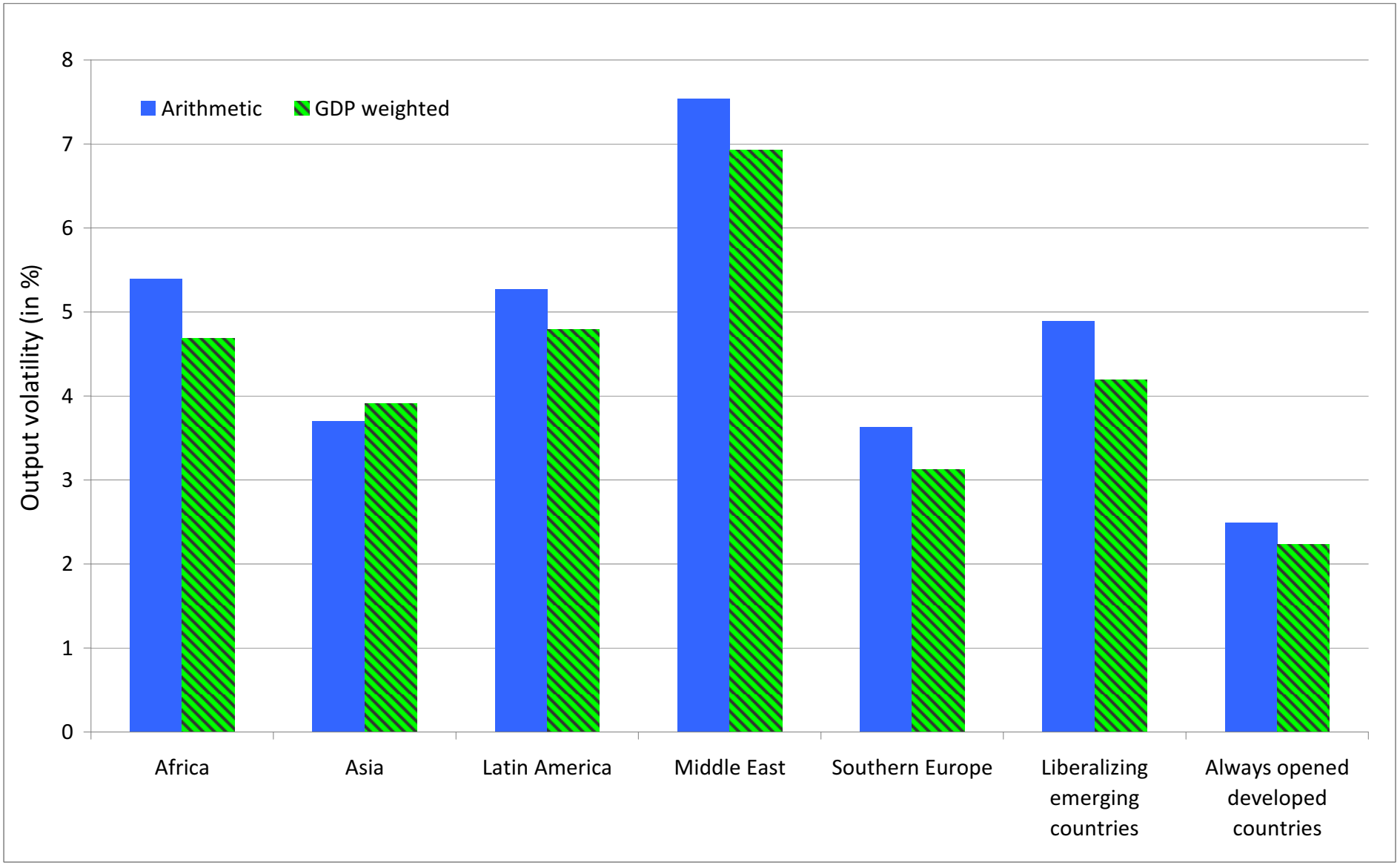


Figure 9: Volatility of real output growth per capita (in %, 1975-1995). back

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

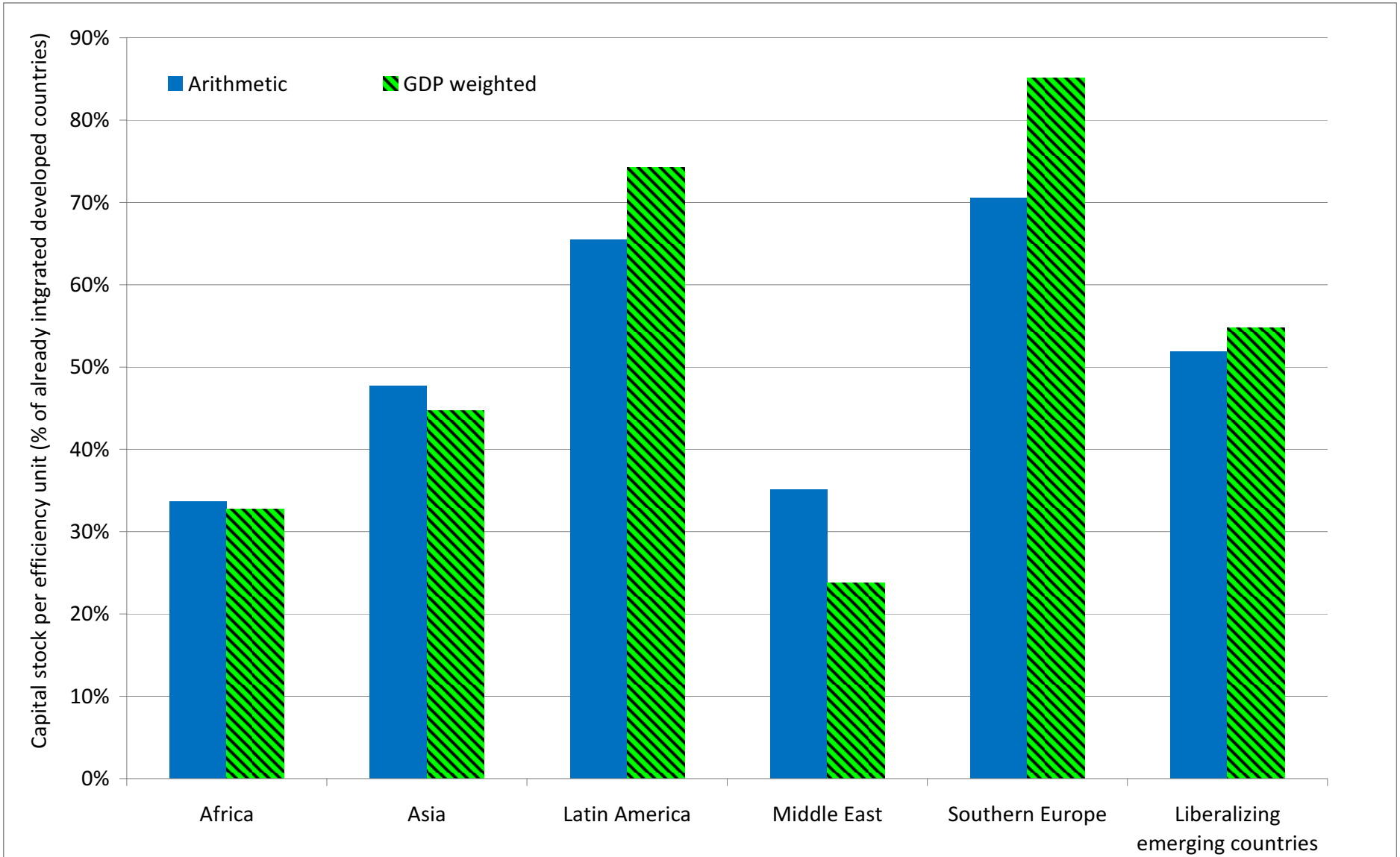


Figure 10: Capital stock at time of integration of emerging markets (ratio w.r.t developed countries). back

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

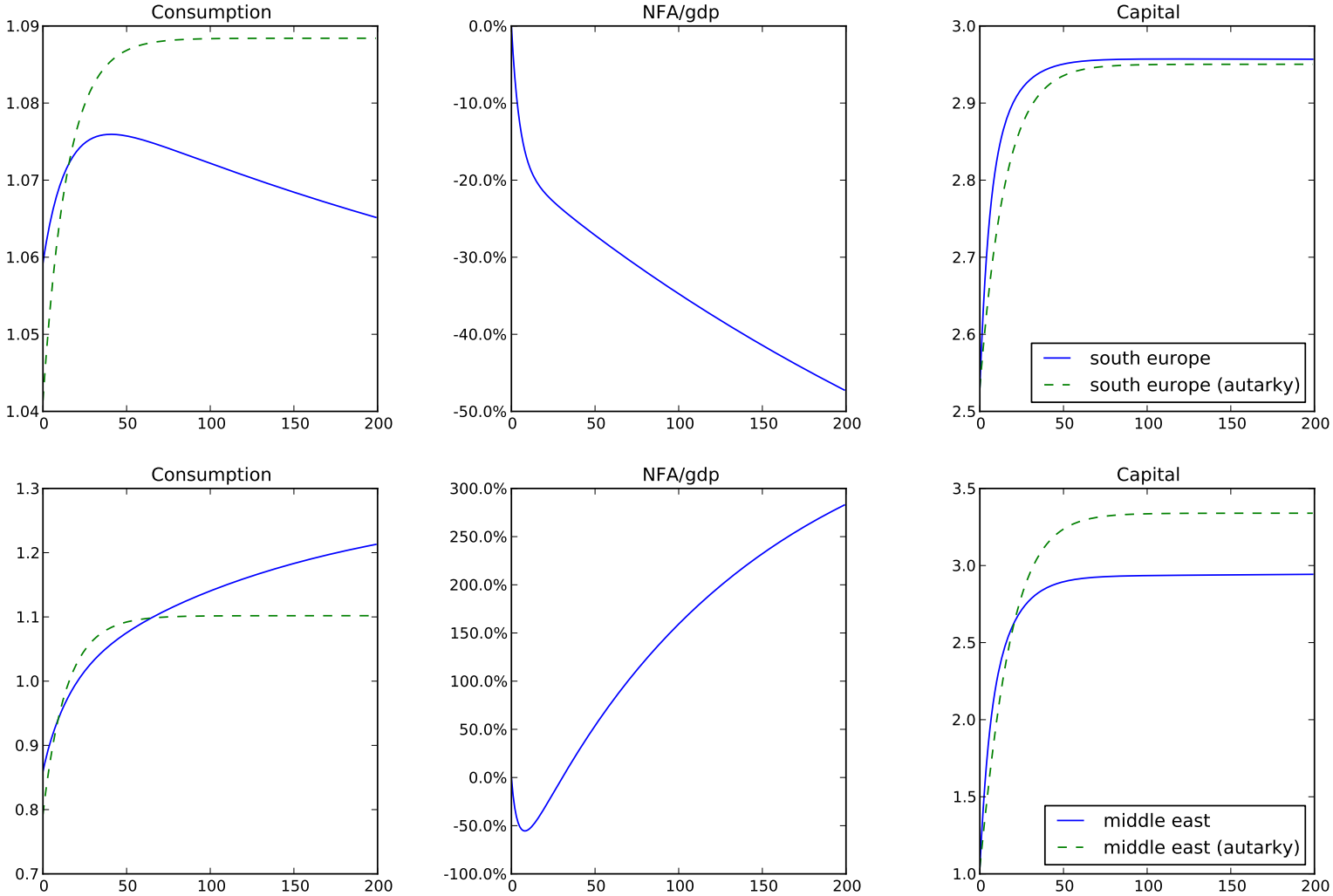


Figure 11: Dynamics along the risky path following integration the case of Early South Europe (top panel) and Late Middle-East (bottom panel). back

South Europe = Greece-Portugal-Spain; Middle-East=Oman-Saudi Arabia.