Financial Integration and Growth in a Risky World

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Motivation
Core question in international macro

- Where do gains from international financial integration come from?
- Conventional view
  - efficient allocation of capital: capital flows emerging countries
  - risk sharing (reduces volatility of aggregate consumption)
- Other explanations (not studied here)
  - Financial markets development
  - TFP increase (institutional development, ...)
  - Macroeconomic discipline
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 does benefit the most?
Two classes of models

- Allocative efficiency of financial integration without aggregate risk

- International risk sharing without production

- Need an integrated framework
  - Both types of gains are intertwined.
  - Convergence gains depend on distance from steady-state, itself modified by financial integration in presence of risk.
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 (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
Our findings

- **Growth and capital flows dynamics**
  - Buildup of precautionary assets by risky (emerging) country potentially offset in the short-run if sufficiently capital scarce.
  - Growth impact of financial integration for risky country depends on these two conflicting forces.
  - Terms of the tradeoff depends on market price of risk.

- **Welfare gains**
  - Remain small for emerging markets. More elusive than we think.
  - If anything, safest (developed) countries main beneficiaries, particularly so if price of risk is high.
Literature review

- Theoretical literature
  - Allocative efficiency
    - Gourinchas and Jeanne (2006)
  - Stochastic models with aggregate uncertainty (without production side)
  - Growth models with idiosyncratic uncertainty

- Empirical literature on financial integration and growth: mixed results and cross-country heterogeneity
  - Surveys: Eichengreen (2002), Kose et al. (2006), 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:**
  \[
  y_{i,t} = a_t k_{i,t}^\theta l_{i,t}^{1-\theta}
  \]

- **Productivity shocks:**
  \[
  \log(a_{i,t}) = \rho \log(a_{i,t-1}) + \epsilon_{i,t}
  \]

- **Investment with convex adjustment costs**
  \[
  k_{i,t+1} = (1 - \delta) k_{i,t} + k_t \varphi \left( \frac{i_{i,t}}{k_{i,t}} \right)
  \]
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)
- \( \gamma \) 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

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

- Euler equation for investment

\[
E_t \left[ m_{i,t+1} \left( \theta \frac{y_{1,t+1}}{k_{1,t+1}} \phi_{i,t} + \frac{\phi'_{i,t}}{\phi'_{i,t+1}} \left( (1 - \delta) + \phi_{i,t+1} - \frac{i_{i,t+1}}{k_{i,t+1} \phi'_{i,t+1}} \right) \right) \right] = 1
\]
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 clears at all dates.
Solution methods

- **Global solution: policy function iteration**
  - Needs a compact set.
    - Bounds for debt $b$
    - Discretization method for productivity shocks (Rouwenhorst (1995))
  - High number of states

- **Why not standard perturbations methods?**
  - capital scarcity and incomplete markets take us away from deterministic steady-state
  - risky steady state versus deterministic steady state
## Calibration

### Structural parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate</td>
<td>$\beta = 0.96$</td>
</tr>
<tr>
<td>Capital share</td>
<td>$\theta = 0.3$</td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>$\delta = 0.1$</td>
</tr>
<tr>
<td>Capital adjustment costs</td>
<td>$\xi = 1.1$</td>
</tr>
<tr>
<td>EIS</td>
<td>$1/\psi = 1/4$</td>
</tr>
<tr>
<td>Risk aversion</td>
<td>$\gamma = 4 \text{ to } 50$</td>
</tr>
</tbody>
</table>

- Capital adjustment costs such that $\sigma^i = 3\sigma^y$
- Low risk aversion $\gamma = 4$, CRRA case.
- High risk aversion $\gamma$ up to 50 to generate meaningful risk premia.
Volatility matches the group of emerging markets $E$ integrating to developed countries $D$ since 1985.

Emerging markets roughly twice as volatile.

<table>
<thead>
<tr>
<th></th>
<th>Autocorrelation</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E=$Risky economy</td>
<td>0.9</td>
<td>5%</td>
</tr>
<tr>
<td>$D=$Safe economy</td>
<td>0.9</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Zero correlation of shocks in the baseline calibration (underestimation compared to the data, roughly 0.2)
Calibration
Size and capital scarcity

- Roughly the same GDP size as developed countries at opening. → GE 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 (per eff. units) for emerging countries $E$ integrating to developed countries $D$ since 1985 (perpetual inventory method).
  - Compare with capital stocks of already integrated countries.
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 (efficiency units) 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)

<table>
<thead>
<tr>
<th>Country</th>
<th>E</th>
<th>Rest of the world</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial</td>
<td>0.53%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>General</td>
<td>0.21%</td>
<td>0.16%</td>
<td></td>
</tr>
</tbody>
</table>

- 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 GE 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 (efficiency units) 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 $\gamma = 50$ to match risk premia.
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. Thus even without initial capital scarcity.
**Figure 2**: Experiment 2: No initial capital scarcity and $\gamma = 4$

Dotted lines (resp. solid lines) refer to autarky levels (resp. levels under integration).
Baseline Experiment 2
Asymmetric risk & no initial capital scarcity & low risk aversion

- Higher precautionary savings in $E$ implies reallocation of capital towards $D$. Capital flows from $E$ to $D$.
- Lower growth in $E$, opposite in $D$. Output permanently lower in $E$ (opposite in $D$).
- Integration beneficial to both countries but gains remain low.
  - Permanent increase in consumption is 0.36% in $D$ and 0.32% in $E$.
  - Gains from risk sharing are low in $D$. Larger in $E$ but at the cost of reallocating capital (=price of insurance).

What happens if $E$ also capital scarce? → Experiment 3
Figure 3: Experiment 3: $E$ capital scarce and $\gamma = 4$

Dotted lines (resp. solid lines) refer to autarky levels (resp. levels under integration).
Baseline Experiment 3
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 $= 0.33\%$ in $D$ and $0.42\%$ 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 4: Experiment 4: $E$ capital scarce and $\gamma = 50$

Dotted lines (resp. solid lines) refer to autarky levels (resp. levels under integration).
Baseline Experiment 4
Asymmetric risk with initial capital scarcity & high risk aversion

- With high market price of risk, stronger reallocation of capital for precautionary motives.
  - Dominates reallocation due to initial differences in capital.
  - Capital flows from $E$ to $D$, even if $E$ has a lower initial capital stock.
  - Lower growth in $E$ compared to autarky initially, opposite in $D$.

- Aggregate welfare gains fairly low and unevenly distributed.
  - Permanent increase in consumption is 0.25% in $E$.
  - Increase significantly in $D$, up to 1.7%.
  - $E$ willing to forego a large amount of consumption for insurance. $F$ issue the safe asset at a very high price.
Figure 5: Welfare gains of financial integration with different degree of risk aversion $\gamma$.

Notes: Gains are expressed in % equivalent of permanent consumption.
Figure 6: Welfare analysis of financial integration. Low vs High risk aversion ($\gamma = 4$ vs 50).

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

- Asset market structure: incomplete vs complete markets
- Stochastic properties of the shocks
- Market sizes
Complete markets

- Results qualitatively unaffected.
- Provides 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.
Stochastic properties of the 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, mostly beneficial to safer country $D$. 
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 very small gains, below 0.5%.
  - Early liberalizers: Southern Europe has small gains due to (i) high correlation; (ii) small initial differences.
  - Late liberalizers: Middle-East has small gains despite being very capital scarce due to strong offsetting precautionary demand for safe assets.

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

Figure 8: Capital stock at time of integration of emerging markets (ratio w.r.t developed countries).

Figure 9: Dynamics along the risky path following integration the case of Early South Europe (top panel) and Late Middle-East (bottom panel).

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