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(Working Papers)

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# MEDIUM AND LONG TERM IMPLICATIONS OF FINANCIAL INTEGRATION WITHOUT FINANCIAL DEVELOPMENT

by Flavia Corneli*

## Abstract

We show that, in a two-country model where the two economies differ in their level of financial market development and initial capital endowment, financial integration has sizeable transitory as well as permanent effects. We confirm that, consistent with the Lucas paradox, financial integration in the medium term can reduce capital accumulation and increase savings in the financially less developed country, characterized by domestic capital market distortions, due to a higher risk premium in production activities. In the long run, however, integration produces higher levels of capital than in the autarky steady state. The opposite happens to the financially advanced economy, where integration initially boosts consumption and leads to a lower saving rate, and in the long run causes a reduction in capital compared with the autarky steady state. Two forces drive these results: precautionary saving and the propensity to move resources from risky capital to safe assets until the risk-adjusted return on capital equalizes the risk-free interest rate; assuming a constant relative risk aversion (CRRA) utility function, these forces are both decreasing in wealth.

**JEL Classification**: F36, F43, G11, O16.
**Keywords**: financial integration, international capital movements, incomplete markets, economic growth.

## Contents



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# 1 Introduction[1]

Standard neoclassical growth models predict that all economies *conditionally* converge to their steady state and that financial integration - through the equalization of the marginal return of capital across countries - has only transitory effects: it accelerates the convergence rate of those scarce in capital and facilitates an efficient allocation of savings towards more productive activities. The present analysis, while being consistent with the Lucas paradox of the international capital movements towards advanced instead of emerging economies, provides novel predictions on the short, medium and long run effects of financial integration among countries that differ in their level of financial development. Our theoretical contribution shows that financial depth, by shaping the saving and investment behavior of individual agents, has important implications for capital movements among countries and can help explaining the emergence of large external imbalances, as observed in the last decades.

The empirical evidence that motivates this work moves from the observation of financial liberalization, financial markets' development and diverging saving behaviors in the last 35 years. Their features and relations can be summarized in four stylized facts:

*Stylized fact 1 - Financial liberalization is still an ongoing process.* Figure 1 shows a *de jure* measure of financial integration elaborated by Chinn and Ito (2006). This index, which ranges between zero and one, illustrates that since the mid-90's both advanced and emerging economies have gradually increased their level of financial integration. However, the gap between the two groups is still substantial and the global financial crisis of 2008-09 doesn't seem to have altered the trend. The role assigned to financial integration is subject to close scrutiny: on one side, a wide range of empirical evidence has not been able to give a univocal answer on the effects of financial integration on growth; on the other side this literature stresses that, besides transitory effects on accumulation, capital account liberalization could impact countries' long run performance.[2]

*Stylized fact 2 - Persistent gap in financial markets' development.* Sahay et al. (2015) among others document that financial development fosters economic growth. Figure 2 shows the evolution of the financial market development index elaborated and recently released by the

[1]This paper benefited from comments by Arpad Abraham, Mark Aguiar, Christopher Carroll, Giancarlo Corsetti, Andrea Finicelli, Hélène Rey and Paolo Surico. The views expressed are those of the author and do not necessarily reflect those of the Bank of Italy.

[2]See Kose et al. (2009), Bumann et al. (2013) and Ostry et al. (2016) for surveys on the empirical literature. Aghion et al. (2005) empirically find that countries with poor financial markets converge to a steady state level of capital lower than economies with better institutions; moreover Fung (2009) shows that countries with under-developed financial sectors are more likely to be trapped in poverty.

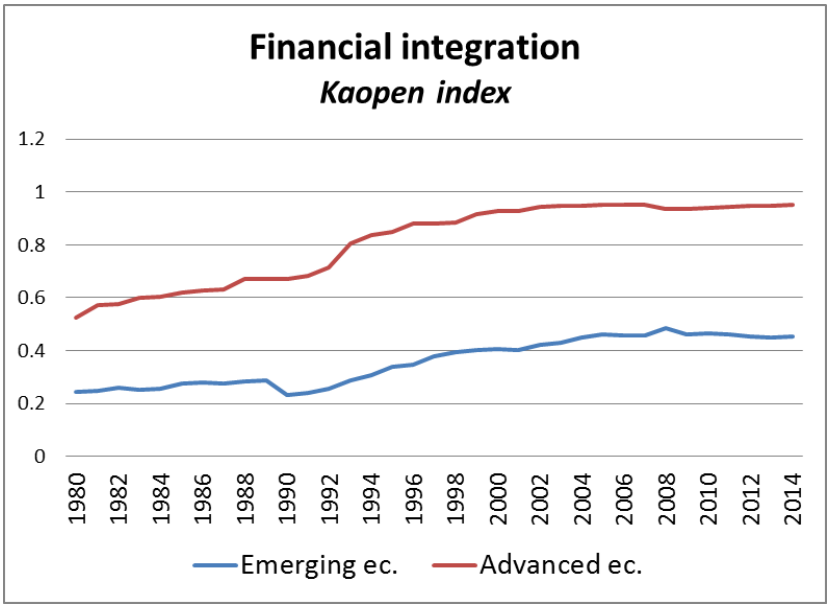


**Figure 1:** Chinn-Ito index (KAOPEN) of capital account openness. Source: Chinn and Ito (2006).

IMF, for advanced and emerging economies: both groups register an increase in financial depth.[3] Starting from the global financial crisis advanced economies registered a slight decrease while emerging economies a slow down in the positive trend of financial market development. The gap is, however, still present and sizable. As found by Bonfiglioli (2008), financial integration does not seem to spur convergence among the two groups, or a catching up in financial development by emerging economies.

*Stylized fact 3 - Diverging savings paths.* Prasad et al. (2007) observe that, in recent years, contrary to neoclassical models' predictions and in spite of increasing financial integration, capital has started to move uphill, from developing to developed economies. Moreover, Aguiar and Amador (2011) and Alfaro et al. (2014) detail those capital flows showing that sovereign transactions account for the upstream capital flows while Gourinchas and Jeanne (2013) and Gros (2013), estimate that capital allocation puzzle reflects countries' aggregate saving decisions. Figure 3 shows that, in fact, saving behavior has been changing over time and with financial integration. As documented also by Coeurdacier, Guibaud and Jin(2015) for emerging Asia and the US, emerging economies experienced a surge in their savings picking up in the late 1990's, while advanced economies experienced a mild downward path.

[3]The chosen measure of financial market development is a proxy for the depth, access and efficiency of financial institutions and financial markets for each economy in each year, as detailed in Sahay et al. (2015) and Svirydzenka (2016).

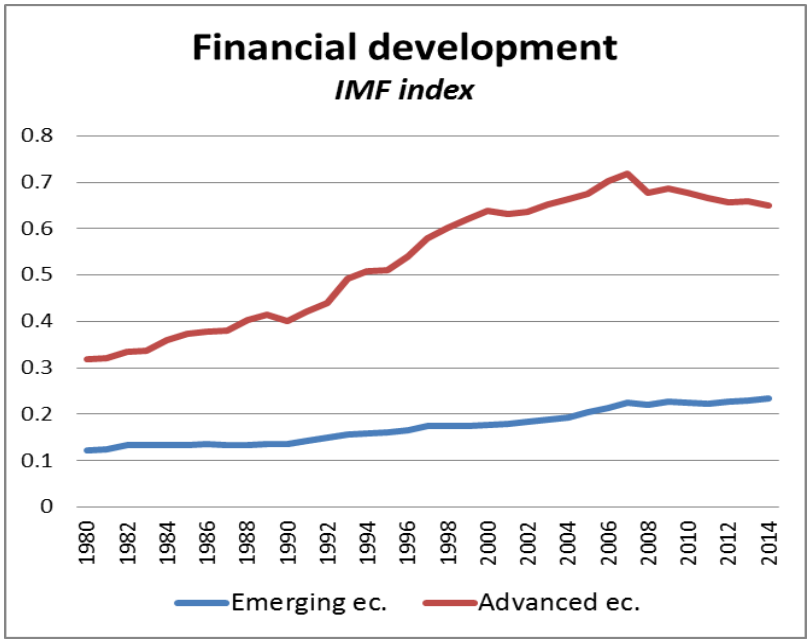


**Figure 2:** Financial development index. Source: IMF.

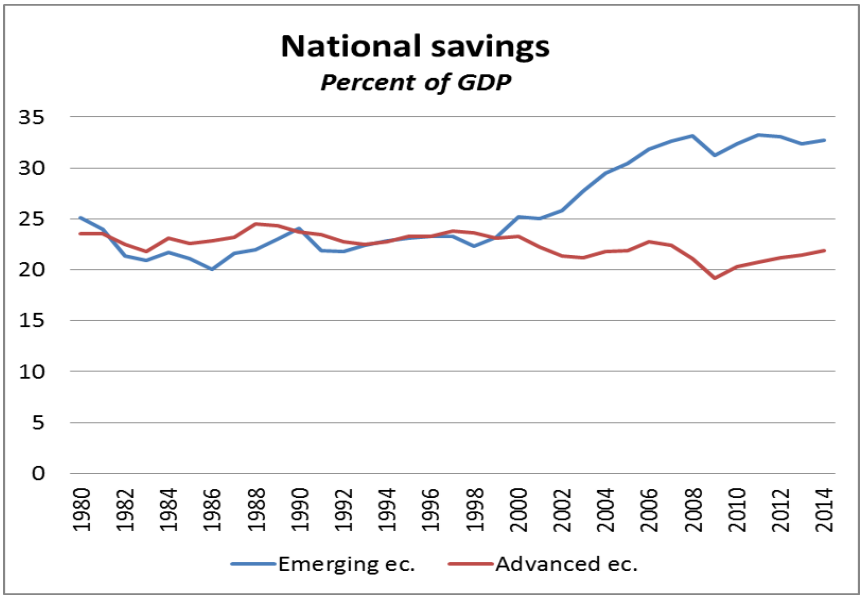


**Figure 3:** Gross national savings as percentage of GDP. Source: IMF.

*Stylized fact 4 - Financially less advanced economies are the ones that save more.* Figure 4 shows the relation between countries' saving rates and financial development (respectively measured with national savings over GDP and the IMF financial development index). Consistent with Aizenman et al. (2015), this figure shows a suggestive evidence that this relation has been changing over time and with the level of financial integration. In the 80's and 90's, when most developing economies were at an early stage of financial integration, the relation was positive, signaling that countries with a more advanced financial system were the ones saving more. From the 2000's the relation reverts and becomes negative, which seems to suggest that emerging markets, with poorer financial institutions, are the ones saving more.

In this paper we argue that financial integration among countries with different degrees of financial development has sizeable transitory as well as permanent effects on their levels of capital and savings. In particular, we confront a developing country that is still in the process of accumulating capital and whose financial markets are at an early development stage, and an advanced country that operates at the steady state and has more developed financial markets. We show that, when these two economies open up their capital accounts, in the medium term the developing country experiences a reduction in the speed of capital accumulation, and therefore in growth, and an increase in savings; in the long run, however, this economy achieves steady state levels of capital and production that are higher than the ones under autarky. The opposite is true for the advanced economy: here financial integration boosts consumption and dissaving in the medium term; high consumption is financed by capital inflows through the accumulation of external debt; this, however, forces agents of the advanced country to reduce both consumption and the capital stock in the long run. The amount of accumulated capital in the developing country at the moment of integration shapes the short run consequences of liberalization: if the developing country is still far from its autarky steady state then on impact it experiences a boost in consumption and capital accumulation financed through the issuance of risk free bonds, while the advanced economy reduces consumption and acquires those bonds. However, if the developing country is close to steady state, the rate of capital accumulation slows down immediately as a consequence of integration and the advanced economy issues bonds and enjoys higher consumption. The medium and long run effects described above only depend on the financial development gap.

We present a two-country model based on Angeletos (2007). In each economy heterogeneous agents are subject to idiosyncratic production shocks; the presence of idiosyncratic risk generates a wedge between the risk-free interest rate and the marginal return on capital (risk premium). Domestic financial markets provide partial insurance against those shocks.[4] Better financial

[4]We follow Angeletos and Calvet (2006) and Angeletos (2007) for the specification of the financial markets.

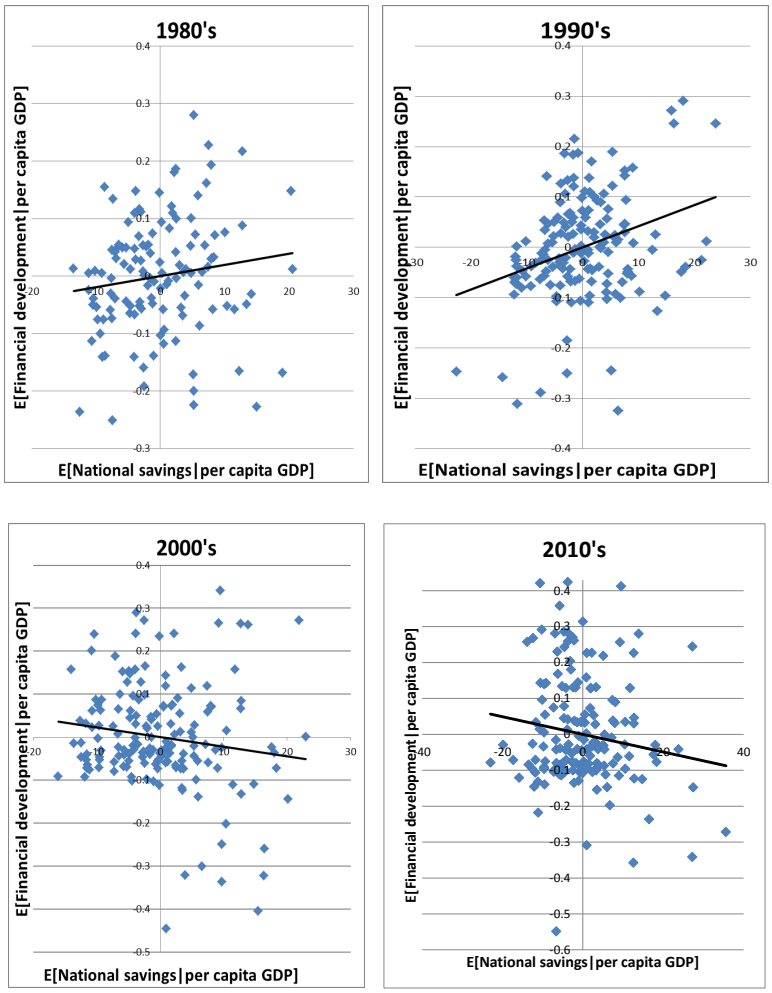


**Figure 4:** Partial correlation between national savings and financial development measured by credit to the private sector (after controlling for per capita GDP). 1980's refers to the decadal average form 1980 to 1989; 1990's refers to the decadal average from 1990 to 1999; 2000's the decadal average from 2000 to 2009; 2010's refers to the five-year average from 2010 to 2014. Source: author's calculation based on IMF data.

institutions, by lowering the portion of shocks that rests on agents, determines a lower risk premium and lesser need for precautionary savings; in equilibrium, this results in a higher risk-free interest rate and, at the same time, a higher level of capital. The two countries differ not only in terms of financial depth, but also in the initial level of accumulated capital: we assume that the advanced economy has already reached the autarky steady state, while the other is still in the process of accumulating capital. When these two countries liberalize their capital accounts (and they can therefore exchange risk-free bonds) the interest rate on bonds is immediately equalized at a level that is between the two interest rates prevailing before integration. As a consequence of integration, in the medium term agents in the developing economy tend to postpone consumption and risky investment and buy safe assets issued by the advanced country; agents in the latter, instead, prefer to raise consumption.[5] The effect is a deceleration of convergence in the developing economy. The exact path for the two levels of capital in the short run depends on the level of accumulated capital at the moment of integration. The advanced country keeps accumulating external debt up to the new steady state, where capital, production and consumption end up lower than they were in autarky. The opposite is true for the developing economy: here in the medium and long term agents accumulate external assets, and in the new steady state they reach levels of capital, production and consumption higher than those corresponding to the autarky steady state.

Two forces drive these results: precautionary saving and the propensity to move resources from risky capital to safe assets until the risk-adjusted return on capital is equal to the risk-free interest rate; under the maintained assumption of constant relative risk aversion (CRRA) utility functions, those forces are both decreasing in wealth. Debt accumulation by the agents in the advanced country, by reducing their willingness to take on risk, depresses the steady state aggregate capital stock and production. In the developing country, in contrast, the increase in wealth, due to accumulation of risk-free assets, boosts the propensity to take on risk, resulting in higher capital, production and consumption in the long run and compared to the autarky steady state. Welfare analysis reveals that integration determines welfare losses for the advanced economy since the increase in consumption in the medium term, with respect to autarky, cannot offset the drop in the long run, and possibly also in the short term, depending on the capital endowment in the other economy at the moment of integration. In the developing country instead, a slowdown in consumption in the medium term is compensated by the increase in the long run; therefore, agents in this economy enjoy welfare gains. Those positive consequences are, however, mitigated or even reverted if, at the moment of financial integration, the country is very close to its autarky steady state.

The rest of the paper is organized as follows. The next section provides a review of the

[5]Depending on the level of the risk-free interest rate in the emerging country before integration, agents in this economy may experience a short-lived boost to consumption and capital accumulation.

literature particularly close to the present analysis. In section 3 we present the theoretical model and derive the steady state in the two cases of autarky and financial integration. In section 4 we calibrate the model and conduct a numerical exercise to study the transition path towards the steady state of integration and the implications in terms of convergence rate and welfare for the two economies. We moreover show the results of the simulations with a different hypothesis on the level of capital accumulation in the developing economy, at the moment of integration. Section 5 concludes with some final remarks.

# 2 Literature review

The focus of this analysis is to understand the effects of financial integration among countries with different levels of financial development, abstracting from risk sharing considerations. Moreover, we look at an emerging economy in the process of accumulating capital at the moment of liberalization, showing that the level of capital has sizable though transitory effects. Angeletos and Panousi (2011) and Corneli (2009) also analyze the implications of financial integration between two economies with different levels of financial development. We share with those papers the idea that financial underdevelopment influences entrepreneurial activities and constrains the ability of the agents to insure against idiosyncratic shocks.[6] Angeletos and Panousi (2011) establish the same important result for the steady state of integration that we also obtain: lower capital, production and consumption with respect to the autarky levels for the advanced economy, and higher capital, production and consumption for the developing country with respect to its autarky steady state. The long run effects of financial integration contrast, instead, with Corneli (2009) due to a different attitude towards risk of single agents, which comes out to be crucial for the long term consequences of financial integration on savings and investment behavior. Due to constant absolute risk aversion, in Corneli (2009) capital choice is independent of the level of agents' wealth; large and widening bond holdings therefore do not affect the level of capital and production, but only the saving-consumption decision. In the present paper, instead, the more plausible hypothesis of constant relative risk aversion makes optimal capital choice dependent on wealth. Mendoza et al. (2007, 2009) are the first contributions that study the impact of financial integration among economies populated by heterogeneous agents, following Aiyagari (1994), and with different levels of financial development. They however predict that the level of capital in the autarky steady-state is higher and the risk-free interest rate is lower for the developing economy than for the advanced one, and this is due to the absence of a wedge (the risk premium) between the risk-free interest rate and the marginal return on capital. In the steady

[6] Analogously to the present work, these two papers adopt the formalization of the financial market development introduced by Angeletos and Calvet (2006).

state of integration, a common and intermediate interest rate is accompanied by higher capital accumulation for the advanced economy and a lower capital level for the developing country, with respect to autarky. All the contributions mentioned so far focus on two countries that are at the autarky steady state at the time of integration. In the present analysis instead, we allow for the economy with less developed financial markets to be still in a transition phase. This way, we are able to assess the effects of integration on the speed of convergence of the developing economy at different stages of capital accumulation, therefore providing novel implications for the transitory effects of capital account liberalization.

In this respect, our contribution is close to Coeurdacier, Rey and Winant (2015): they also analyze the transition path from autharky to steady state of two economies that differ in the level of capital scarcity at the moment of financial integration. Their analysis is however targeted to highlight the risk sharing gains of two countries that differ in their level of aggregate uncertainty while they abstract from heterogeneity inside each economy. Our contribution could then be viewed as a complement to Coeurdacier, Rey and Winant (2015) since we focus on the determinants of different saving-investment behaviors inside each country.

The welfare consequences of financial integration in the present paper differ from Mendoza et al. (2007, 2009) and Corneli (2009), which find that financial integration brings welfare gains for the agents in the advanced economy, where lower precautionary motive boosts consumption in the first periods after capital account liberalization, and welfare losses for the developing economy. This is due to two important differences: in the mentioned contributions the financial development gap between the two economies is larger but, more importantly, the developing country is already at its autarky steady state at the moment of integration. The welfare analysis therefore reveals that the assumption of the capital accumulation in the emerging economy is crucial to understand the consequences of financial liberalization, even if the effects on saving - investment decisions are only transitory. Importantly, Mendoza et al. (2007, 2009) show that, abstracting from risk sharing, financial integration can bring negative welfare effects in those cases in which welfare findings are mainly a consequence of changes in the interest rate. Coeurdacier, Rey and Winant (2015) moreover, focusing exclusively on the risk-sharing consequences of financial liberalization, obtain positive though modest welfare gains for all. In Coeurdacier, Rey and Winant (2015) the welfare gain for the developing country is larger than for the other economy only in the presence of capital scarcity at the moment of integration, in line with the present study.

The contributions mentioned so far are able to replicate, in line with the present work, the global imbalances observed in the data, and explain them as a result of differences in savings and investment attitudes. Other studies establish analogous results focusing on economies hit by aggregate risks (Caballero et al., 2008, Prades and Rabitsch, 2012, Fogli and Perri, 2006).

Our analysis is also related to the contributions of Carroll and Jeanne (2009) and Sandri (2014): both these papers find that financial integration can reduce the speed of capital accumulation for financially underdeveloped economies. However, they focus on a small open economy, therefore they are not interested in the two sides of global imbalances; moreover in their analyses the interaction between financial underdevelopment and capital account liberalization has no impact on the steady state level of capital and consumption.

Gourinchas and Jeanne (2006) and Antunes and Cavalcanti (2013) study the welfare consequences of capital account liberalization for a small open economy that is converging towards its steady state.[7] They find positive welfare gains for the country; those gains are higher for an economy that liberalizes its capital account at an early stage of capital accumulation. We share with these studies the fact that financial integration has relatively better effects for countries at an early stage of capital accumulation than for economies closer to their steady state. The main difference is that in our setup, after capital account liberalization, the risk premium for investing in production activities induces agents of the developing country to reduce the speed of capital accumulation. Also in our two-country world, different precautionary saving motive (higher in the developing country than in the other economy) determines an equilibrium interest rate at which the developing economy is a net lender in the medium and long term, since its agents tend to postpone consumption and increase savings.

Finally, following Gourinchas and Jeanne (2013), we could extend our model to include a benevolent government choosing its net borrowing in order to finance lump sum transfers to the country's agents. Our aggregate levels of borrowing would constitute the optimal government choice and our results would therefore be in line with the empirical findings that high public debt, by decreasing total wealth, can hamper growth (IMF, 2015). Reinhart and Rogoff (2010) estimate that high levels of debt (above 90% of GDP) are associated with lower growth. In our simulations we find that the financially advanced economy issues bonds (at abound 100% of GDP in steady state) and at the same time decreases the level of production, due to the increase in risk aversion, which is negatively correlated with total wealth. We obtain therefore that widening global imbalances are not neutral for countries' long run performance.

# 3 The model

The model we present is based on Angeletos (2007). It is a neoclassical economy with heterogeneous agents, convex technologies and idiosyncratic production risks. Financial markets are incomplete and agents can trade only riskless bonds. Wealth can be allocated either to consumption, risky productive capital or risk free bonds. Time is discrete; there are two countries

[7] In Gourinchas and Jeanne (2006) financial markets are complete, while in Antunes and Cavalcanti (2013) heterogeneous agents are subject to idiosyncratic shocks to their labor income, *à la* Aiyagari.

indexed with $i$, each populated by a continuum of atomistic agents.[8] Each household is a consumer - entrepreneur, owns a firm, and supplies inelastically one unit of labor in a competitive labor market; on the other hand she can accumulate capital only in her own firm.[9]

The flows of utility of each agent at time zero can be written as:

$$U_{i0} = \sum_{t=0}^{\infty} \beta^t c_{i,t}^{1-\gamma}/(1-\gamma) \tag{1}$$

We assume a standard CRRA utility function, where $\gamma > 0$ represents the coefficient of relative risk aversion (and the reciprocal of the elasticity of intertemporal substitution) and $c_{i,t}$ is the chosen level of consumption at time $t$ by an individual agent living in country $i$.

Each period the agent allocates her wealth $w_{it}$ to consumption $c_{it}$, capital $k_{it+1}$, to be used in the production of the final good the period after, and risk-free bonds $b_{it+1}$, according to the budget constraint:

$$c_{it} + k_{it+1} + b_{it+1} = \pi_{it} + R_{it} b_{it} + \omega_{it} \equiv w_{it} \tag{2}$$

Total wealth is given by the profit earned by the household-entrepreneur $\pi_{it}$, the gross return $R_{it}$ on the bonds $b_{it}$ purchased the period before and the wage $\omega_{it}$.

Profits are given by total production less labor costs:

$$\pi_{it} = f(a_{it}, k_{it}, n_{it}) - \omega_{it} n_{it} \tag{3}$$

Where

$$f(a_{it}, k_{it}, n_{it}) = a_{it} k_{it}^{\alpha} n_{it}^{1-\alpha} + (1-\delta) k_{it} \tag{4}$$

and

$a_{i,\min} = 0$, $Ea_{it} = 1$, $\ln a_{it} \sim N(-\sigma_{ia}^2/2, \sigma_{ia}^2)$

The production is a Cobb-Douglas aggregator of capital and labor $n_{it}$. Capital is chosen one period in advance, it depreciates at a rate $\delta$ and cannot be reshuffled once the idiosyncratic productivity shock $a_{it}$ realizes. The level of employed labor is instead decided after observing the shock. $a_{it}$ is log-normally distributed with p.d.f. $\zeta$, $a_{it}$ is i.i.d. across agents and time. The parameter $\sigma_{ia}^2$, which is the variance of the associated normal distribution, is the formalization of the financial market development. It represents the portion of the production risk that cannot be insured through the financial market and, therefore, rests on the individual entrepreneurs.[10] Throughout the rest of the paper we maintain the assumption that the variance

[8] Small letters represent single agents' variables, while capital letters are aggregate variables.

[9] Alternatively we could think of each "agent's unit" as a couple, one of them owning a firm, the other being a worker.

[10] $\sigma$ is the short-cut for the level of production variability that cannot be insured. We do not make assumption on the "total" variability of the production process, thus we do not compare this measure across countries. We

of the idiosyncratic shock is lower in country 1 (the advanced economy, with more developed financial markets, therefore with more efficient and accessible financial institutions and markets, as defined in footnote 2) and higher in country 2 (the developing country with less developed financial markets).

Given the assumptions on the distribution of the shock, the model generates an endogenous or "natural" borrowing constraint that must be satisfied in every period:

$$b_{it} \geq -h_{it} \ , \ h_{it} = \sum_{j=1}^{\infty} \frac{\omega_{it+j}}{R_{t+1}...R_{t+j}} \tag{5}$$

$h_{it}$ is the human wealth, computed as the discounted flow of wages; it also represents the wealth of an agent subject to the worse productivity outcome in every period from $t$ onwards (i.e. $a_{i,t}$=$a_{i,\min} = 0 \ \forall t$). Since the labor market is competitive, in equilibrium the agents are paid identical wages, therefore human wealth is the same across agents.

## 3.1 Optimization problem

Given a deterministic sequence of prices $\{\omega_{it}, R_{it+1}\}_{t=0}^{\infty}$ , agents choose consumption, labor supply, capital and risk-free bonds $\{c_{it}, n_{it}, k_{it+1}, b_{it+1}\}_{t=0}^{\infty}$ in order to maximize their lifetime utility (1), subject to their budget constraint (2) and the non-negativity constraints (see below).

The optimization problem for each agent can be written with a value function:

$$V(k, b, a; t) = \max_{n,c,b',k'} \{U(c) + \beta E_t V(k', b', a'; t+1)\} \tag{6}$$

s.t.

$$c + k' + b' = \pi + Rb + \omega \tag{7}$$

$c \geq 0, n \geq 0, k' \geq 0, b' \geq -h_t$

Where, again

$$\pi = f(a, k, n) - \omega n \tag{8}$$

Angeletos (2007) proves that the policy functions for consumption, capital and bonds can be written as linear functions of financial wealth $w_{it}$ (see the appendix for the derivation), in

are interested in the variability that stays on households, cannot be redistributed, and therefore affects agents' wealth.

particular:

$$c_{it} = (1-\psi_{it})(w_{it}+h_{it}) \quad (9)$$

$$k_{it+1} = \psi_{it}\phi_{it}(w_{it}+h_{it}) \quad (10)$$

$$b_{it} = \psi_{it}(1-\phi_{it})(w_{it}+h_{it}) - h_{it} \quad (11)$$

where $\psi_{it} = \psi(\omega_{it+1}, R_{it+1})$, $\phi_{it} = \phi(\omega_{it+1}, R_{it+1})$
$\phi_{it} \approx \frac{\ln \bar{r}_{it+1} - \ln R_{it+1}}{\gamma \sigma^2_{it+1}}$

$\bar{r}_{it+1}$ is the mean of the returns to risky capital across the agents, $\sigma^2_{it+1}$ their variance that coincides with $\sigma^2_{ia}$, the variability of the idiosyncratic production shock.

The above equations define the equilibrium choices as a linear function of the effective wealth, defined as financial plus the human wealth ($w_{it}+ h_{it}$), multiplied by two coefficients that are deterministic and vary with wage $\omega_{it+1}$ and bond return $R_{it+1}$. The proportion of wealth the agent decides to allocate to savings and investment ($\psi_{it}$), therefore to future consumption, is a function of the discount rate $\beta$ and of the return to savings; it in fact comes from the Euler equation combined with the FOC for capital and bonds. The proportion of stored resources that are invested in risky capital ($\phi_{it}$) is a measure of the risk premium the agents receive for investing in the production activity instead of risk-free assets, and is decreasing in the riskiness of the financial environment $\sigma^2_{ia}$: the higher is the portion of production risk that cannot be insured through the financial markets, the lower the amount of resources invested in risky capital. It is also important to notice that $\phi_{it}$ is negatively affected by the risk aversion parameter: the more the agent is risk averse (higher $\gamma$), the lower the amount of resources employed in risky activities.

## 3.2 General equilibrium and steady state under autarky

Since the policy functions for consumption, capital and bonds are linear in wealth, it is possible to aggregate the equilibrium choices of $c_{it}, k_{it+1}, b_{it+1}$; the wealth distribution does not affect the aggregate dynamics. In addition, since the shock to productivity is idiosyncratic, it cancels out in the aggregate, so that the general equilibrium is deterministic. In the closed economy in every period bonds are in zero net supply since the market has to clear; also, the offer of labor equals its supply:

$$B_{it} = 0 \quad (12)$$

$$N_{it} = 1 \quad (13)$$

In what follows we assume that $\gamma = 1$, a plausible calibration for the parameter of relative risk aversion that is widely used in the literature and allows to simplify the parameter that defines the propensity to consume, which reduces to $\psi_{it} = \beta$. Aggregating across the agents, the budget and the borrowing constraints (2) and (5) become:

$$C_{it} + K_{it+1} = W_{it} \equiv K_{it}^{\alpha} N_{it}^{1-\alpha} + (1-\delta)K_{it} \tag{14}$$

$$H_{it} = \frac{\omega_{it+1} + H_{it+1}}{R_{it+1}}, \text{ where } \omega_{it} = (1-\alpha)K_{it}^{\alpha} \tag{15}$$

The policy functions (9) and (10) become:

$$C_{it} = (1-\beta)(W_{it} + H_{it}) \tag{16}$$

$$K_{it+1} = \beta\phi_{it}(W_{it} + H_{it}) \tag{17}$$

The mean of the returns to capital simply becomes equal to the net marginal productivity of capital, taking into account capital depreciation, ($\bar{r}_{it+1} = \alpha K_{it+1}^{\alpha-1} + 1 - \delta$) therefore the propensity to invest in capital is equal to:

$$\phi_{it} \approx \frac{\ln(\alpha K_{it+1}^{\alpha-1} + 1 - \delta) - \ln R_{it+1}}{\gamma \sigma_{ia}^2}$$

The equilibrium path for capital accumulation is positively affected by the financial market development: for any level of the effective wealth the share of resources invested in capital is higher the lower is $\sigma_{ia}^2$.

The steady state versions of (14) - (17) are (given that $N_{it} = 1 \ \forall t$):

$$C_i + K_i = W_i = K_i^{\alpha} + (1-\delta)K_i \tag{18}$$

$$H_i = \frac{(1-\alpha)K_i^{\alpha}}{R_i - 1} \tag{19}$$

$$C_i = (1-\beta)(K_i^{\alpha} + (1-\delta)K_i + H_i) \tag{20}$$

$$K_i = \beta\phi_i(K_i^{\alpha} + (1-\delta)K_i + H_i) \tag{21}$$

Figure 5 shows the steady state values of the main variables as function of $\sigma_{ia}$, which is varied between zero and 1.1.[11] Angeletos (2007) proves that, for plausible values of the model parameters, capital and the risk-free interest rate are decreasing in $\sigma_{ia}^2$, which is also the case

[11] The calibration of the parameters used in this simulation is reported below is section 4.1.

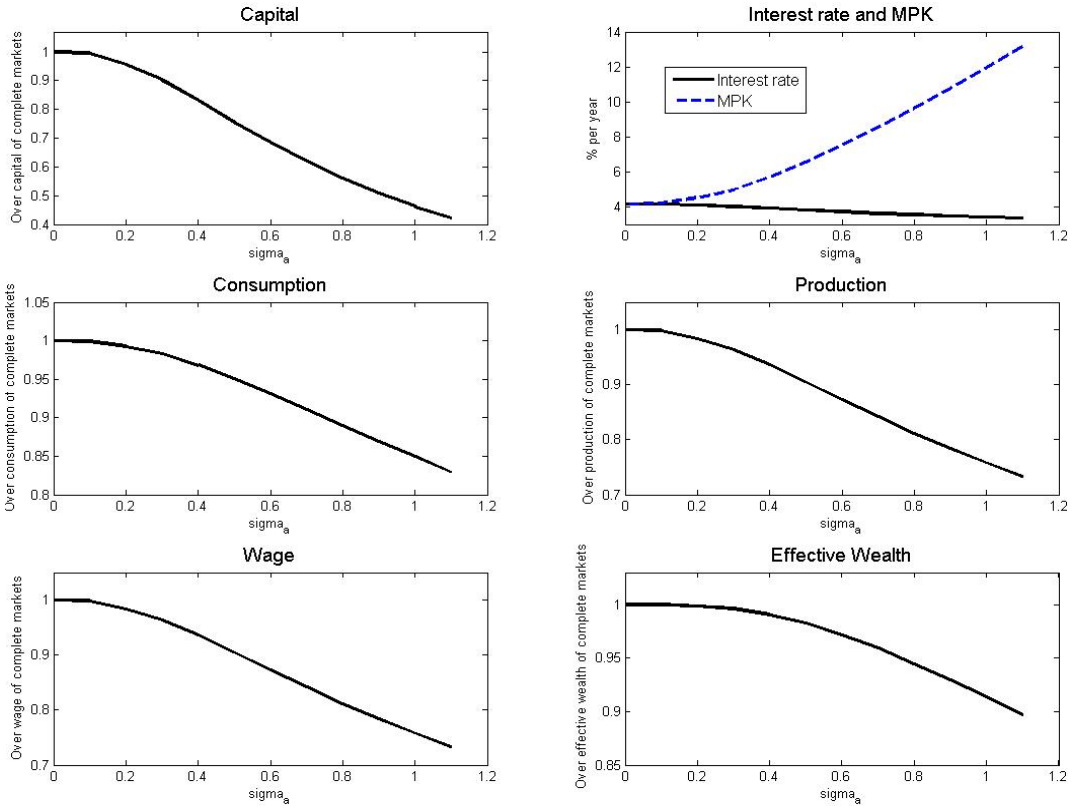


**Figure 5:** The impact of uninsurable risks $\sigma_{ia}$ on the steady state relations.

in the figure. The risk premium, measured by the gap between the marginal return to capital and the risk-free interest rate, is increasing in the riskiness of production, i.e. in the degree of financial market underdevelopment: this results both from an increase in the risk compensation demanded for investing in the productive capital and from an increase in the demand for precautionary savings, which drives down the risk-free interest rate. Less developed financial markets are associated with a lower steady state capital level and, therefore, with lower production, consumption and wages. It is worth noting that the level of effective wealth decreases less rapidly than production, as it is smoothed by the fall in the risk-free rate; it follows that the fall in consumption is also muted.

The equations (18)-(21) can be combined to obtain the following:

$$K_i^{1-\alpha}(\delta + 1 - \beta) = \beta - \frac{(1-\alpha)(1-\beta)}{1-R_i} \tag{22}$$

$$\frac{1-\phi_i}{\phi_i} K_i^{1-\alpha} = \frac{(1-\alpha)}{(R_i - 1)} \tag{23}$$

Equation (22) derives from the Euler condition at the steady state of zero consumption growth; it therefore represents the agents' saving decision or the supply of capital to the firms.

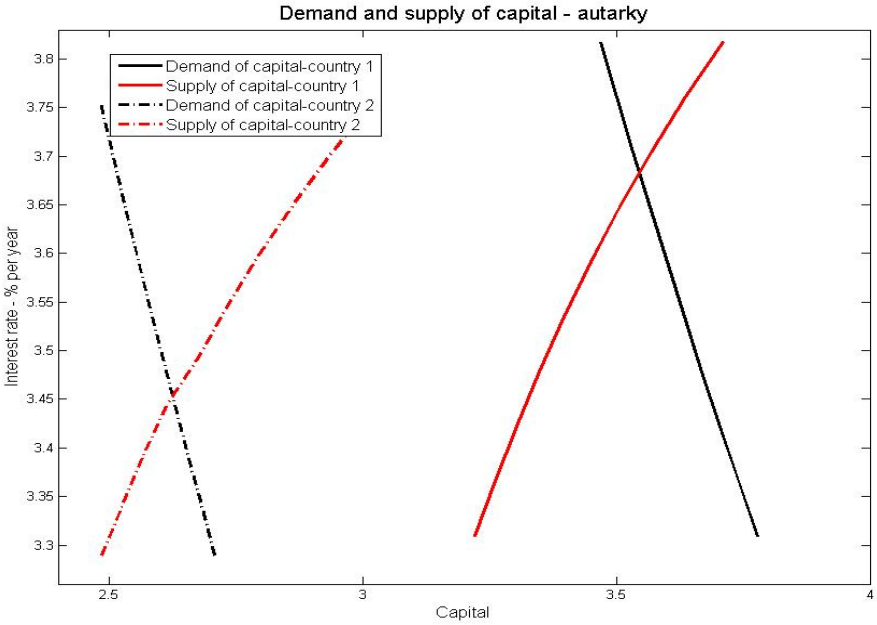


**Figure 6:** Steady state demand and supply of capital in two countries with different degree of financial development.

This equation implies a positive relationship between the risk-free interest rate and the capital stock: higher interest rates induce agents to postpone consumption and therefore to devote more resources to saving - investment. Equation (23) represents, instead, the demand for capital by the entrepreneurs, or their investment decision. Given decreasing returns to capital, higher interest rates on risk free bonds imply lower levels of capital in order to keep the return on capital adjusted for risk equal to the interest rate.

Equations (22) and (23) are plotted in Figure 6 for two countries that differ only in their level of financial development. The Figure provides a visual insight of the result that in the autarky steady state deeper financial markets are associated with higher capital and higher risk-free interest rate.

## 3.3 Steady state with integrated financial markets

In this section we solve the model assuming that the two countries open up their capital accounts, i.e. they start exchanging risk-free bonds. Financial integration brings the immediate equalization of the two countries' risk-free interest rates. The individual agents' optimization problem is identical to the closed economy case, therefore conditions (9)-(11) remain valid. The open economy case differs in that, when deriving the general equilibrium and computing the aggregate equilibrium relationships, the condition that bonds are in zero net supply in each country (equation (12)) need not be satisfied, and is replaced by the condition that the world

demand and supply of bonds are equal. The general equilibrium is again deterministic, given the absence of aggregate shocks, and is characterized by the sequence of consumption, labor supply, capital and risk-free bonds $\{C_{it}, N_{it}, K_{it+1}, B_{it+1}\}_{t=0}^{\infty}$ and of prices $\{\omega_{it}, R_{t+1}\}_{t=0}^{\infty}$ such that the following aggregate relationships are satisfied in every period:

$$
\begin{aligned}
C_{it} + K_{it+1} + B_{it+1} &= W_{it} \equiv K_{it}^{\alpha} + (1-\delta)K_{it} + R_t B_{it} && (24)\\
B_{1t} + B_{2t} &= 0 && (25)\\
H_{it} &= \frac{(1-\alpha)K_{it+1}^{\alpha} + H_{it+1}}{R_{t+1}} && (26)\\
C_{it} &= (1-\beta)(W_{it} + H_{it}) && (27)\\
K_{it+1} &= \beta\phi_{it}(W_{it} + H_{it}) && (28)
\end{aligned}
$$

Equation (24) is the analogous of the budget constraint (14) in the closed economy case, except that here aggregate bond holdings can be non-zero. Equation (25) imposes equilibrium in the world bond market. Equations (26) - (28) are identical to the closed economy.

The following proposition establishes the steady state equilibrium result of the model with financial integration among two countries.

**Proposition 1:** *Suppose that in a two - country world, with country 1 financially more developed than country 2, in the* autarky steady states *the risk-free interest rates are such that* $R_1 > R_2$. *The steady state equilibrium with financial integration is characterized by a common risk-free interest rate* $R_{ss}$, *such that* $R_2 < R_{ss} < R_1$, *and country 1 issues a strictly positive level of risk free bonds.*

The steady state versions of (24)-(28) are:

$$
\begin{aligned}
C_i &= K_i^{\alpha} - \delta K_i + (R_{ss} - 1)B_i && (29)\\
B_1 + B_2 &= 0 && (30)\\
H_i &= \frac{(1-\alpha)K_i^{\alpha}}{R_{ss} - 1} && (31)\\
C_i &= (1-\beta)(K_i^{\alpha} + (1-\delta)K_i + R_{ss}B_i + H_i) && (32)\\
K_i &= \beta\phi_i(K_i^{\alpha} + (1-\delta)K_i + R_{ss}B_i + H_i) && (33)
\end{aligned}
$$

Equations (29)-(33) help to understand the novel result of the present analysis, that is in contrast with previous studies (e.g. Mendoza et al, 2007, and Corneli, 2009). The levels of consumption and capital, determined by the aggregation of the policy functions (equations (32) and (33) respectively) are increasing functions of wealth, therefore they are increasing in the steady state level of the bond holdings. In the advanced economy (country 1), capital and

consumption are lower now than in the autarky steady state, since this economy is net issuer of bonds. The opposite is true of country 2: the levels of capital and consumption are higher in the integration steady state than in the autarky steady state. The complete dynamics of those variables are simulated in the next section.

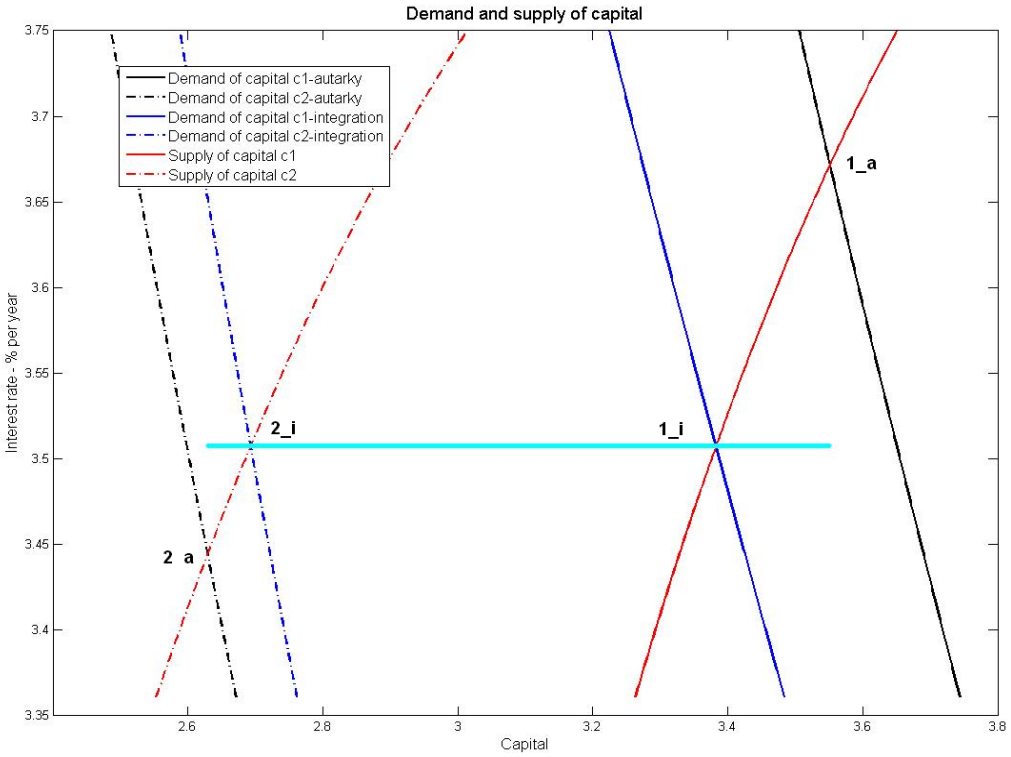


**Figure 7:** Steady state demand and supply of capital in two countries with different degree of financial development. Autarky and integration.

Figure 7 gives a further visual representation of the movements of capital and the interest rate (holding the amount of debt constant with sign determined by Proposition 1): it shows the capital supply and demand curves for the two countries at the steady state both in autarky and integration. Equilibria $1\_a$ and $2\_a$ are the autarky interest rate - capital combinations respectively in country 1 and country 2, derived in the previous section, while the equilibria with financial integration are indicated by $1\_i$ and $2\_i$ respectively. As stated in Proposition 1 the world interest rate is between the autarky risk-free interest rates. The most important message from figure 3 is that the steady state level of capital in country 1 is smaller than its autarky level while the opposite is true of country 2. By looking at figure 7 we also see that the capital accumulated by agents in country 2 always remains below the level in country 1; this happens because the financial development gap generates a higher risk premium and higher precautionary savings in the developing economy, even in the financial integration.

We obtain the apparently surprising result that in the long run, the country with poor financial institutions accumulates more capital than under autarky, while the advanced economy

decumulates capital and shrinks production. This novel result is induced by the different behavior of the supply and demand curves. Consider country 1. On the one hand, the supply does not move, since the propensity to consume does not change after integration; the only implication of being able to lend or borrow from abroad is a movement along the curve: the interest rate of integration, being lower than the one of autarky, induces agents to reduce their savings and increase consumption. On the other hand, two distinct effects influence the demand of capital. The first movement, in line with the supply side, is along the curve: entrepreneurs in country 1 are willing to increase investment at the new interest rate. The second movement is a shift of the demand curve due to changes in the propensity to invest in risky activities: since agents have CRRA utility function, their risk aversion increases with the decrease in wealth therefore they reduce their level of capital further. The positive impact of a smaller risk-free interest rate on the demand of capital is therefore more than offset by the increase in the risk aversion. The opposite is true of the demand curve in country 2: it moves to the right due to the higher propensity to invest in risky activities that derives from the increase in wealth. Moreover, in this economy, agents are willing to save more at the interest rate of integration which is higher than the one of autarkic steady state.

# 4 Quantitative analysis

In this section we calibrate the model and simulate the dynamics during the transition towards the new steady state. In particular, the scope of this exercise is to highlight the implications of financial integration for a developing country (country 2) that is still in the process of accumulating capital when it opens its capital account towards an economy financially more advanced and which is already at its autarky steady state (country 1).

## 4.1 Calibration

Each period corresponds to one year. We calibrate 7 parameters in order to match some important features of the data. We choose two blocks as classified in the IMF - WEO: on the one side advanced countries, on the other side emerging and developing countries. Compared to the analytical representation, we introduce capital-adjustment costs in order to get smooth transition paths for capital movements and to be consistent with our previous study (Corneli, 2009). We use a standard quadratic form ($\phi(k_{it+1}/K_{it} - 1)^2$) for capital-adjustment costs as specified in Kehoe and Perri (2002), making use of their calibration of the parameter $\phi$.

**Parameter values**

| | | |
|---|---|---|
| $\alpha$ | income share of capital | 0.36 |
| $1-\beta$ | annual discount rate | 0.04 |
| $\delta$ | annual capital depreciation rate | 0.08 |
| $\phi$ | annual capital adjustment cost | 0.6 |
| $\gamma$ | risk aversion | 1 |
| $\sigma_{1a}$ | st. dev. of uninsured idiosyncratic prod.shock, AE | .71 |
| $\sigma_{2a}$ | st. dev. of uninsured idiosyncratic prod.shock, EM | .88 |

The income share of capital, the annual discount rate and the annual capital depreciation rate are taken from the literature. The parameter of relative risk aversion (which defines also its reciprocal, the elasticity of intertemposal substitution) is set to 1. The choice of this parameter, already used by Aiagari (1994) and Angeletos (2007), represents a lower bound for the main mechanisms that drive the analysis: as shown in Angeletos (2007), the higher the risk aversion parameter the stronger is the impact of financial market frictions on the saving-investment decisions. A higher risk aversion would therefore amplify the quantitative results without changing the qualitative implications of financial integration.

In order to estimate the share of productivity shock variability $\sigma$ that cannot be insured through the financial markets, I start from the work of Bloom (2009): he provides a model and an estimation of how uncertainty affects single firms' decisions that in turn determine the overall macroeconomic performance of a country. He shows that various measures of uncertainty at firm level are highly correlated with stock-market volatility. In the same vein, Baker and Bloom (2013) find that uncertainty, proxied again by stock-market volatility, is higher in developing countries. A more direct way of estimating the uninsured productivity shock in the present analysis is by matching the risk premium, defined in the model as the wedge between the risk-free interest rate and the marginal return to capital (as shown in figure 5 in the autharky steady state). Damodaran provides a measure of the equity risk premium since 2000. For 2014 he provides risk premium estimates for 144 countries. This variable is computed starting from an estimation of the US equity risk premium and then adding an additional country risk premium that he finds to be much higher for emerging economies. Moreover, this variable is negatively correlated with financial market development, as shown in figure 8, supporting the idea that better financial markets and institutions reduce the risk premium for investing in risky activity. We obtain the values of $\sigma$ parameters by matching the risk premium of the two blocks at the final steady state of integration. In particular, we use data elaborated by Damodaran for the interest rate adjusted for risk (our measure of the marginal return to capital). The estimated interest rate adjusted

for risk is 5.6% for the advanced economy (country 1) and 7.6% for the developing one, country 2 (therefore there is a gap of 2%) from which I derive the values of $\sigma$ in the table.[12]

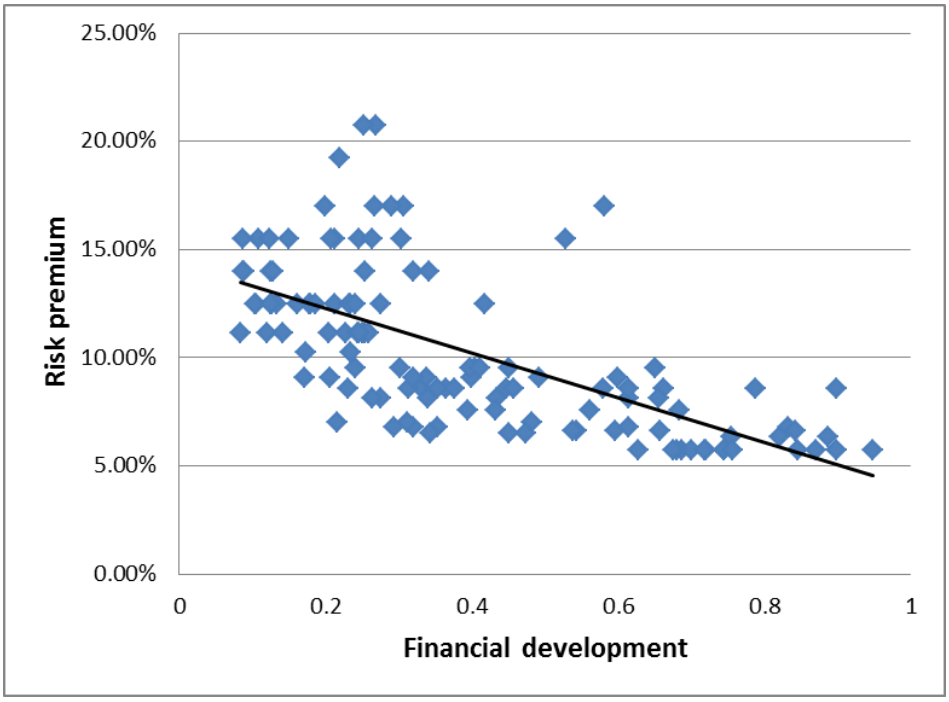


**Figure 8:** Financial development index and total risk premium for 2014. Sources: IMF, Damodaran

## 4.2 Simulations

In order to reproduce the dynamic transition from the initial equilibrium in the closed economy to the steady state of integration, we adopt the computational procedure proposed by Mendoza et al. (2009): we solve the model backward, updating our guess on one variable until all the policy functions and the resource constraints are satisfied in every period.

We first focus our attention on the transition path towards the autarky steady state for the country 2 starting from a given level of capital $K_0$. We then make the assumption that the same country, at $K = K_0$, decides to open up its capital account to an economy with more developed financial markets and which is already at its autarky steady state, country 1. We compare

[12]See Corneli (2009) for a discussion on the use of the dataset constructed by Damodaran (http://pages.stern.nyu.edu/˜adamodar/New_Home_Page/) to formalize the financial market development. In the two economies, countries are weighted by their participation in the international capital market (IFIGDP, from Lane and Milesi-Ferretti, 2007).

the speed of convergence towards the two different steady states (autarky and integration) for country 2 and highlight the transition of the main variables of interest for the two economies.

### 4.2.1 Autarky

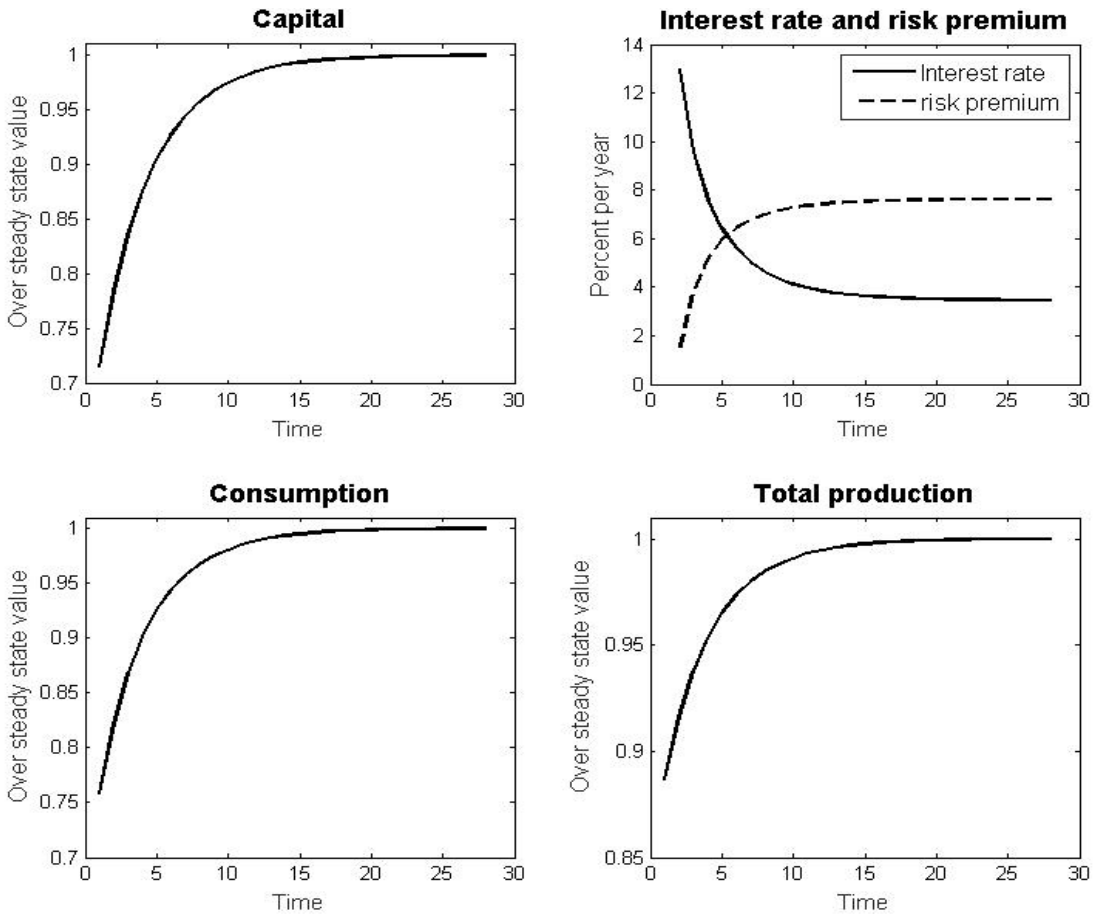


**Figure 9:** Country 2 - transition towards the steady state in autarky.

Figure 9 reports the transition to the autarky steady state of the main variables in country 2. The initial level of capital is set to 60% of the country one steady state level in autarky, slightly above the 50% level estimated by Coeurdacier et al. (2015). The transition is smooth and takes 28 years to complete.[13] The interest rate declines while the risk premium increases following the capital increase.

[13]Without capital adjustment costs convergence would be slightly faster.

### 4.2.2 Integration

In all the following simulations, at time 1 the two countries are in autarky, at time 2 they financially integrate without pre-announcement. At the moment of financial integration the interest rate on risk free bonds is equalized in the two economies. The transition towards the final steady state is extremely slow and takes several years. The level of capital accumulated by country 2 at the time of the capital account liberalization crucially determines the transition path in the short and medium run. Consistently with the above exercise we consider $K_0$ to be 60% of the autarky steady state level of country 1 ($K_0$ is moreover equal to 70% of the steady state of integration).

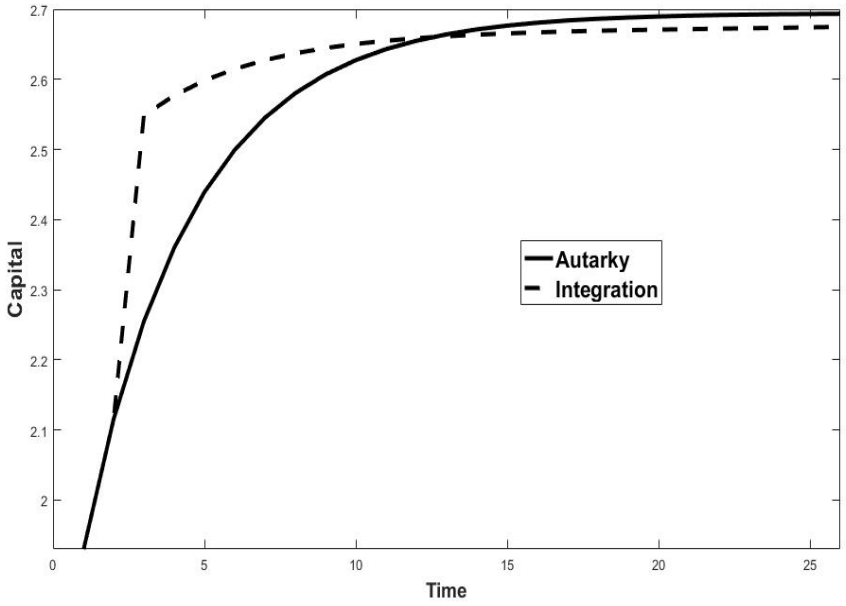


**Figure 10:** Capital accumulation in country 2 for the first 25 years after integration - autarky vs integration.

Figure 10 compares the capital accumulation path for country 2 in autarky and integration for 25 periods. In the first two periods the two curves coincides (recall that capital is set one period in advance). Then there is a jump in the level of capital chosen in integration and capital goes above the level of autarky. In fact, in this scenario, at the time of integration the interest rate moves to a value that is lower than the risk-free interest rate of country 2; in this economy, agents are therefore willing to invest in risky activities, because the return to capital adjusted for risk is above the risk-free interest rate. The boost in capital accumulation is exhausts after

12 years, when the level of capital moves below the one of autarky. Agents in country 2 can now diversify their portfolios by accumulating (on aggregate) positive levels of bonds, and they do so as they are more risk averse than agents in country 1. The novel result of the present analysis is that financial integration may boost capital accumulation in the short to medium time because of positive and high differentials of return on capital between the two countries, even when adjusted for risk; however the implications of different savings and investment behaviors have longer lasting consequences in that they slow down convergence toward the (new) steady state.

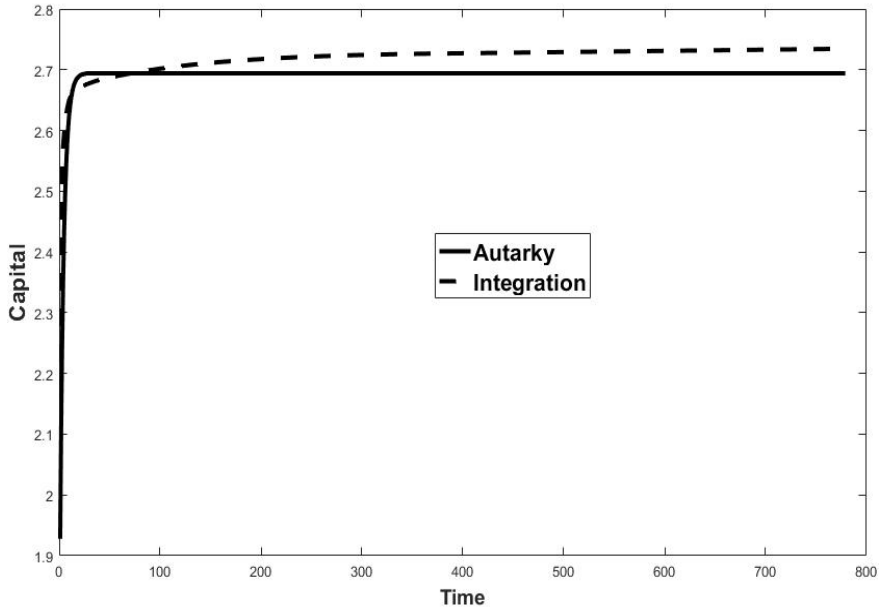


**Figure 11:** Capital accumulation in country 2 in the long run - autarky vs integration.

In fact, from Figure 11 it emerges that after financial integration (instead of 35 in the autarky regime) agents in country 2 reach a level of capital equal to the autarky steady state after many years. From that point on, they keep accumulating capital until they get to the steady state level, which is 1.5% higher than the autarky one.

As mentioned above the very long run result is positive for this economy in terms of final level of capital independently of the variables at the moment of integration: the final steady state depends only on the combination of parameters of the two economies and in particular on the financial development gap, as represented in Figure 7.

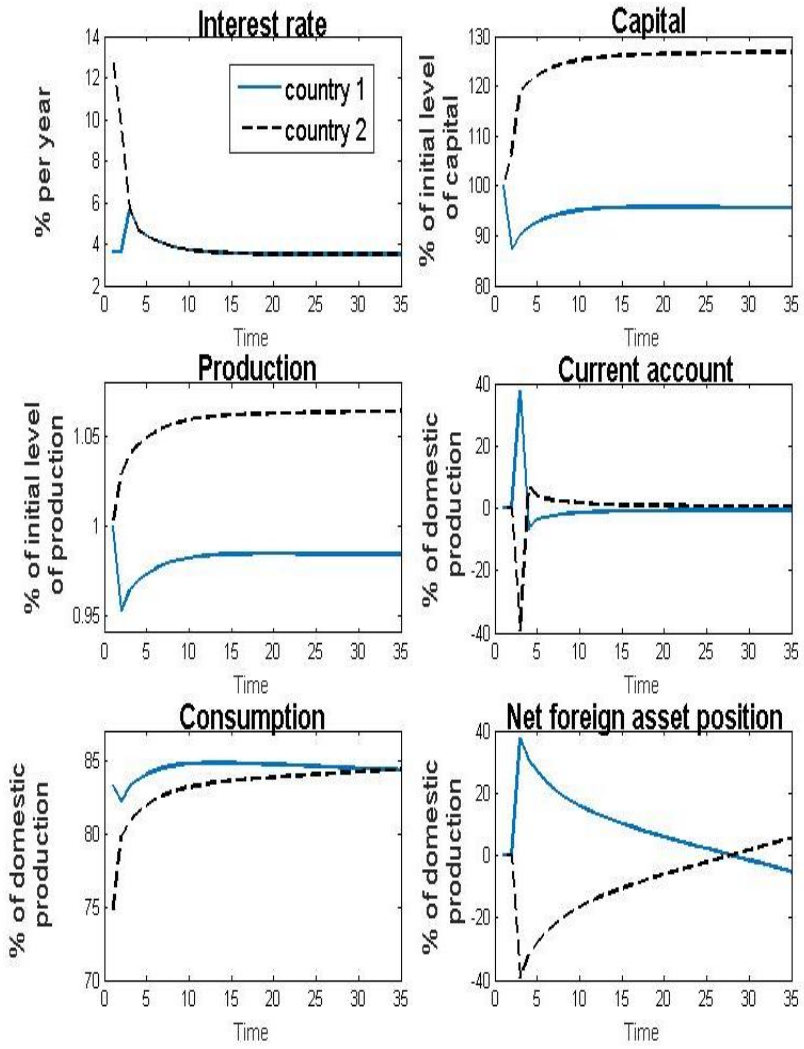


**Figure 12:** Transition dynamics - first year in autarky then first 34 years of integration.

Figure 12 shows the behavior of the variables of interest in the first 34 years after integration.[14] At the moment of integration the interest rate immediately jumps to a common intermediate level; it then moves to the steady state level in about 20 years[15]. The risk-free interest rate

[14]The interest rate is expressed as a percentage rate per year; the capital is reported over the initial level of capital and the same for production, while consumption, current account and bonds are reported as a percentage of current domestic production.

[15]When the two countries are both at the autarky steady state at the moment of financial integration, the interest rate jumps immediately to the new steady state, since capital liberalization induces only a capital reshuffle, in line with the results obtained in Corneli (2009). The result is very close to the one analysed in section 3.4, where $K_0$ is about 85% of the autarky steady state level of country 1.

differential before integration determines the short time reaction of the other variables: in the present scenario at time 1 country's 2 risk-free interest rate is higher than the interest rate of integration (and also higher than country 1's interest rate).[16] At the time of capital account liberalization agents in country 2 are willing to invest more resources in their risky activity, since the return on capital adjusted for risk turns out to be higher than the new interest rate; this boosts capital accumulation as illustrated above. The opposite happens in the other economy: on impact agents in country 1 decreases the level of capital, because the return on capital adjusted for risk is lower than the new risk-free interest rate. Also at the time of integration agents in country 1 reduces the level of consumption, but only for the first periods; then the lower precautionary motive, with respect to the other economy, induces them to increase the level of consumption and to finance it by issuing debt. The current account therefore first jumps to a surplus of 37% of production for country 1, followed by a jump to a deficit of around 7% of its GDP, which subsequently starts shrinking until it reaches zero at the steady state of integration. Agents in country 1 keep issuing debt in the entire transition until it reaches almost 100% of production at the final steady state. Due to the large increase in the negative asset position, total wealth decreases and therefore consumption and capital, that are a fraction of wealth, decrease as well. On one hand, agents have to repay interests on the accumulated debt; on the other hand, they become more risk-averse as total wealth decreases (given CRRA preferences). These two forces, namely lower wealth and higher risk aversion, push agents to reduce the level of capital, that at the final steady state is 6% lower than the autarky level. The level of consumption falls back to the autarky steady state value in 25 years, it then keeps diminishing down to 5% below the autarky one.

On the other hand, agents in country 2 keep accumulating capital: in the first part of the transition this is due mainly to the decrease in the risk-free interest rate, which must be matched by a decline of the risk-adjusted return on capital; in the second very long transition phase, capital accumulation is driven by the increasing share of resources they want to invest in risky activities. In the steady state of integration capital in country 2 is 1.5% higher than its level in autarky steady state. At the moment of integration agents increase their level of consumption given the lower interest rate on savings, they however start consuming less already five years after integration, when they become willing to postpone consumption in order to save and invest more; they get to the autarky steady state level of consumption in about 50 years and then they steadily raise it up to a final steady state which is 4.5% higher than the autarky steady state level. The current account of country 2 mirrors the one of the other economy. Therefore

[16] On the contrary, if the risk-free interest rate of country 1 is lower than the new common level, agents in this country move resources from risky activities to safe foreign bonds, decumulating capital (this second case, with country's 2 interest rate below the one of integration is presented in section 3.4).

a large deficit in the first periods is followed by a persistent surplus; then the current account shrinks towards zero at the final steady state, where negative net exports are balanced by the interests on the accumulated assets. The final level of accumulated foreign assets reaches almost 200% of total production.

Agents in country 2 enjoy a first boost in capital accumulation and consumption, and also capital inflows following capital account liberalization. The sign of the capital account changes however after a few years. This result is in line with the observations of Prasad et al. (2007), who show a tendency for this reversal: until the end of the 1990's capital importing countries were the poorer economies, while in the last decade richer economies tended to attract net flows of capital.

## 4.3 Welfare analysis

We now turn our attention to the welfare consequences of financial integration. The two economies produce a single homogeneous good therefore the gains from trade come from relative price adjustments and the possibility of capital reallocation between production activity and risk-free assets, away from the consumption choice. However, due to the heterogeneous agents hypothesis, and as shown in Mendoza et al. (2007, 2009) and Corneli (2009), the welfare implications of financial integration are very different also inside each country depending on the wealth of each single agent at the moment of liberalization. In particular, poor agents are better off after liberalization in the emerging economy since they pay a lower interest on accumulated debt, while rich agents are worse off since they gain lower return on risk-free assets. The contrary is true in the advanced economy. Therefore financial integration has important redistributional effects due to changes in the risk-free interest rate that, has described in Mendoza et al. (2009), dominate the positive welfare consequences from capital reallocation (i.e. speed-up in capital accumulation in the emerging economy and reduction in the other country). In order to compare the welfare consequences in the two economies, we focus again on the aggregated level of consumption, or equivalently, at the consumption path of the "average agent", an agent that has zero asset position at the moment of financial liberalization and whose productivity shock realizations are at the expected value for the entire transition. We compute the Hicksian equivalent variation, defined as the amount of consumption agents must receive in order to remain in autarky instead of moving to integration; it represents the amount of immediate consumption agents want at the moment of capital account liberalization in order to be indifferent between autarky and integration. A positive value therefore means that the agent of this economy prefers

to move to integration (integration is welfare improving) while a negative value implies a higher utility from remaining in autarky (integration is welfare decreasing).[17]

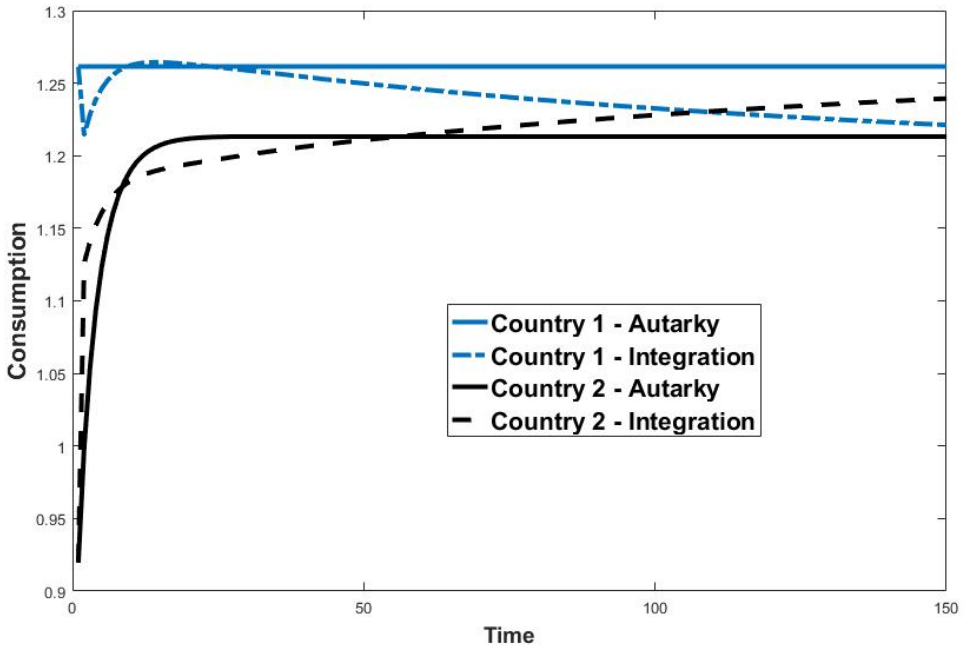


**Figure 13:** Consumption in the two countries - autarky vs integration.

Figure 13 reports the path of consumption in the two economies in autarky and integration. In country 1 the temporary drop in consumption at the moment of integration and in the subsequent 9 years is only partially offset in the 11 following years by consumption levels above the one of autarky. Integration implies a negative welfare impact corresponding to a 36% decrease in immediate consumption.

The opposite is true for the agents in the developing country, where integration is slightly welfare improving with an impact of 8% of consumption at time 1. The increase in the consumption level at the time of integration and in the long run compensates for the slowdown in the medium term, which is due to the strong precautionary motive.

The welfare implications of the model are sensitive to the initial level of capital in country 2 at the moment of integration. For instance, if the value of $K_0$ for country 2 is 80% of the

[17] We compute the Hicksian equivalent variation for the "average" agent. This measure is different from the one used by Antunes and Cavalcanti (2013), who assume a benevolent planner that averages across agents' welfare. However given the monotonicity of the utility function the "sign" of the welfare consequence is the same, even if the magnitude of the two measures is not comparable.

autarky steady state level of country 1 ($K_0$ is moreover equal to about 94% of the steady state of integration for country 2), the welfare loss for country 1 reduces to about 11 percent of autarky consumption level, and country 2 now experiences as well welfare loss of about 15% of autarky consumption level, due to the stronger consumption smoothing at the new common interest rate.

## 4.4 Alternative hypotheses on the level of initial capital $K_0$

We now modify the initial value of capital for country 2 at the moment of financial integration. We set it at about 85% of the autarky steady state level of country 1 (or about 98% of the steady state of integration for country 2). More importantly, at this stage of capital accumulation, the interest rate in autarky is below the one of steady state of integration.

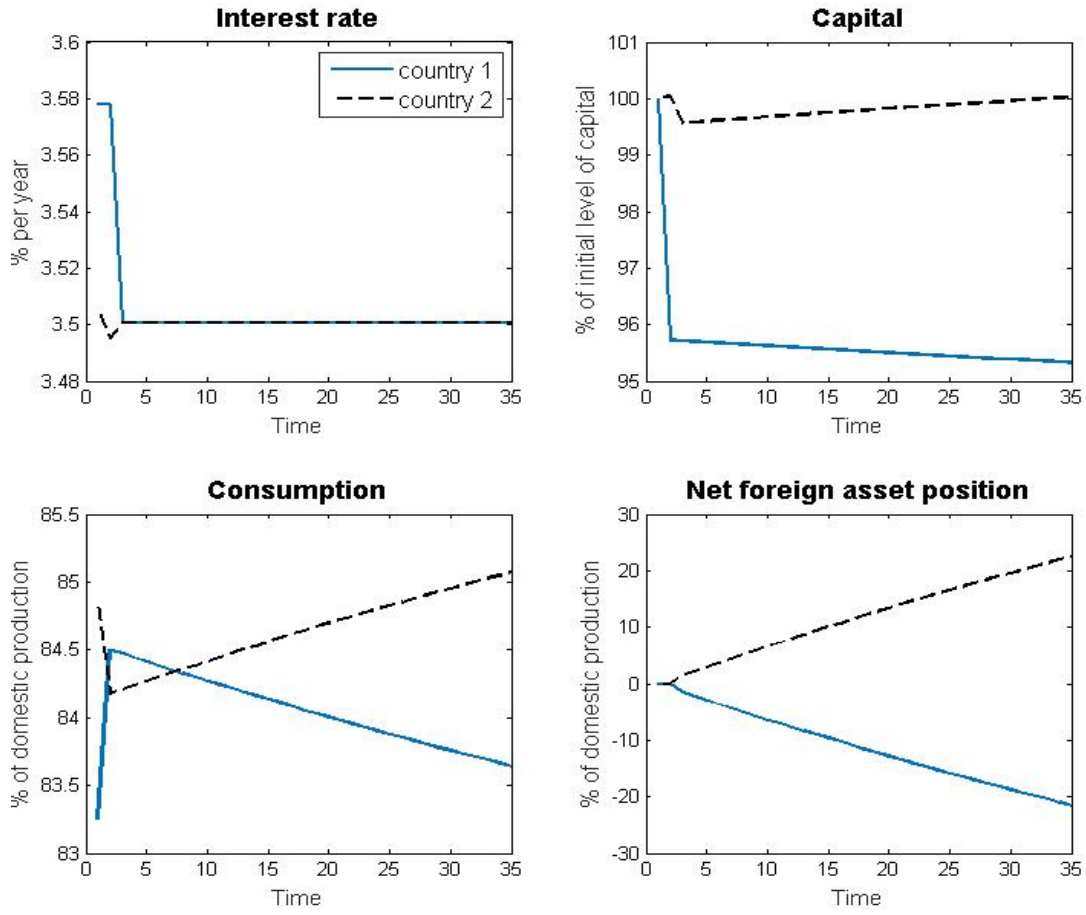


**Figure 14:** Transition dynamics - first year in autarky then first 34 years of integration.

In Figure 14, we report the main variables in the two economies. In this scenario, upon integration, the interest rate jumps to the steady state level, which is in between the two of autarky, and capital in country 1 starts decreasing immediately, while agents increases consumption and buy risk free assets. In country 2, capital account liberalization reduces on impact the level of resources invested in risky activities due to the increase in the interest rate. Then capital accumulation starts to slowly recover and reaches the level of the autarky steady state after 34 years, instead of 8 years in the autarky case. At the moment of financial integration, agents in country 2 are willing to issue debt. The long run paths for all variables are instead in line with the results of the previous scenario.

# 5 Final remarks

The goal of the present analysis is to study the effects of integration among countries with different degrees of capital market distortions. We highlight that financial depth influences agents' decisions in terms of investment as well as savings. In this respect our analysis is in line with the empirical findings of Gourinchas and Jeanne (2013):[18] we obtain savings and investment wedges with respect to the complete markets case, which, in the present study, is equivalent to assuming a production process with zero variance, $\sigma_i^2$.

This exercise, beside making predictions about long run effects of financial integration, is able to account for the diverging savings' behavior observed in the data, providing a theoretical ground for the observed international capital movements, from countries with higher marginal productivity of capital towards countries with larger capital-output ratios. Moreover, the analysis is able to characterize the entire transition path from closed economy to the steady-state of integration, for developing countries at different stages of capital accumulation. From the study of the transition path, it emerges that the level of capital accumulation at the moment of integration crucially shapes the short term choices of savings, investment and consumption. We also show that, on the one hand, financial integration can be welfare improving for financially poorer economies if they are at an early stage of capital accumulation and if their level of financial development is high enough. On the other hand, financially more advanced economies can experience welfare losses after integration. Different behaviors of savings and investment, determined by different appetite for risk, shape the choice of production, consumption and safe investment.

[18] Gourinchas and Jeanne (2013) are able to reproduce international capital movements and growth observed in the data by introducing savings and investment wedges into the neoclassical growth model.

Moreover the propensity towards risky production activities increases with wealth: this mechanism determines the long run levels of the main variables, independently of the conditions at the moment of financial integration.

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# Appendix

Following Lemma 1 of Angeletos (2007), we obtain labor demand and capital income as linear functions of $k_t$, by maximizing $\hat{f}(a, 1, \hat{n})$ with respect to $\hat{n}$ [19]:

$$n_t = n(a_t, \omega_t)k_t \tag{34}$$

$$\pi_t = r(a_t, \omega_t)k_t \tag{35}$$

Where
$\hat{f}(a_t, 1, \hat{n}_t) = f(a_t, k_t, n_t)/k_t$
$\hat{n}_t = n_t/k_t$

The maximization problem reduces to:

$$V(w; t) = \max_{c,b',k'} \{U(c) + \beta E_t V(w'; t + 1)\} \tag{36}$$

s.t.

$$c + k' + b' = w \tag{37}$$

$$w' = r(a', \omega_{t+1})k' + R_{t+1}b' + \omega_{t+1} \tag{38}$$

We obtain the solution in equations (9) - (11) by proposing and verifying the following solution:

[19] In what follows, for simplicity we drop the index $i$ for the countries, which is attached to every variable.

$$
\begin{aligned}
V(w;t) &= U(\lambda_t(w+h_t)) && (39)\\
c(w;t) &= (1-\psi_t)(w+h_t) && (40)\\
k(w;t) &= \psi_t(w+h_t) && (41)\\
b(w;t) &= (1-\phi_t)\psi_t(w+h_t) - h_t && (42)
\end{aligned}
$$

Where the last is obtained by substituting (40) and (41) in the budget constraint (37). For simplicity, we call $r(a_{t+1}, \omega_{t+1}) = r_{t+1}$.

The first-order conditions for capital and bonds become:

$c_t^{-\gamma} = \beta\lambda_{t+1}^{1-\gamma} E_t[r_{t+1}(w_{t+1}+h_{t+1})^{-\gamma}]$

$c_t^{-\gamma} = \beta\lambda_{t+1}^{1-\gamma} E_t[R_{t+1}(w_{t+1}+h_{t+1})^{-\gamma}]$

Combining these two expressions and substituting $(w_{t+1}+h_{t+1})$ from the budget constraint we obtain an expression for $\phi_t = \phi(\omega_{t+1}, R_{t+1})$:

$$
E_t[(r_{t+1}-R_{t+1})((r_{t+1}-R_{t+1})\phi_t + R_{t+1})^{-\gamma}] = 0 \qquad (43)
$$

From the envelope condition $(V'(w;t) = U'(c))$ we obtain the following relation:

$\lambda_t^{1-\gamma} = (1-\psi_t)^{-\gamma}$

Moreover summing the FOC above, pre-multiplied respectively by $\phi_t$ and $(1-\phi_t)$, we have the recursive structure for the coefficient $\psi_t$:

$$
(1-\psi_t)^{-1} = 1 + \beta^{1/\gamma}\rho_t^{1/\gamma-1}(1-\psi_{t+1})^{-1} \qquad (44)
$$

Where

$\rho_t = E_t[(r_{t+1}-R_{t+1})\phi_t + R_{t+1})]$

Finally $\phi_t$ and $\rho_t$ are approximated with a second-order Taylor expansion of $\ln\rho_t$ around $\sigma_t = 0$, by employing the derivation of the log - portfolio return in Campbell and Viceira (2002):

$\ln\rho_t \approx \phi_t E_t(\ln r_{t+1}) + (1-\phi_t)\ln R_{t+1} + \frac{1}{2}\phi_t(1-\phi_t)\sigma_{t+1}^2 + \frac{1-\gamma}{2}\phi_t^2\sigma_{t+1}^2$

Where

$\bar{r}_{it+1} = E_t r_{t+1}$

Solving for $\phi_t$ and using the fact that $E_t(\ln r_{t+1}) = \ln E_t(r_{t+1}) - \frac{1}{2}\sigma^2_{t+1}$ we obtain the expressions:

$\phi_t \approx \frac{\ln \bar{r}_{t+1} - \ln R_{t+1}}{\gamma \sigma^2_{t+1}}$

$\rho_t \approx R_{t+1} \exp(\frac{(\ln \bar{r}_{t+1} - \ln R_{t+1})^2}{2\gamma\sigma^2_{t+1}})$.

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