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The Saving Glut Explanation of Global Imbalances: the Role of Underinvestment

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Abstract

According to the 'Saving Glut hypothesis', global imbalances are caused by inefficiently high level of precautionary savings in financially underdeveloped regions, where agents have limited opportunity to diversify idiosyncratic risk. This paper generalizes the approach by modeling idiosyncratic risk in entrepreneurial activities, which can be only partially hedged. As a result, agents save too much and invest too little, relative to the efficient allocation, depressing production activities and the real interest rate. Capital account liberalization towards financially more advanced economies then produces an outflow of capital in search of safer investment, with the effect of further reducing domestic investment in countries with poor financial institutions. The model predicts welfare losses for less financially developed economies, and an increase in wealth inequality for advanced economies. Finally, the present analysis is able to explain the direct link between the financial crisis and global recession and the long run implications of worsening financial conditions on countries' net external positions.

JEL classification: D52, E44, F32, G11, G15, O16

Keywords: Current Account, Financial Markets, Heterogeneity, Incomplete Markets, International Capital Movements.

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1 Introduction

"*Over the past decades a combination of diverse forces has created a significant increase in the global supply of savings - a global saving glut - which helps to explain both the increase in the US current account deficit and the relative low level of long-term real interest rate.*"

Ben Bernanke, March 10, 2005 speech at the Sandridge Lecture, Richmond, Virginia

Bernanke is credited with the idea that the US current account deficits in recent years are due to saving glut in the rest of the world. According to this view, financial global imbalances are therefore the equilibrium result of structural differences emerged among groups of countries. Bernanke's position has been recently developed and formalized in the international portfolio literature: several contributions point at gaps in financial market development, financial integration or growth potential among countries to generate precautionary savings differences in US with respect to other developed and emerging economies that in turn cause financial global imbalances, as observed in the data. Only the savings side of the current account is therefore analyzed in these studies. The aim of our work is to go one step further and disentangle the two components of the current account: investment and savings; we explicitly model the impact of financial market institutions on investment demand and savings supply in order to show that financial integration among economies with structural differences in their financial markets generates not only precautionary savings but also underinvestment in the financially less developed countries. The two aspects together concur in generating the large and persistent net financial borrowing of the financially more advanced economy.

Finally the present analysis contributes to the discussion on the effects of the financial crisis with two important results: on the one hand worsened global financial conditions have the direct effect of reducing investment and lowering interest rate, bringing to a global reduction in output. On the other hand the widened gap between industrialized and emerging worlds in their level of financial development exacerbates the saving glut in its two components of underinvestment and higher precautionary savings, and therefore the negative net external position of the US.

We present a two-country model with heterogeneous agents and idiosyncratic production risks. The development of financial institutions is formalized as the ability of the market to absorb and redistribute idiosyncratic shocks to production, therefore the higher the sophistication of the financial market the lower is the impact of idiosyncratic shocks on agents' wealth. In this framework consumers decide to accumulate more savings the higher their uninsurable risk; the new element of our analysis is that entrepreneurs face a risk premium for investing

in risky production, instead of risk free bonds, and therefore they are willing to invest less the more variable their productive activities are. Financial market's development has a strong impact on the equilibrium level of interest rate and GDP: the lower the ability to insure entrepreneurs against idiosyncratic shocks, the lower the capital and interest rate in the steady state. When two countries with different financial institutions decide to reciprocally open their capital accounts by exchanging risk free bonds, in the less financially developed economy agents decrease risky investments and increase savings by purchasing foreign risk free bonds, while in the other country agents produce more and accumulate liabilities. This paper therefore replicates not only the large financial imbalances of developed countries, but also lower risk-free interest rate and lower capital accumulation in less financially developed economies, condition that worsens when the country opens to foreign capital.

The welfare consequences of financial integration are overall negative welfare gains for the poorer economies and slightly positive for the others. The main channel is the increase in the interest rate with respect to the risk-adjusted return on production investment for emerging economies; this divergence pushes agents to accumulate savings, postpone consumption and shift investment to foreign bonds instead of internal production capital. The wealth conditions worsen for the poorer in developing countries, since they face higher interest on their debt; only the richest, in the last decile of the wealth distribution, are better off since they receive higher returns on their accumulated assets. The financially more developed economies experience instead a decrease in interest rate that boosts consumption and investment in entrepreneurial activities. They therefore move resources from safe investment in bonds, which are now less profitable, to risky production capital; this is the main cause of the increased dispersion in wealth distribution, therefore an increased wealth inequality.

The immediate consequences of the financial crisis are worsened financial conditions, that in this setup translate in higher uninsurable risks associated with production activities, in all countries; the direct effect is the decrease in the level of invested capital and a lower equilibrium interest rate for all. Poorer economies however experience larger drops in their financial market's development compared with financially more advanced economies, and this, in an integrated world, results in a further reduction in the level of risky investment and an additional incentive to accumulate precautionary savings in the form of foreign risk free bonds. In countries that are financially more advanced integration helps in mitigating the negative effects of the financial turmoil since the new and very low level of interest rate discourages excessive drop in production investment, boosts consumption and further reduces the precautionary saving motive; the present analysis therefore predicts an acceleration in the negative and growing net external position of the US.

Welfare consequences are negative for all the countries hit by the financial crisis. However

the very poor in the financially more advanced economies have slightly positive welfare gains due to lower interest rate paid on the accumulated debt and a boost in consumption (two hypotheses drive this result: no borrowing constraints and no possibilities of default).

In the literature there are several contributions that stress the role of financial institutions in explaining international capital flows. Caballero, Farhi and Gourinchas (2006) stress the importance of the availability of domestic financial instruments for real investments together with growth differentials to generate capital flows toward the US. Prasad and Rabitsch (2007) look at differences in financial liberalization processes and aggregate productivity to explain financial global imbalances and in particular the US external deficit. In this contest, Fogli and Perri (2006) point at the effect of financial innovation in decreasing output volatility that in turn reduces precautionary saving needs and brings to large global imbalances.

In the present work however emphasis is put on idiosyncratic risks, since, as documented by Angeledis among others, they explain more than half of total economy variability in the US; we want to show that heterogeneity among agents, by influencing their choices, has an impact on the aggregate equilibrium of the economy, and also on its interactions with other countries. In this sense the contribution of Mendoza, Quadrini and Rios-Rull (2007) (MQR henceforth), is the closest to our analysis. MQR model economies in which agents are subject only to idiosyncratic shocks to labor productivity. They build a model based on Aiyagari (1994) but extended to two countries, and formalize financial market institutions by introducing limited liability constraint on net worth: in the first country with less developed financial markets households are subject to tight borrowing constraints, therefore they save more at any level of the interest rate in order to have enough resources to face bad idiosyncratic shocks. When this country frees its capital movements with a financially more developed country (with therefore looser borrowing constraints and higher interest rate in equilibrium) agents of the former country are encouraged to save even more given the higher interest rate in equilibrium; the opposite happens for households of the developed economy: they prefer to consume more in the present since they can borrow at cheaper price than before. MQR are able to give an explanation of the large and persistent financial imbalances observed in the data: they are generated by different financial structures of countries that open their capital account.

There are two main differences between MQR and the present study. First of all MQR results is driven by the impact of financial depth on consumer's behavior; they however obtain that before opening to global financing a developing country is saving and producing more than a developed one, bringing the ambiguous message that better financial institutions are detrimental for countries' capital accumulation; this is moreover at odd with the data[1].

[1] Bonfiglioli (2007) for example finds no direct relation between financial openness and investment while she

In our analysis we focus on the impact of financial markets on entrepreneurial decisions as well as on consumers' choices: in equilibrium poor financial institutions lead to lower capital accumulation and lower interest rate in less financially developed economies. Improvements in developing countries' financial markets generate only positive outcomes since they help to enhance welfare, stimulate investment and dampen large uninsurable financial volatility. The second difference stays in the formalization of financial markets: MQR introduce a borrowing limit. In our study instead, agents are not constrained on short sales, this enables the model to fully show the effect of financial incompleteness, formalized as missing insurance markets, on savings and investment decisions. Moreover the investment risk premium generated by financial underdevelopment has its counterpart in financial data series therefore it creates a clear mapping from the model to the empirical study, as highlighted in the next section.

The rest of the paper is organized as follows. The next section illustrates important stylized facts on financial globalization and financial development. Section 3 presents the closed economy model and focus in particular on the impact of market incompleteness on saving and investment choices for single agents and for the aggregate steady state of the economy. Section 4 moves to the two country-setup and the new steady state where risk free bonds can be exchanged across countries. In section 5 we show the results of the quantitative exercise. Section 6 extends the results to account for the financial crisis. In section 7 some sensitivity analysis is conducted. Section 8 concludes with some final remarks.

2 Stylized facts

The present section aims at motivating our analysis by explaining the definitions and presenting important figures on financial openness, international capital flows and measures of financial development (before and at the moment of the financial crisis) used in the rest of this study.

Figure 1 shows that the US current account has been negative since the end of the 80's and it has dropped dramatically during the last 10 years reported in the picture. The other industrialized economies have instead experienced an overall improvement in the last 10 years. Finally emerging economies ' negative position is recovering in the last 5 years of the sample.

Capital account liberalization is still an ongoing process and there are substantial differences among countries. Chinn and Ito (2007) construct an index of countries' financial integration based on *de jure* and *de facto* measure of financial restrictions. We divide their sample in industrialized versus emerging economies[2] and plot this information in figures 2

finds a positive relation that links financial depth with capital accumulation.

[2] This division is taken from Lane and Milesi - Ferretti (2007).

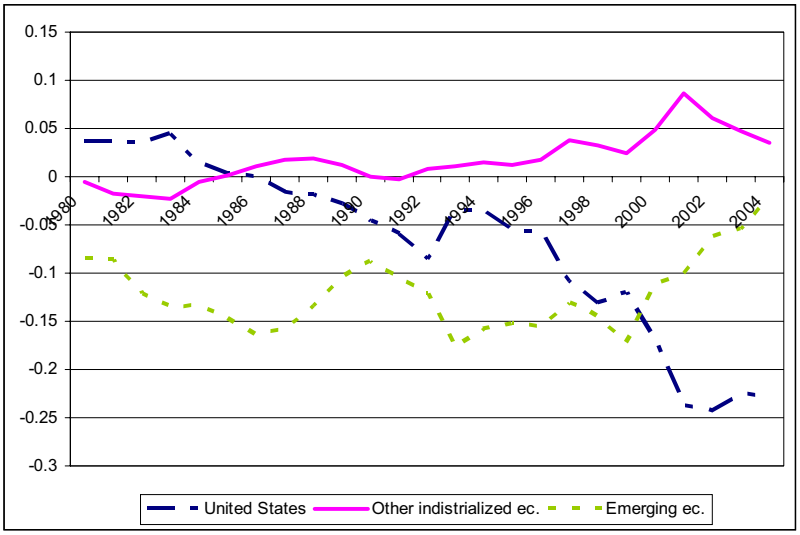

Figure 1: Net foreign asset position over GDP. Data source: Lane and Milesi - Ferretti (2007)

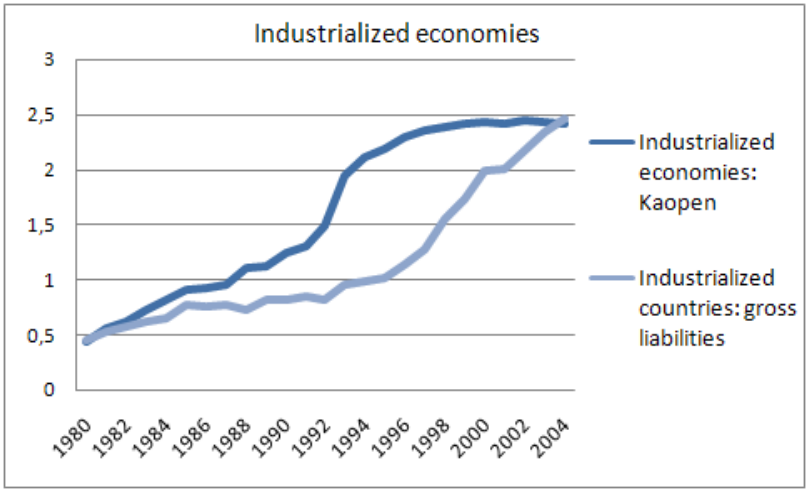

Figure 2: Financial integration (Kaopen), source: Chinn and Ito (2007); gross countries' liabilities, source: Lane and Milesi-Ferretti (2007).

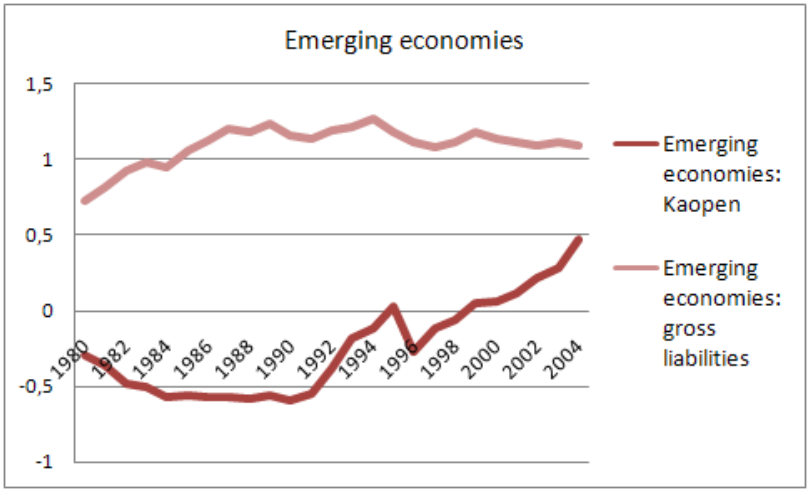

Figure 3: Financial integration (Kaopen), source: Chinn and Ito (2007); gross countries' liabilities, source: Lane and Milesi-Ferretti (2007).

and 3. It is clear that emerging countries are further less integrated in international capital markets, therefore it is important for them to understand the possible effects of further liberalization in order to get all positive benefits and avoid negative outcomes.

Figures 2 and 3 also compare the evolution of gross country liabilities with the one of financial integration. Again there are important differences between the two groups of countries. For emerging economies an increasing financial globalization seems to bring to a slight decrease in gross liabilities, therefore lower capital inflows, while the opposite is true for industrialized economies. This observation is at odd with the neoclassical paradigm which predicts that countries scarce in capital will experience capital inflows once they open their current account.

Figure 4 points in the same direction as figure 3: it shows that countries with negative net asset positions are no longer the emerging economies (with therefore lower per capita GDP). This has been first observed by Prasad, Rajan and Subramanian (2007) that talk about "uphill" flow of capital from developing to developed economies; moreover they show that nonindustrial countries that rely less on foreign capital grow faster. The difference with Prasad et al. (2007) figure is that in our estimation countries are weighted by their *de facto* participation in the international financial markets, as defined by Lane and Milesi-Ferretti (2007) (sum of foreign assets and liabilities) while Prasad et al (2007) use net asset positions. As showed in the previous figure, emerging economies experience an acceleration in the integration process in the last 15 years, but this period seems to do not correspond with an overall capita inflow in those countries.

The analysis of financial deepness reports that there are still large differences among coun-

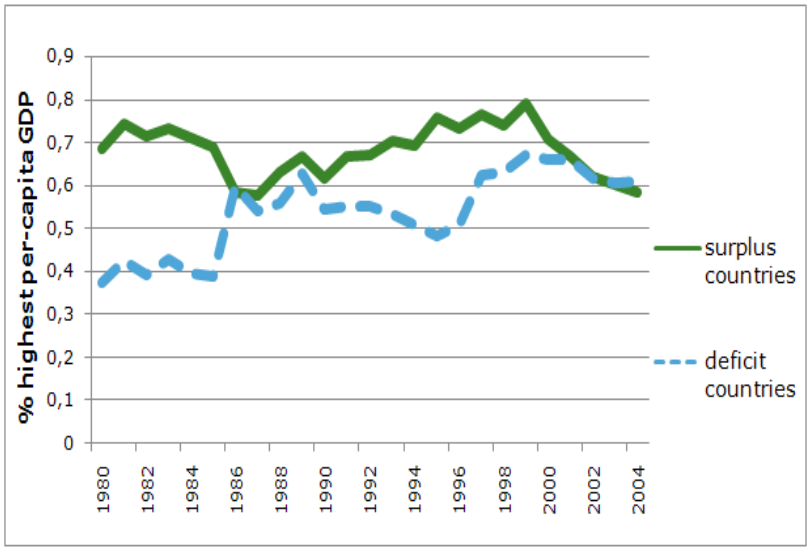

Figure 4: Average per-capita GDP, weighted by participation in international financial markets (Assets+Liabilities) over highest per-capita GDP in each year. Source: Lane and Milesi-Ferretti (2007)

Table 1: *de jure* and *de facto* measures of financial depth. Source: Beck, Demirguc-Kunt and Maksimovic (2002).

	Privo	Laworder		Privo	Laworder
North America and West Europe			**East Europe**		
Canada	0.83	6	Belarus	0.16	4
Germany	1.06	6	Estonia	0.16	4
Spain	0.79	4	Hungary	0.22	6
France	0.84	5	Poland	0.12	5
Italy	0.57	6	Romania	0.09	4.77
Mexico	0.22	2.41	Slovakia	0.3	5
Sweden	0.82	6	Slovenia	0.26	5
U.K.	1.16	6	Ukraine	0.02	4
U.S.	1.84	6			
Latin America			**Asia**		
Argentina	0.21	5	China	0.85	5
Bolivia	0.51	3	Indonesia	0.52	2.64
Brazil	0.32	2.05	Malaysia	1.31	4.59
Chile	0.68	5	Pakistan	0.23	3.14
Ecuador	0.3	3.36	Philippines	0.5	4
El Salvador	0.36	3	Singapore	1.11	6
Venezuela	0.1	4			

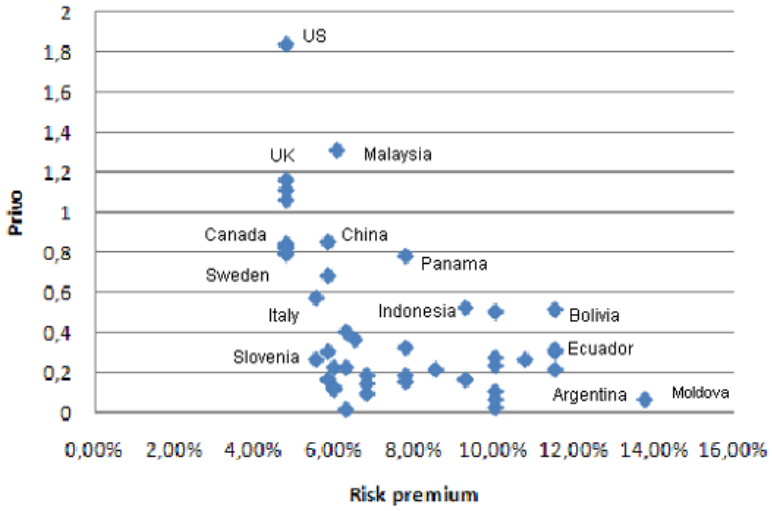

Figure 5: Measure of financial market development (Privo), source: Beck, Demirguc-Kunt and Maksimovic (2002); measure of country risk premium in 2007, source: Damodaran (2008).

tries. Beck, Demirguc-Kunt and Maksimovic (2002) propose two measures of financial depth (reported in table 1): *PRIVO* is the total credit to private sector over GDP, therefore is a *de facto* indicator, while *Laworder* is an index, ranging between 1 and 6, which summarizes the information on legal system and citizens' protections.

Figure 5 is the scatter plot of data on financial development, *PRIVO*, and data on risk premium estimated by Aswath Damodaran [3], who elaborates data furnished by Moody's, Bloomberg and Standard&Poor's. The measure of financial market development, *PRIVO*, seems to be negatively correlated with risk premium therefore countries with large risk premium are also the ones with poor financial market development. Risk premium seems therefore a good proxy for financial market development. We therefore use this risk premium measure, which represents financial institutions deepness, to calibrate our parameter on financial development in the quantitative exercise through the investment risk premium generated by our model.

Figure 6 reports the scatter plot of PRIVO and the risk premium in 2008. Compared with 2007 data, the risk premium has increased in almost every country, but this raise is particularly strong in emerging markets. Worsened financial conditions have a deeper impact in countries with weaker financial institutions, therefore the gap between industrialized and emerging economies on their level of risk has increased during the current financial crisis.

[3]It is the measure of risk premium for a mature equity market adjusted by country rating and default spread for that rating. Data are available at www.pages.stern.nyu.edu/-adamodar/New_Home_Page/data.html

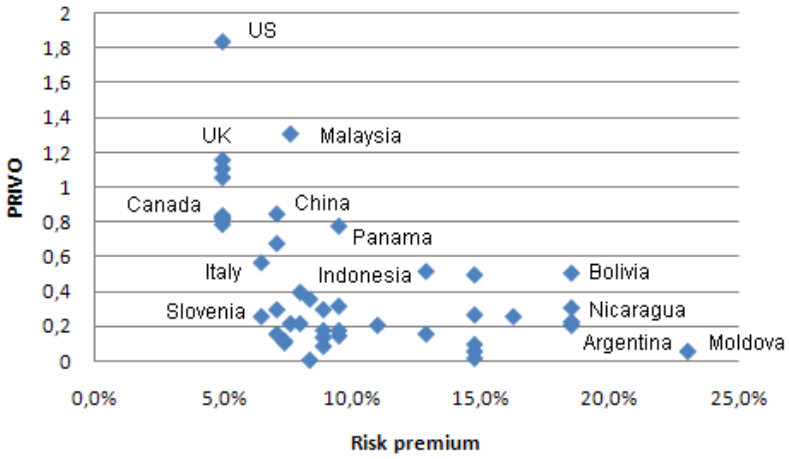

Figure 6: Measure of financial market development (Privo), source: Beck, Demirguc-Kunt and Maksimovic (2002); measure of country risk premium in 2008, source: Damodaran (2009).

As mentioned in the previous section, the development of financial markets in the present analysis is defined as the ability of financial institutions to transfer resources among agents and in particular to help consumers and entrepreneurs hedge their idiosyncratic shocks. The importance of firm-level shocks is documented among others by Angelidis (2008) who documents that 55% of US market volatility is due to single firms' volatility; moreover Jermann and Quadrini (2006) show that US firms have experienced greater financial flexibility given by the increased ability to issue equities and bonds, that in turn are used to face bad shocks instead of reducing investment and production.

3 The model

The model we present is based on Angeletos and Calvet (2006). It is a neoclassical economy with heterogeneous agents, convex technologies and idiosyncratic production risks; financial markets are incomplete and agents take it into account when deciding how to allocate the production of the final good, either to consumption, investment in risky production or risk free bonds. Two main assumptions make this model easily tractable: the CARA specification for the utility function and the normal distribution of the shocks. These assumptions allow to get a closed form solution for the policy functions and therefore to track investments and savings choice and the impact of each parameter on them. There are some drawbacks in this specification: first of all the CARA utility function does not rule out negative consumption

especially in the early stage of capital accumulation or if income is highly variable; the present exercise however looks at steady state when agents have accumulated capital and the probability of negative wealth is very close to zero (even if still positive). Also the normal distribution of productivity shocks might bring to negative production that could be interpreted as negative profits but still implies that a positive investment brings to destruction of some of the inputs employed in the production. As mentioned above there are no borrowing constraints however Angeletos and Calvet (2005) prove that since the optimal decision rules of the infinite setup are the limit of the finite horizon problem, Ponzi schemes are ruled out in the strongest conceivable way, along any possible path. Moreover, Wang (2003) proves that in this setup the transversality condition on bond demand is always satisfied.

Angeletos (2007) shows that a model with more standard assumptions on preferences and technology, CRRA utility function and finite support for the production risks therefore the possibility of defining a natural borrowing limit, produces in equilibrium exactly the same interesting results: lower interest rate and lower capital accumulation with respect to the complete markets case. The CARA-Normal specification is therefore not essential to obtain the big insights of the model and in particular the relationship between financial development and the aggregate dynamics; the CARA-Normal is indeed highly more tractable.

There are 2 countries *1, 2*. Each country is indexed with *i*. Time is discrete. There is a continuum of consumers - producers of mass 1 in each country. Each agent has an income of:

$$y_{it} = A_{it} f(k_{it}) \tag{1}$$

The first term to the right is the production of consumption goods each agent runs, by investing the amount of capital *k*. *A* is a productivity shock distributed as normal $(1, \sigma_{iA}^2)$. σ_{iA} represents the formalization of the financial market underdevelopment: it is the share of idiosyncratic risk associated with entrepreneurial activities that financial markets are not able to insure. A value of zero for σ_{iA} indicates that financial markets are able to hedge all production risk. Angeletos and Calvet (2006) proves that lowering σ_{iA}, corresponds to introducing in the economy financial activities that are able to partially hedge production shocks (Appendix A analyzes this interpretation of the parameter σ_{iA}).

The capital stock is chosen at *t-1* and cannot be reshuffled once agents observe their shocks at time *t*. The production function f exhibits decreasing return to scale for capital; we choose a simple specification widely used in the literature: $f(k_{it}) = k_{it}^{\alpha}$.

At time t agents can purchase a risk-free bond b_{it+1}, this will yield $(1 + r_{it+1})$ units of

consumption goods at time *t+1*. The riskless bond is in zero net supply in the closed economy[4].

The budget constraint of each agent at time t is therefore:

$$c_{it} + k_{it+1} + b_{it+1} = y_{it} + (1 + r_{it})b_{it} + (1 - \delta)k_{it} \tag{2}$$

or

$$c_{it} + k_{it+1} + b_{it+1} = w_{it} \tag{3}$$

Where w_{it} represents the total wealth at time t that can be used to consume, invest in risky production or invest in risk free bonds.

The utility function is a CARA utility:

$$U_t = -\sum_{l=t}^{\infty} \beta^{-(t-l)} e^{-\gamma c_{i,l}} / \gamma \tag{4}$$

Where the parameter γ represents the degree of risk aversion but it also represents the willingness to substitute consumption over time.

3.1 Optimization problem

Given a deterministic sequence of price $\{r_{it+1}\}_{t=0}^{\infty}$, households choose consumption, capital and risk-free bonds $\{c_{it}, k_{it+1}, b_{it+1}\}_{t=0}^{\infty}$ that satisfy their lifetime utility subject to their budget constraints.

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

$$V_{it}(w_{it}) = \max_{c_{it}, k_{it+1}, b_{it+1}} \{u(c_{it}) + \beta E_t V_{it+1}(w_{it+1})\} \tag{5}$$

Given the properties of the CARA-normal specification, the educated guess for the value function and the consumption rule are:

$$V_{it}(w_{it}) = u(a_{it} w_{it} + d_{it}) \tag{6}$$

$$c_{it} = \hat{a}_{it} w_{it} + \hat{d}_{it} \tag{7}$$

And the certainty equivalent for the value function specification of a normal is:

[4]The case of perfect insurance in this model corresponds to the variance σ_{iA}^2 being equal to zero. In our setup this case is computationally equivalent to an economy with contingent bonds.

$$E_t V_{it+1}(w_{it+1}) = V_{it+1}\left(E_t w_{it+1} - \frac{\Gamma_{it}}{2} Var_t(w_{it+1})\right) \tag{8}$$

Where Γ_{it}, that represents the effective absolute risk aversion, is equal to:

$$\Gamma_{it} = \gamma a_{it+1} \tag{9}$$

Therefore the value function becomes:

$$V_{it}(w_{it}) = \max_{c_{it}, k_{it+1}, b_{it+1}} \left\{u(c_{it}) + \beta V_{it+1}\left(E_t w_{it+1} - \frac{\Gamma_{it}}{2} Var_t(w_{it+1})\right)\right\} \tag{10}$$

The quantity inside the round brackets can also be expressed as:

$$E_t w_{it+1} - \frac{\Gamma_{it}}{2} Var_t(w_{it+1}) = (1 + r_{it+1}) b_{it+1} + G(k_{it+1}, \Gamma_{it}) \tag{11}$$

Where

$$G(k_{it+1}, \Gamma_{it}) = y_{it+1} + (1 - \delta) k_{it+1} - \frac{\Gamma_{it}}{2}(\sigma_{iA}^2 k_{it+1}^{\alpha}) \tag{12}$$

This quantity represents the risk-adjusted level of non-financial wealth.

Combining the first order conditions for capital and bonds we get the relation for the optimal demand of investment:

$$1 + r_{it+1} = 1 - \delta + \alpha k_{it+1}^{\alpha - 1}(1 - \Gamma_{it}\sigma_{iA}^2 k_{it+1}^{\alpha}) \tag{13}$$

The interest rate on the risk free bond is therefore equal to the marginal product of capital minus a risk premium that takes into account the risk of investing in the production, represented by σ_{iA}^2.

From the envelope condition, and making use of the educated guess, the Euler equation is obtained:

$$u'(c_{it}) = \beta(1 + r_{it+1}) u'(E_t c_{it+1} - \frac{\gamma}{2} Var_t(c_{it+1})) \tag{14}$$

The variance of the consumption can be written as:

$$Var_t(c_{it+1}) = a_{it+1}^2 (k_{it+1}^{2\alpha} \sigma_{iA}^2) \tag{15}$$

Therefore the Euler equation becomes:

$$E_t c_{it+1} - c_{it} = \frac{1}{\gamma} \ln(\beta(1 + r_{it+1})) + \frac{\gamma}{2} a_{it+1}^2 (k_{it+1}^{2\alpha} \sigma_{iA}^2) \tag{16}$$

The choice between consumption and savings is affected by the production variability. It directly pushes the agents to postpone consumption. However production risk has also the indirect effect of lowering the level of capital invested in production, so the overall effect is ambiguous.

From the envelope and the Euler equations it is also possible to derive the following relation:

$$\frac{1}{a_{it}} = 1 + \frac{1}{a_{it+1}(1 + r_{it+1})} \tag{17}$$

3.2 General equilibrium and steady state

Since the agents are characterized by CARA-normal specification, their investment behavior is independent on the wealth and also consumption is linear in wealth. The wealth distribution does not affect the aggregate dynamics therefore it is possible to generalize each agent choices to the general equilibrium of this economy.

Since the shock to productivity is idiosyncratic, the general equilibrium is deterministic and characterized by the optimal choices of consumption and capital $\{C_{it}, K_{it+1}\}_{t=0}^{\infty}$ and the interest rate $\{r_{it+1}\}_{t=0}^{\infty}$ such that the following relations are satisfied at any $t \geq 0$:

$$C_{it} + K_{it+1} = K_{it}^{\alpha} + (1 - \delta) K_{it} \tag{18}$$

$$r_{it+1} + \delta = \alpha K_{it+1}^{\alpha - 1} (1 - \Gamma_{it} \sigma_{iA}^2 K_{it+1}^{\alpha}) \tag{19}$$

$$C_{it+1} - C_{it} = \frac{1}{\gamma} \ln(\beta(1 + r_{it+1})) + \frac{\gamma}{2} a_{it+1}^2 (K_{it+1}^{2\alpha} \sigma_{iA}^2) \tag{20}$$

$$K_{it}^{\alpha} + (1 - \delta) K_{it} \geq 0 \tag{21}$$

The above condition is the limited liability constraint since it implies that countries cannot accumulate negative levels of wealth. In closed economy this condition is always verified and never binding for any level of $K_{it} > 0$.

The steady state relations therefore are:

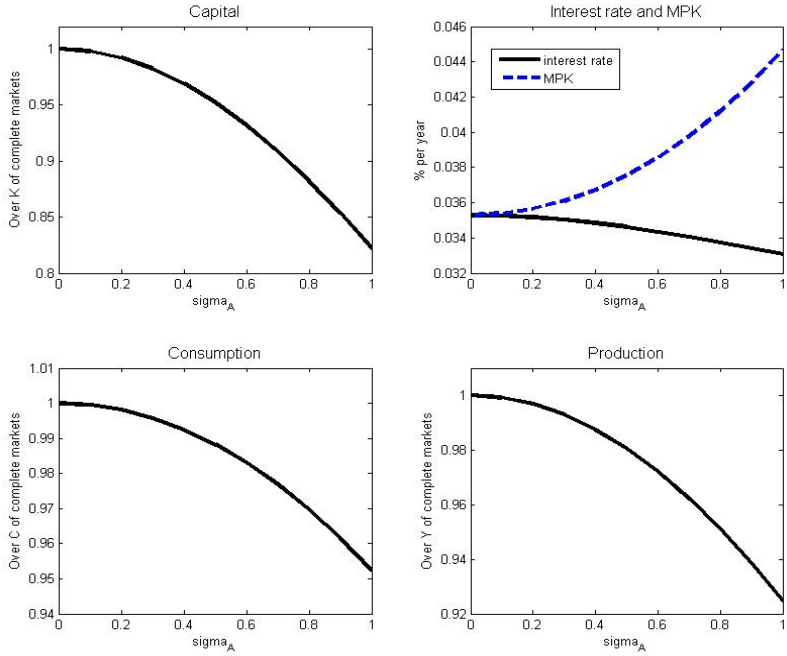

Figure 7: The impact of uninsurable risks on the steady state relations.

$$C_{iss} + K_{iss} = K_{iss}^{\alpha} + (1-\delta)K_{iss} \tag{22}$$

$$r_{iss} + \delta = \alpha K_{iss}^{\alpha-1}(1 - \frac{\gamma r_{iss}}{1+r_{iss}}\sigma_{iA}^2 K_{iss}^{\alpha}) \tag{23}$$

$$\frac{1}{\gamma}\ln(\beta(1+r_{iss})) = -\frac{\gamma}{2}\left(\frac{r_{iss}}{1+r_{iss}}\right)^2 (K_{iss}^{2\alpha}\sigma_{iA}^2) \tag{24}$$

$$K_{iss}^{\alpha} + (1-\delta)K_{iss} \geq 0 \tag{25}$$

Where the first equation is the resource constraint, the second represents the aggregate demand for investment and the third is the aggregate supply of savings. The last is the limited liability constraint.

Figure 7[5] shows how the steady state values for capital, interest rate, consumption and production vary as the shock to productivity becomes more variable. In this setting in fact,

[5]See Section 5 for details on the parameters calibration. The values chosen are standard in the literature and insure locally unique steady states.

the variance σ^2_{iA} (the standard deviation associated to it is the variable on the x-axis, $sigma_A$) represents the coefficient of variation in private consumption and investment returns. Contrary to the Aiyagari (1994) result (which predicts that higher variability on the endowment generates larger precautionary savings. therefore more capital accumulated at any level of interest rate), a financial market that is not able to fully insure productivity shocks creates the conditions to invest less and save more at any give interest rate. The second panel shows how the spread between marginal productivity of capital and interest rate increases as the production variability gets larger. It gives therefore a clear picture of the impact of the financial development on the investment choice: it represents the risk premium for investing in risky activities. High risk premium for investing in risky activities discourages capital accumulation and depresses the equilibrium risk free interest rate. GDP is therefore lower in countries with higher uninsurable production variability. Panel 3 shows that high production risks induce agents to decrease consumption due to lower production and to higher precautionary savings, that push interest rate down even further.

4 Two-country integration

Capital account liberalization is formalized as the possibility of exchanging risk free bonds across borders, opening of financial markets is not announced before. The integration is not subject to restrictions nor costs for international transactions. The hypotheses are extreme since there are no intermediate steps or constraints.

When the two countries liberalize their capital markets the interest rate is equalized immediately, since it is the interest rate that regulates the exchange of risk free bonds and equalize its global demand and supply.

The general equilibrium is again deterministic, since there are no aggregate shocks, and characterized by the optimal choices of consumption, capital and bonds in the two countries $\{C_{1t},\ K_{1t+1},\ B_{1t+1},\ C_{2t},\ K_{2t+1},\ B_{2t+1}\}_{t=0}^{\infty}$ and the interest rate $\{r_{t+1}\}_{t=0}^{\infty}$ such that the following relations are satisfied at any $t \geq 0$ in both countries:

$$C_{it} + K_{it+1} + B_{it+1} = K_{it}^{\alpha} + (1-\delta)K_{it} + (1+r_t)B_{it} \tag{26}$$

$$r_{t+1} + \delta = \alpha K_{it+1}^{\alpha-1}(1 - \Gamma_{it}\sigma^2_{iA}K_{it+1}^{\alpha}) \tag{27}$$

$$C_{it+1} - C_{it} = \frac{1}{\gamma}\ln(\beta(1+r_{t+1})) + \frac{\gamma}{2}a_{it+1}^2(K_{it+1}^{2\alpha}\sigma_{iA}^2) \tag{28}$$

$$B_{1t+1} + B_{2t+1} = 0 \tag{29}$$

Where the last equation is the equilibrium condition in the aggregate levels of bonds exchanged between the two countries.

$$K_{it}^{\alpha} + (1-\delta)K_{it} + (1+r_t)B_{it} \geq 0 \tag{30}$$

The limited liability constraint in this case might be binding since each country can accumulate positive or negative amounts of bonds. This constraint however is not internalized by agents that do not face individual borrowing constraints, therefore the optimal demand and supply of savings are not affected.

Proposition 1 formalizes the characterization of the steady state with financial integration.

Proposition 1: *Suppose that in a two- country world with one country (country 1) financially more developed than the other (country 2), in the autarky steady states it is true that* $r_1 > r_2$*. The steady state equilibrium with financial integration is characterized by an interest rate* r_{ss}*, such that* $r_2 < r_{ss} < r_1$ *and country 1 is net issuer of risk free bonds.*

Appendix B reports the proof of this proposition.

4.1 Steady state - intuition

We first of all highlight the main differences in the autarky steady state of two countries that are identical except for their level of financial deepness, measured in terms of completeness of financial markets, therefore ability of the financial markets to absorb and redistribute agent's idiosyncratic shocks. Then we explain the result of proposition 1 on the open economy steady state equilibrium.

We analyze the equilibrium without financial integration of two countries: in the first one financial markets are incomplete, but the variability of uninsurable shock is small ($\sigma_{1A} = 0.9$) and in the second country financial markets are less developed ($\sigma_{2A} = 1.1$).

Figure 8 shows that there are important differences in the demand and supply of capital in the two countries before integration. In particular the demand for investment curve represents

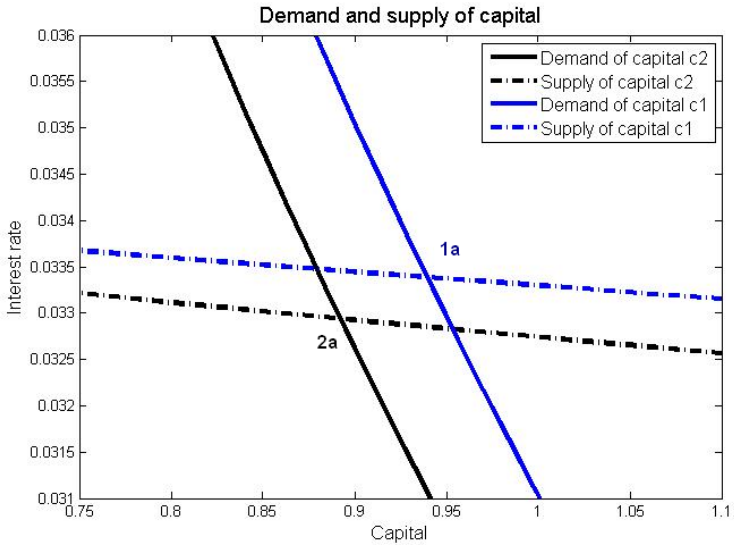

Figure 8: Autarky steady state capital and interest rate in two countries with different financial depth.

firms' choice on how much capital to implement in the production. At the steady state the demand is regulated by the equation:

$$r_{iss} + \delta = \alpha K_{iss}^{\alpha-1}(1 - \frac{\gamma r_{iss}}{1 + r_{iss}}\sigma_{iA}^2 K_{iss}^{\alpha}) \tag{31}$$

Uninsured productivity shocks have a negative impact on the level of steady state capital at any level of the interest rate, r. In fact at any level of r in country 1 the capital of steady state is higher than in country 2 since the risk premium for investing in firms located in country 1 is smaller than for the ones in country 2.

The supply of capital is the choice made by consumers on how much to save and consume. It is determined by the Euler equation that in the steady state looks like:

$$\frac{1}{\gamma}\ln(\beta(1 + r_{iss})) = -\frac{\gamma}{2}\left(\frac{r_{iSS}}{1 + r_{iSS}}\right)^2 (K_{iSS}^{2\alpha}\sigma_{iA}^2) \tag{32}$$

Uninsured shocks to production have a direct effect of increasing the precautionary savings at any level of the interest rate. Production risk has however the indirect negative impact due to lower level of capital the higher the volatility of this shock. Wealth variability is amplified by the total production, this determines the positive relationship between capital accumulation and precautionary savings, therefore the negative slope of the supply of capital curve in the R-K space.

From figure 7 it can be therefore inferred that a less financially developed country at the steady state has a lower level of capital accumulation and lower interest rate.

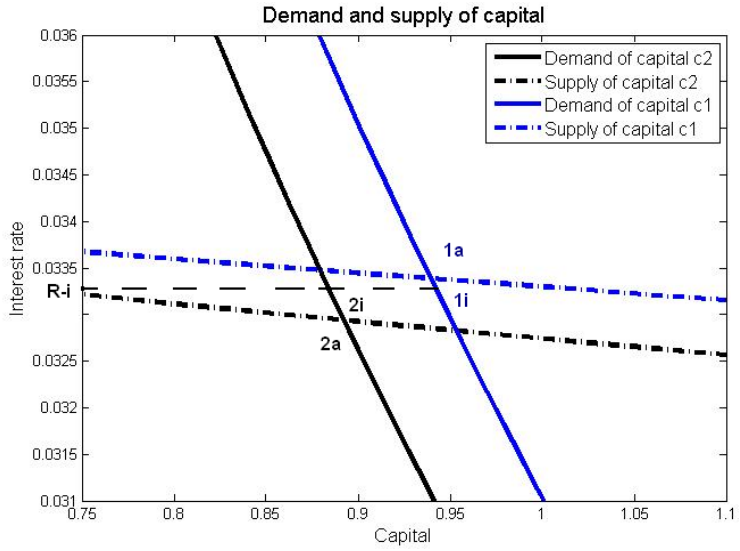

Figure 9: Steady state capital and interest rate in two countries with different financial depth that exchange risk free bonds.

When the two countries liberalize their capital markets the interest rate is equalized immediately, since it is the interest rate that regulates the exchange of risk free bonds and equalize its global demand and supply.

Figure 9 qualitatively represents what happens after liberalization. Intuitively, when the two countries integrate interest rate (called r_i in the figure) gets to an intermediate value between the higher interest rate of country 1, the more financially developed, and the lower one of country 2, as exposed in the previous section. From the firms' investment decision curves we are able to infer that the new interest rate stimulates investments in country 1, leading to additional capital accumulation, while it reduces country 2 level of investment and therefore production, since at the new interest rate the risk premium faced by entrepreneurs is too high compared with the risk free bond option. They decrease investment up to the point in which risk free interest rate and the productivity of capital adjusted for risk are again equalized.

The figure also shows that it is not possible to find an interest rate level for which agents in the two countries contemporaneously have a constant level of consumption - savings. This is because the precautionary saving motive in the two countries is always different due to different wealth variability. The only special case of integration in which the two countries reach a steady state with no permanent increase or decrease of savings in equilibrium is when the supply curves coincide (either the two countries have the same level of financial development, or for a combination of the parameters; both cases are however not interesting from an economic point of view).

5 Quantitative results

In this section we provide quantitative simulations of the model presented above. In particular, by calibrating the model with actual data, the simulations presented are able to reproduce long term movements in net capital flows. The assumptions on capital account liberalization are "extreme": the two economies move from autarky to full integration in two subsequent periods, without previous announcements.

5.1 Calibration

Each time period is set to 5 years, in order to capture the horizon of an investment project. We calibrate 9 parameters to match some features on the global economy. In particular we consider two blocks in our analysis: the US versus the rest of the world. Since we are interested in the aggregate financial flows we calibrate the 2 economies considering that our "country 1", the US, is 29% of the world GDP[6] , while we are not interested in matching differences in productivity or population size.

Parameter values

α	income share of capital	0.4
$1-\beta$	annual discount rate	0.03
δ	annual capital depreciation rate	0.04
ϕ	annual capital adjustment cost	0.6
γ	absolute risk aversion	1
ψ	elasticity of intertemporal substitution	1
σ_{A1}	uninsured idiosyncratic production shock st. dev., US	0.9
σ_{A2}	uninsured idiosyncratic production shock st. dev., RoW	1.1
ξ	Country 1(US) share of total GDP	0.289

The table above summarizes the calibration. The values of the parameters are the standard values widely used in the literature, and are in line with existing micro-evidence: the annual discount factor β is set to .97, the share of capital on income α is set to .4, the annual capital depreciation rate δ is .04, the absolute risk aversion γ and elasticity of substitution ψ are equal to 1. In this quantitative simulation quadratic adjustment costs to capital are

[6]Data surce: Lane and Milesi-Ferretti (2007).

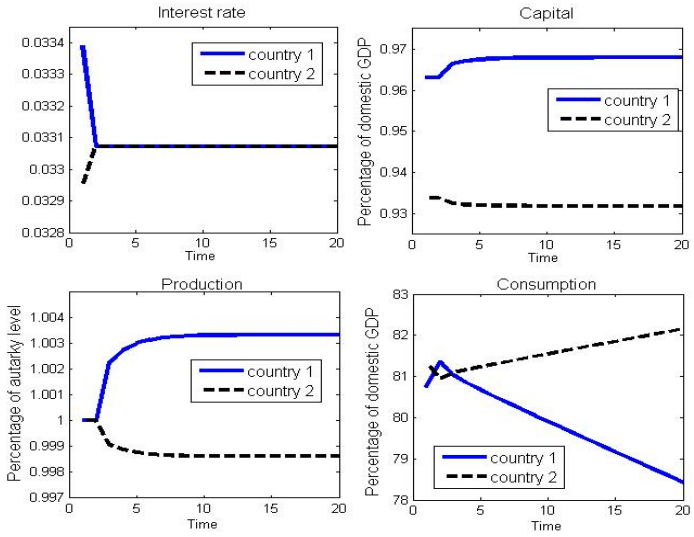

Figure 10: Response to capital account liberalization

introduced in order to get smooth capital movements; they however do not alter the main results of the exercise and in particular international capital flows. The standard quadratic form $\phi(k_{it+1}/K_{it} - 1)^2$ is used, where k_{it+1} is the optimal level of capital chosen at period t by each agent, K_{it} is the aggregate capital stock implemented at time t. The annual capital adjustment shock, parameter $\phi = .6$, is taken from Kehoe and Perri (2002). The variability of US production activities that cannot be insured through the financial market is chosen to get an interest rate of 4.79%[7] after integration, while the uninsurable variability of the rest of the world production is assigned to match the average country risk premium over the US interest rate of 1.6%[8].

5.2 Aggregate movements

Figures 10 and 11 report the transition of the main macroeconomic variables from autarky to the steady state of integration.

In the first period the two economies are in autarky. As documented in the previous sections, country 1 (the US in this exercise) is financially more developed therefore in autarky it experiences higher interest rate, higher ratio of investment in risky activity (capital) over its GDP and therefore higher production and lower share of consumption on GDP. Once the two

[7] This data is taken from the estimated interest rate by Damodaran, as mentioned in section 2.

[8] An estimation of average risk premium made by Damodaran. See section 2 for details. Countries are weighted by their partecipation in the international capital flows (IFIGDP from Lane and Milesi-Ferretti (2007)).

economies open their markets for risk free bonds the interest rate on safe assets is immediately equalized to a value that is between the autarky levels, as proved in proposition 1. In country 1 agents are willing to increase their investment in production activities, since at the margin the return on capital adjusted for risk is too high. They start therefore accumulating capital but due to the costs of adjusting capital stock the process is not immediate, it lasts for 10 periods. The reverse happens in country 2 where the risk premium on production activities is now too high compared with the safe investment in bonds, therefore agents in this economy dismantle installed capital; output is therefore reduced in this country while it increases in country 1. Two forces drive the consumption choice: on the one hand agents face a new interest rate that induces agents in country 1 to consume immediately since they are more impatient, while it induces consumers in 2 to postpone consumption due to their stronger and increased precautionary savings motive; on the other hand the increase in production in country 1 stimulate precautionary savings since total production amplifies the production risk. The first effect however dominates, it induces a positive jump in country 1 consumption choice for the first periods and negative for country 2 (this is preserved also with no capital adjustment costs). In the long run however, due to the high debt issued by country 1, agents in this economy start decreasing consumption in a very long lasting process; on the contrary agents of country 2 enjoy the positive interest on the accumulated bonds.

The net export between the two economies, in figure 11, mimics the consumption evolution. In the first 5 periods, first 25 years, after integration country 1 imports goods from the other country since agents are willing to consume more than what is internally produced, but after period 6 they have to repay the growing interests on accumulated debt therefore start reducing consumption below their total production. Country 2 accumulates bond issued by the other economy in a long lasting process, as showed in the net foreign asset position panel, while country 1 has a growing debt and therefore also growing factor payments.

The US current account drops in the first period of liberalization to around -1.5% of GDP then slightly recover, but remains negative. The last two panel represent the decomposition of current account in variation with respect to the autarky level in investment and saving decisions[9]. Country 1 therefore experiences a negative current account variation because investment increases and saving decreases due to lower precautionary savings at the new interest rate; the stimulus on investment demand from the side of firms generates a drop in the current account of around 0.48% of GDP, while the decrease in the aggregate savings produces a variation in the current account on impact of around 1% of GDP. The contrary happens in country 2: agents want to move their savings from internal risky activities to safe foreign bonds since risk premium of production investment becomes too high compared with outside

[9] $\Delta CA = \Delta S - \Delta I$, therefore the investment positions in the panel should be interpreted with a minus sign.

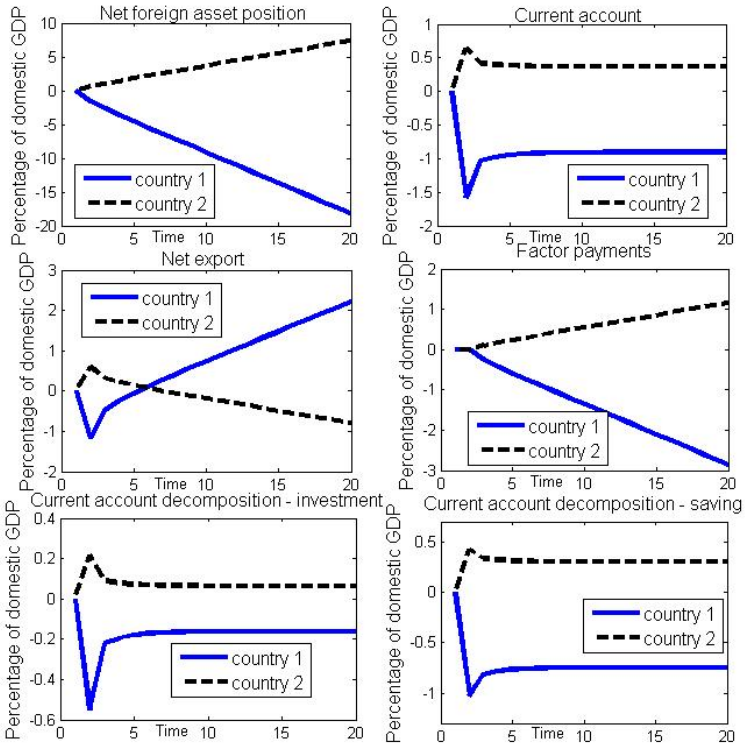

Figure 11: Response to capital account liberalization

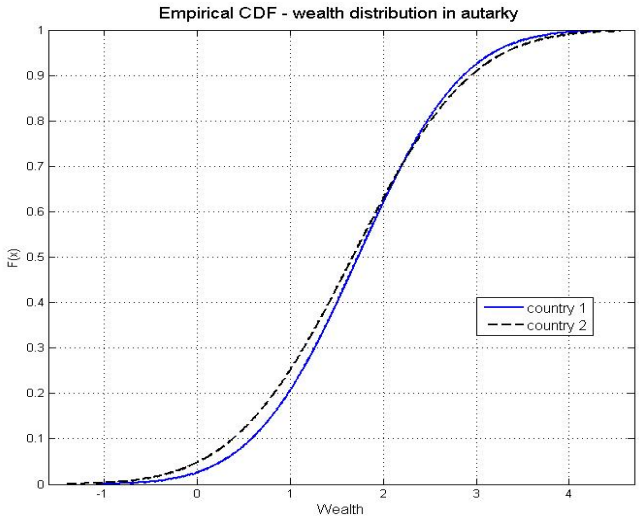

Figure 12: Wealth distribution in autarky

options, but they also want to increase their precautionary savings.

5.3 Wealth distribution and welfare

We now turn our attention to the distributional and welfare effects of capital account liberalization in each country. Since the two economies are populated by heterogeneous agents, we are able to study the consequences of financial globalization for agents with different levels of wealth at the moment of liberalization.

Figure 12 shows the wealth distribution in the two countries in the autarky steady states. The uninsurable shock to production risk is higher in country 2, but the aggregate production (that amplifies the impact of the shock) is higher in country 1. The overall result is that wealth is more dispersed in the financially less developed economy. This model generates a variation in wealth dispersion when countries move from autarky to integration. As mentioned before wealth variability depends on the development of the financial markets, as well as the total level of production in the economy.

When moving towards integration agents in country 1 have strong incentives to invest in risky activities, since these activities are now more profitable with respect to safe investments in bonds; they invest more in production capital, since their relative risk aversion decreases. Country 1 experiences therefore an increase in wealth dispersion that at the new steady state reaches 0.43% of its autarky wealth standard deviation. In country 2 on the contrary, after

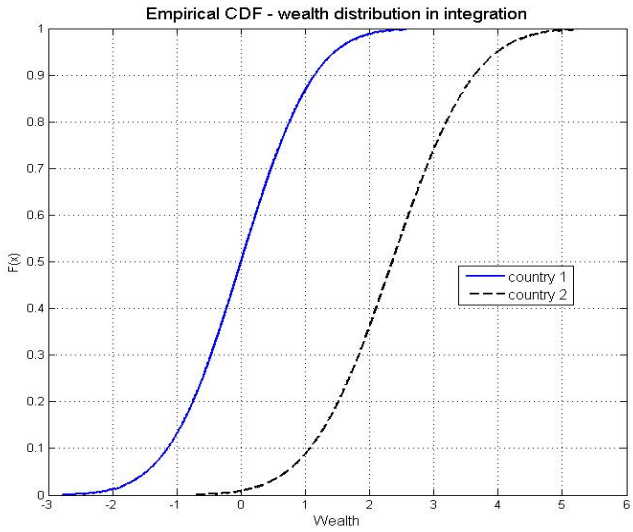

Figure 13: Wealth distribution in integration steady state when limited liability becomes binding for country 1.

integration agents prefer safer activities therefore they increase their investment in foreign bonds and decreases the exposition to productivity shocks. Wealth dispersion decreases by 0.17% of wealth standard deviation at the steady state of integration. Accumulation of bonds at country level produces a shift in wealth distribution until the limited liability constraint becomes binding for country 1. Figure 13 reports the wealth distribution at the integration steady state when bonds reach their lower bound in country 1 and the aggregate wealth is zero (in the picture it coincides with the wealth of agents in the fifth decile). The incresing inequality for country 1 is consistent with the data on wealth distribution registered in the US in recent years.

We analyze the welfare consequences of integration by computing the Hicksian equivalent variation for the two economies overall and inside each country for agents with different levels of wealth. The Hicksian equivalent variation is defined as the percentage increase in consumption at time zero that brings the agent as well in autarky as in integration. A positive value then means that agents are better of in integration, a negative value instead says that integration as negative impact on agents welfare. This measure is intuitively equal to:

$$\mu_{i1} \simeq U^{-1}(\frac{U_{i1aut}}{U_{i1int}}) - 1 \tag{33}$$

$$\mu_{i2} \simeq U^{-1}(\frac{U_{i2aut}}{U_{i2int}}) - 1 \tag{34}$$

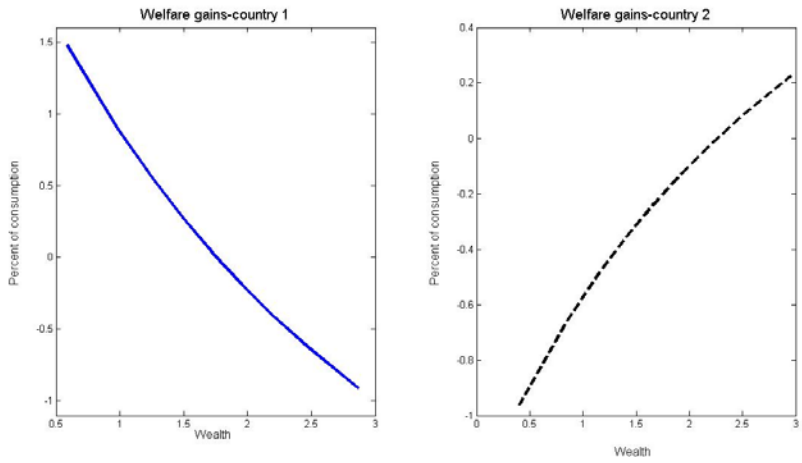

Figure 14: Hicksian equivalent variation

Figure 14 and 15 show the Hicksian equivalent variation inside the two countries for agents with different levels of wealth. In figure 14 in particular x-axis scales are different because, as mentioned before, country 2 wealth is more dispersed than country 1's. Figure 15 reports instead wealth deciles, to show the impact of integration on different income-groups. In country 1 integration has a positive welfare impact for the overall mass of agents, however gains are high for very poor people and decrease as agents wealth increase until it reaches a negative value for the upper part of the distribution. Risk free interest rate is the main cause of such different reactions. The poor people experience welfare gain since with integration the interests paid on the accumulated debt drops so they can consume more. The contrary is trues for the very rich since the interests they receive on their financial activities fall. The entire population experience an increase in consumption in the first period, as highlighted above, therefore on average the population of country 1 is better off in integration.

In country 2 poorer agents have to pay higher interests on their debt after integration, therefore their welfare conditions worsen. Richer people instead receive higher returns on their bonds, therefore are better off. The overall result is however negative, since it is true for the all population that the new economic conditions push them to postpone consumption to the future periods.

Figure 16 reports the Hicksian decomposition of integration effects in the two countries and nine deciles in the first period of integration. The first panel simply shows the percentage change in consumption for moving from autarky to integration. As expected agents in country 1 increase their consumption, but the effect is stronger for the poor deciles of the population, as explained above; in country 2 instead the population experiences a generalized drop in consumption, and the effect is again stronger for the poorest. Welfare effects are defined now

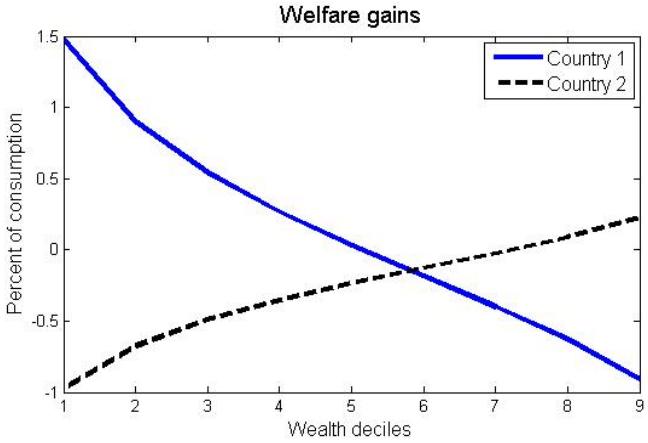

Figure 15: Hicksian equivalent variation

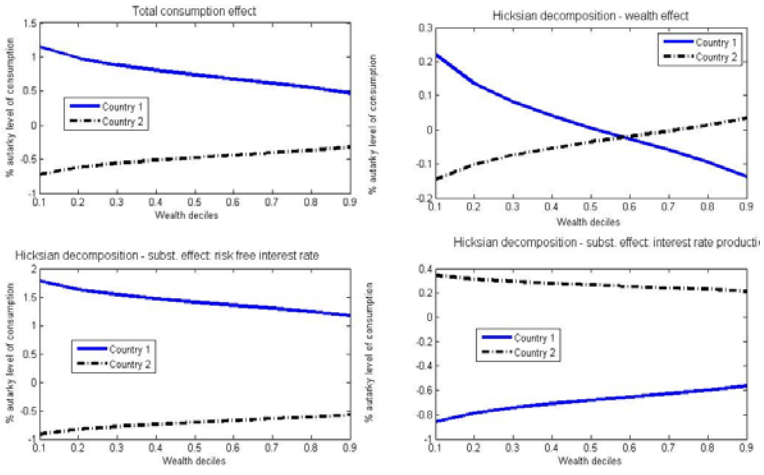

Figure 16: Hicksian decomposition - first period

as the additional consumption in every future period that makes agents as well in autarky as in integration. The result is equivalent to the one presented in figure 15.

The substitution effect is decomposed in the third and forth panel. The substitution effect represents the impact of changes in prices on consumption decisions; it can be additionally decomposed in the impact of changes in the interest rate and impact of variation in the cost of production activities. The third panel shows that in country 1 the drop in interest rate pushes all agents to consume more due to lower precautionary motive at the new interest rate. The effect of production cost is instead negative on consumption: the pressure on marginal return differential with respect to the risk free interest rate pushes agents to invest more in risky activities and therefore consume less.

The contrary is true in country 1. Agents are induced to consume less and accumulate more savings at the new interest rate. They however have also incentives to consume more instead of accumulating more capital since the risk-adjusted capital returns are now too high compared with the returns on foreign bonds.

6 Financial crisis

We now turn our attention to the effects of the financial crisis on the main variables of interest examined in the previous section. Before any consequences on the real economy, the immediate effects of the financial crisis are worsened financial conditions and less secure capital markets. As showed in the second section, the risk premium for investing in risky activities increases in all countries between 2007 and 2008: in the US the interest rate adjusted for risk premium moves from 4.79% to 5%, while in the rest of the world the increase is even stronger, therefore the gap over the US position moves from 1.6% to 2.6%. Two parameters need therefore to be calibrated to account for the effects of the crisis on the financial market development.

Parameter values - financial crisis

σ_{A1}	uninsured idiosyncratic production shock st. dev., US	0.94
σ_{A2}	uninsured idiosyncratic production shock st. dev., RoW	1.2

In line with estimates of the proxy for financial liberalization, KAOPEN, plotted in section 2, we consider that around 1994, there has been a boost in financial integration, therefore in the simulations below we consider that in the first period the two economies are in autarky, then they financially integrate without announcement and for the subsequent three periods, 15 years, they are in the situation illustrated in section 5; in the fifth period, and without announcement, the financial crisis worsens the financial institutions in both economies, bringing to higer risk associated with investment in production activities.

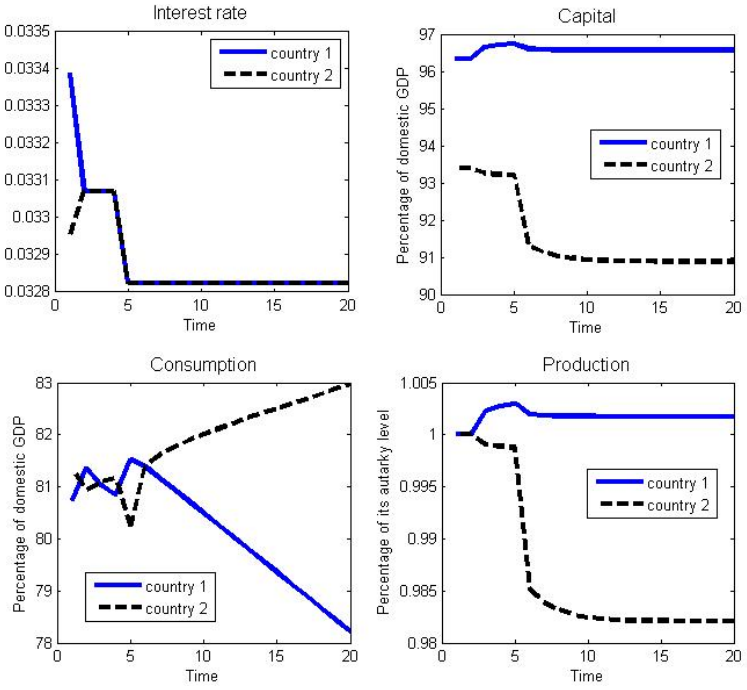

Figure 17: Capital account liberalization and financial crisis in period 5

6.1 Aggregate movements

Figures 17 and 18 report the results of the simulations. As illustrated before, after the financial integration the two economies reach an interest rate in between the values of autarky; the effect of the financial crisis, as illustrated for the closed economy, is to lower the interest rate to a new common level[10] in which both countries optimally decide to reduce their production activities, since now the risk premium associated with risky capital increases in both economies. The overall result is capital accumulation in country 1 for the first three periods, as illustrated above, and smooth decumulation for the subsequent periods up to the new steady state, that is however higher than the autarky initial capital level; in country 1 capital decumulation is mitigated by the integration with another economy that experiences worse financial turmoil. In country 2 the financial crisis exacerbates the already negative accumulation of capital with a sensitive drop due to two forces that point in the same direction of discouraging risky investments: new internal financial conditions and especially the larger gap with the other economy.

Consumption in country 1 experiences a first increase, as illustrated above, due to more

[10] This new level of interest rate is between the two levels of autarky interest rate but with worsened financial conditions, in line with proposition 1.

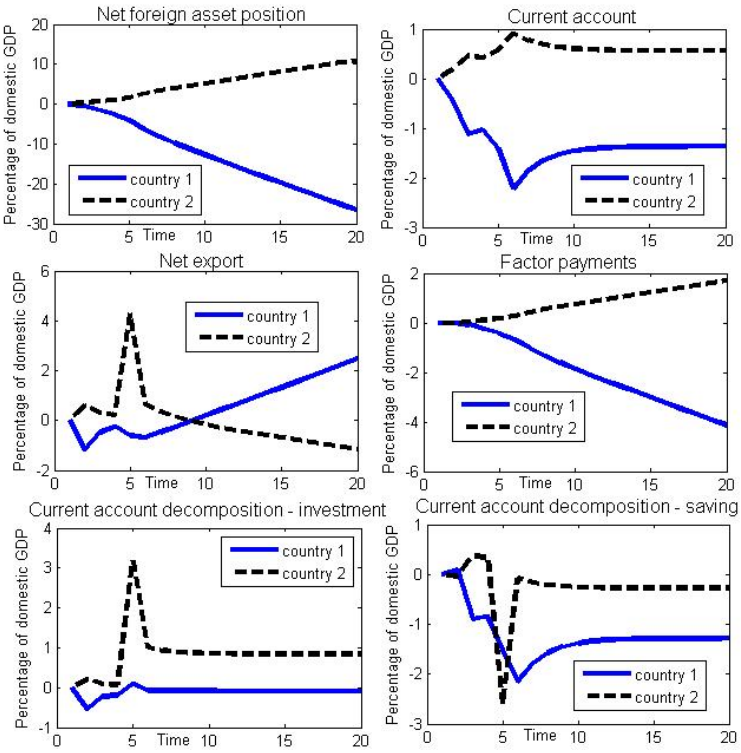

Figure 18: Capital account liberalization and financial crisis in period 5

impatient agents, the second increase in period 5 is due again to even stronger willingness to anticipate consumption at the new interest rate. Finally consumption of agents in country 1 needs to decrease due to the burden of the interests on the accumulated debt that needs to be paid. Agents in country 2 on the other hand decide to postpone consumption in the first three periods, as illustrated above, due to precautionary savings; this motive is even stronger with the worsened financial conditions, and larger gap with respect to the partner economy, therefore overall agents experience a further and more dramatic reduction in their consumption level. Eventually they will experience higher consumption in the future driven by positive interests earned on financial activities.

Net exports of country 2 towards the US experience a first increase due to integration and a second one as consequence of changing in the precautionary savings motive of agents in the two country, as described in the consumption choice. Country 2 starts immediately acquiring country 1's issued debt, and the financial crisis increases the speed of this accumulation; factor payments follow the increasing burden of the US debt and experience an acceleration after the financial crisis even if the equilibrium interest rate decreases.

The US current account drops after financial integration and experience a more dramatic

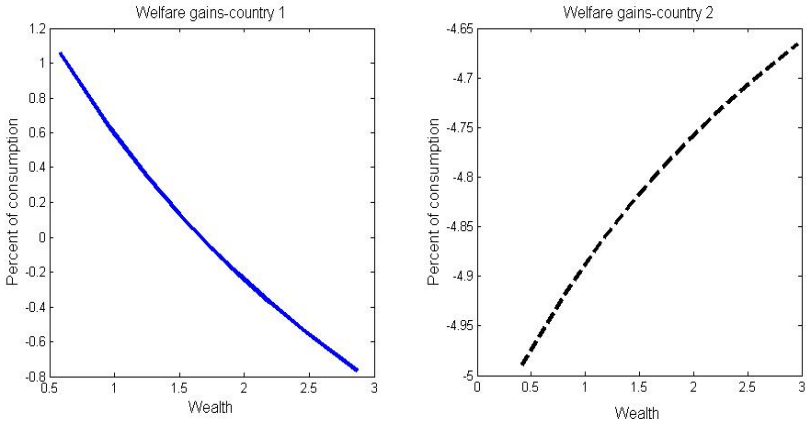

Figure 19: Hicksian equivalent variation - financial crisis

decrease after the financial crisis, of around 2.5%, especially two periods after it, in period 6, finally it remains negative and stable. The investment component of the US current account decreases, therefore there is a positive variation in risky capital, after financial integration, while capital decumulates, therefore the investment position improves, as consequence of the financial crisis. Country 2 instead experiences two contractions in the investment choice, where the second is more dramatic than the first. When country 2 is hit by the financial crisis the effect on capital accumulation (underinvestment) is so strong that the saving variation experiences a drop, but then a fast recover to positive positions the period after. Country 1 instead has negative and growing saving variations.

6.2 Welfare analysis

We now investigate the welfare consequences of the financial crisis. In line with section 5.3 we compute the Hicksian equivalent variation, defined as the consumption that makes agents indifferent between the levels of consumption reached three periods after integration and integration with financial crisis.

Figures 19 and 20 report the welfare gains in the two countries. In particular figure 19 shows the gains for agents with different levels of wealth. In country 1 all agents decide to anticipate consumption since they become more impatient; they also experience a drop in their production activities due to the crisis. The very poor agents are better off since they experience a drop in the level of interest rates due to the crisis, that makes them enjoy higher consumption; the richers are instead worse off since they gain lower interests on the accumulated activities. In country 2 instead all agents decide to postpone consumption and also produce less; they

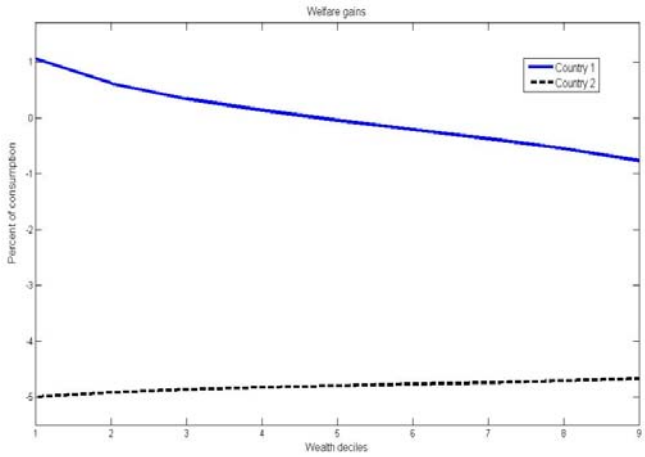

Figure 20: Hicksian equivalent variation - financial crisis

have negative welfare gains with no large differences for different levels of wealth. The positive effects of lower interest rate are not relevant for agents in country 2 compared with the two strong effects illustrated.

Figure 20 highlights different gains at different wealth deciles. Here it is important to notice that the median-mean US citizens experience negative welfare gains, as well as the one the the rest of the world, therefore the overall welfare consequences are negative in both countries.

7 Sensitivity analysis

This section reports the result of the quantitative analysis with different parametrizations of the two economies. In particular in the first part we show that changes in the income share of capital and the annual discount rate do not affect the transition to the integration steady state.

Figure 21 and 22 reports the simulated transition from the autarky steady state to integration with a different value for the income share of capital: $\alpha = .3$. The dynamics toward the new steady state do not change. The impact of liberalization on the two components of the current account are slightly stronger in the two economies.

Figures 23 and 24 report instead the transition dynamics of the two economies toward the integration steady state when agents are more impatient ($1 - \beta = .05$). Again there are no differences in the response of the main variables with respect to the benchmark specification.

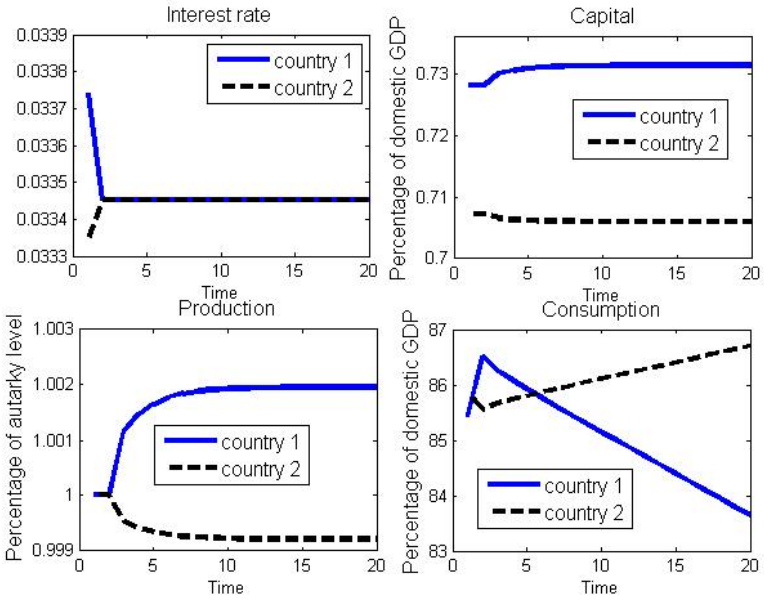

Figure 21: Response to capital account liberalization - $\alpha = .3$

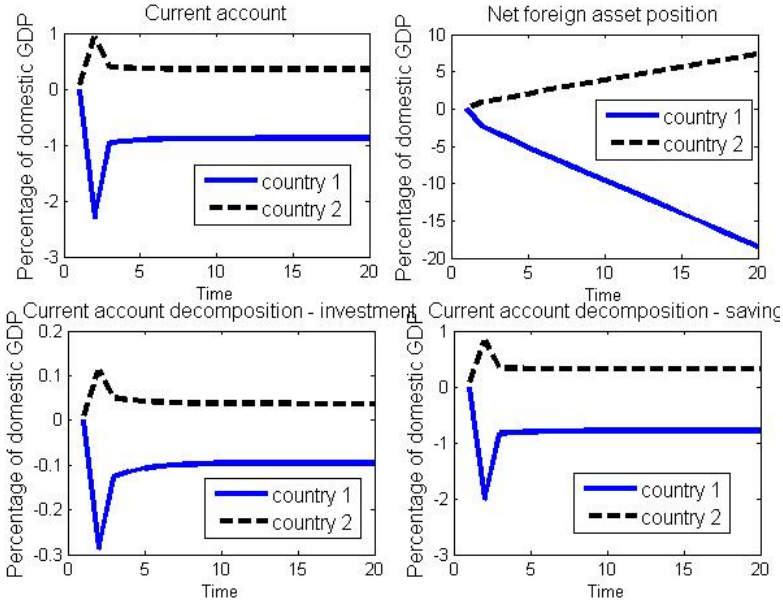

Figure 22: Response to capital account liberalization - $\alpha = .3$

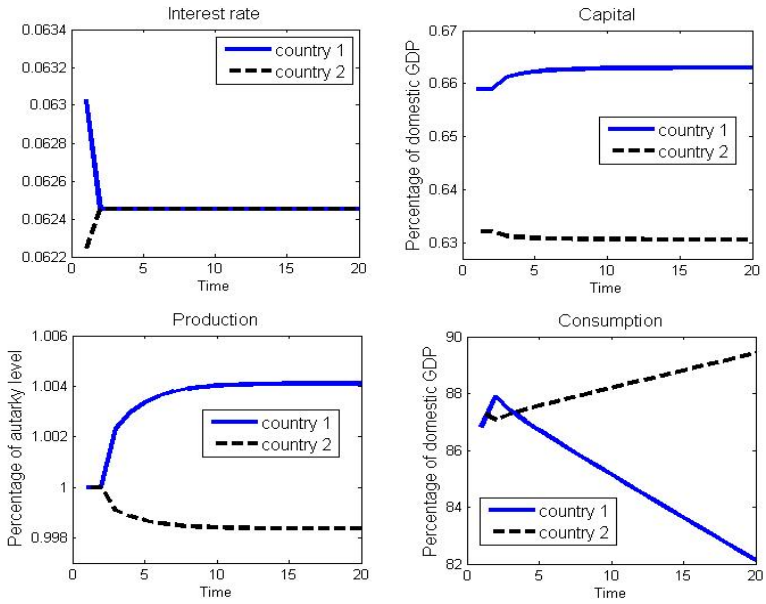

Figure 23: Response to capital account liberalization - $1 - \beta = .05$

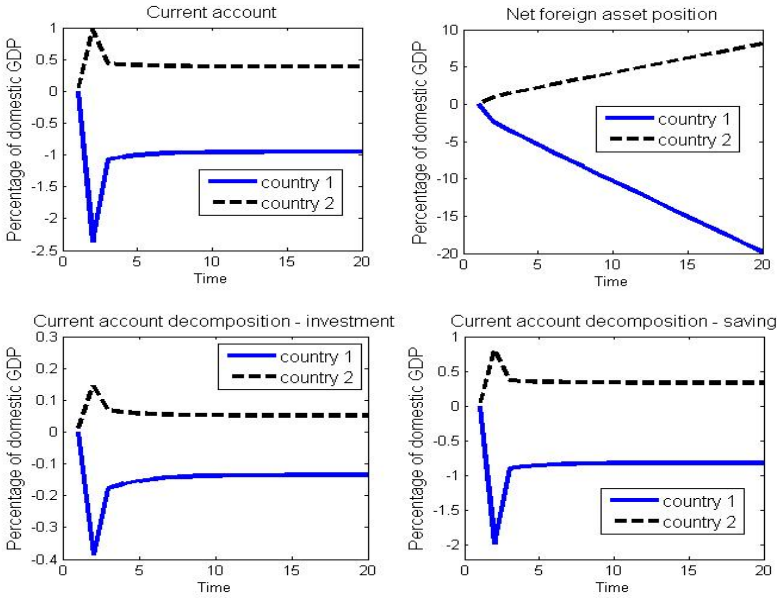

Figure 24: Response to capital account liberalization - $1 - \beta = .05$

The interest rate of equilibrium in autarky and then in integration is higher, and the share of consumption on GDP is always higher. The current account deficit of country 1 is higher in this case, and it is due to higher savings variation while the impact on investment decision remains the same.

8 Final remarks

The present analysis provides a novel explanation on how financial development differences can shape international portfolio choices. We shed light on the role of financial development in simultaneously affecting consumers' saving preferences as well as entrepreneurial investment decisions. These two effects have important implications for the countries' variables in equilibrium: countries with poor financial institutions have lower capital accumulation and lower interest rate, and financial liberalization exacerbates the underinvestment condition of those economies. We focus on the long run implications of the impact of financial liberalization on countries' savings and investment decisions; we stress the importance of structural differences among countries in determining in equilibrium increasing positive or negative net assets positions. In a two country model were the two economies differ only in their ability to insure firms against their idiosyncratic shocks, we are able to reproduce financial global imbalances observed in the data: large and rising current account deficit for the financially more advanced economy (in the calibration is the US), accumulation of the risk-free assets for the rest of the world. Our model provides quantitative evidence that financial integration among economies with different financial development can harm emerging countries since it dampens capital accumulation, boosts precautionary savings and reduces welfare; it also increases wealth inequality in financially more developed economies.

The present work stresses the unambiguously positive effects of improvements in financial market institutions to promote capital accumulation, contrary to the results obtained by Aiyagari (1994) of higher capital levels in equilibrium for less financially advanced economies. Moreover, in line with the recent empirical literature, we question the positive direct effects of financial globalization for countries with weak financial markets.

Finally the present work contributes to the debate on the effects of the financial crisis: it is first of all able to show that worsening financial conditions cause global recession by increasing the risk-adjusted cost of investing in production activities; welfare consequences of this shock are negative for all economies involved. We then go one step further to explain the long run implications of the financial turmoil; our model predicts that poorer economies, already integrated with financially more advanced countries, suffer a further reduction in production

activities and even stronger precautionary saving motive, their capital therefore goes abroad towards foreign risk-free activities. On the contrary financial integration mitigates the real effects of the crisis on richer economies, under-investment is reduced by the large drop in the interest rate, and agents still want to anticipate their consumption; overall these countries experience negative and growing net foreign asset positions.

This analysis therefore is not able to catch the slight recovery of the current account deficit and savings registered in recent US data; this is due mainly to two features of the model: no borrowing constraints and no possibility of default for single agents. As already mentioned however, ours is an analysis of the long run implications and we believe that while the current data might be short run reactions to the recession, there are no signs of changes in agents' preferences with respect to the pre-crisis period.

Appendix A

Agents' budget constraint (equation 3) can be re-written in the following way:

$$c_{it} + k_{it+1} + b_{it+1} + \boldsymbol{\pi}_t \boldsymbol{\phi}_t = w_{it} \tag{2'}$$

Where the term $\phi_t = (\phi_{m,t})_{m=1}^{M_i}$ is a portfolio of M_i risky financial assets and $\pi_t = (\pi_{m,t})_{m=1}^{M_i}$ is the associated price vector. Agents of country i can invest in those assets in order to maximize their utility. In each period wealth is given by:

$$w_{it} = \tilde{A}_{it} k_{it}^{\alpha} + (1 + r_{it}) b_{it} + (1 - \delta) k_{it} + \boldsymbol{d}_t \boldsymbol{\phi}_{t-1} \tag{3'}$$

Where $d_{t+1} = (d_{m,t})_{m=1}^{M_i}$ is the vector of payoffs of the financial assets that are jointly normal, independent and with expected value $E_t d_{t+1} = 0$.$\tilde{A}_{it}$ is the productivity shock, distributed as a normal $(1, \sigma^2_{\tilde{A}})$; $\sigma^2_{\tilde{A}}$ in this representation is the total variance associated with the idiosyncratic production risk.

Agents choose the optimal level of risky activities ϕ_t as to minimize the variance of their wealth: the optimal portfolios are able to fully hedge the diversifiable idiosyncratic risk, leaving agents with a residual undiversifiable risk with variance $\sigma^2_{iA} = Var(w_{it}) < \sigma^2_{\tilde{A}}$. We can assume that the idiosyncratic production risks are identically distributed in the two countries, while the number of assets available M_i varies; M_i gives the dimension of financial market development in each country i, the higher the number of assets available, the lower is the residual production risk consumers-entrepreneurs have to face.

Appendix B

Proof of Proposition 1: Given the monotonicity of the R - K relationship in the firm's investment demand at the steady state:

$$r_{SS} + \delta = \alpha K_{iSS}^{\alpha - 1} (1 - \tfrac{r_{SS}}{1 + r_{SS}} \sigma^2_{iA} K_{iSS}^{\alpha})$$

One and only one level of capital choice in each of the two countries corresponds to any level of interest rate r.

We now need to prove that the interest rate, r_{ss}, is $r_2 < r_{ss} < r_1$. If r_{ss} was larger than country 1 steady state interest rate, $r_{ss} \geq r_1$, agents of country 1 would like to have a non-decreasing consumption path, and agents of country 2 an increasing consumption path (since $r_2 < r_1$), this would bring to positive consumption growth in the steady state that cannot be an equilibrium. Therefore it has to be that $r_{ss} < r_1$.

If $r_{ss} \leq r_2$ then agents of country 1 would like to have a decreasing consumption path (since $r_2 < r_1$) and agents in country 2 a non-increasing consumption path. The only way to anticipate consumption is by issuing bonds (since capital is constant at the steady state), but the two countries cannot contemporaneously have respectively a negative and a non-positive bond position since the market for bonds has to clear in equilibrium. Therefore it has to be that $r_2 < r_{ss} < r_1$, country 1 holds a negative foreign asset position and country 2 a positive one. Country 1 keeps accumulating debt until its aggregate wealth reaches zero.

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