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Anne Épaulard, Aude Pommeret

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FINANCIAL INTEGRATION, GROWTH AND VOLATILITY

ANNE EPAULARD* *University of Paris Dauphine, PSL Research University*
AUDE POMMERET *City University of Hong Kong and Université de Savoie - IREGE*

Abstract. The aim of this paper is to evaluate the welfare gains from financial integration for developing and emerging market economies. To do so, we build a stochastic endogenous growth model for a small open economy that can: (i) borrow from the rest of the world; (ii) invest in foreign assets; and (iii) receive foreign direct investment. The model is calibrated on 46 emerging market and developing economies for which we evaluate the upper bound for the welfare gain from financial integration. For plausible values of preference parameters and actual levels of financial integration, the mean welfare gain from financial integration is around 13.5% of initial wealth. Compared with financial autarky, actual levels of financial integration translate into higher annual growth rates.

1. INTRODUCTION

What are the benefits of financial integration for developing and emerging market economies?

Economic theory tells us that financial integration brings four types of benefits:

- First, financial integration potentially allows risk sharing. As in the basic portfolio allocation model, global diversification reduces the portfolio risk for a given expected rate of return. In turn, this reduction in risk affects domestic saving.
- Second, financial integration potentially eases the capital scarcity constraint a developing/emerging economy might face.
- Third, financial integration may bring foreign direct investments (FDI) into the country. Part of the income generated with this FDI remains in the country because of taxes or other trickle-down effects.
- Finally, financial integration may boost productivity through a number of channels. For instance, when financial integration increases FDI, foreign investors bring into the country not only capital, but their technology as well.

However, there is mixed empirical evidence on whether capital account liberalization and financial integration have resulted in increased long-run economic growth in developing economies (see the surveys by Edison *et al.* (2004), Kose *et al.* (2007) and Obstfeld (2009)).

How can we reconcile theoretical prediction with empirical evidence? The absence of clear empirical evidence on the benefits of financial integration may

*Addresses for Correspondence: University of Paris Dauphine, France. E-mail: Anne.Epaulard@dauphine.fr. The authors are grateful to Philippe Bacchetta, Raouf Boucekine, Jean-Pierre Danthine, Andrew Feldstein, Olivier Jeanne, Pascal Saint-Amour and the participants of the conference of the China World Economic Association, held at Zhejiang University, 2014 for their comments on previous versions of this paper.

result from the fact that the benefits listed above exist but are small, either because financial integration is not completed yet or because there is not much to gain even under complete financial integration. The gap between theoretical prediction and empirical evidence can also come from the fact that, in addition to the benefits pointed out by economic theory, financial integration brings potential losses (associated, for instance, with sudden stops or reversals of capital flows) that cancel out the benefits. In addition, rapid growth associated with capital inflows can generate specific macroeconomic imbalances (see Aizenman (2015) for China).

The aim of this paper is to give a measure of the potential benefits that countries could have seen given the nature of their financial integration and its level. To do so, we build and calibrate a stochastic growth model that encompasses most of the features that are supposed to convert financial integration into economic growth for 46 developing and emerging economies. The aim of this calibration is to derive an upper bound (indeed, we consider only the potential benefits of financial integration and completely neglect potential losses that can arise following, for instance, sudden stops and reverse capital flows) for the benefits of financial integration of emerging and developing economies, given their actual degree of financial integration. This upper bound provides a benchmark for econometric studies on the effect of financial integration.

To be more precise, we build a stochastic endogenous growth model for a small open economy that can: (i) borrow from the rest of the world so as to relax its capital constraint; (ii) invest in foreign assets so as to benefit from risk sharing; and (iii) receive FDI. This means that the model is able to account for cases in which some capital enters the domestic economy through FDI while domestic capital is reduced in that same economy through investment abroad. In addition, there are two sources of uncertainty in the model: domestic productivity shocks and foreign prices shocks. Given these shocks, we derive a closed-form solution for the required rate of return for foreign investors to invest into the country, the optimal portfolio choice of the domestic investor, the growth rate of the economy, and the welfare gain from financial integration. The model is then calibrated on 46 emerging and developing economies for which we can evaluate the upper bound for the welfare gain from financial integration.

For plausible values of the preference parameters, we conclude that the gains from financial integration are significant but not huge: they represent approximately 13.5% of the existing wealth and, in terms of the annual growth differential, actual financial integration brings up to an additional 1.8 percentage points compared with growth under financial autarky. It may well be that once costs of financial integration are taken into account, net gains are no longer significant.

The paper is organized as follows. Section 2 reviews the literature and discusses the empirical evidence on the effects of financial integration on economic growth and volatility. In Section 3, we develop a simple stochastic endogenous growth model that encompasses the main theoretical features linking financial integration, growth, and volatility. The model is solved in Section 4 and the analytical expression of the welfare gain of financial integration is derived. Finally, in Section 5, the model is calibrated on 46 emerging and developing

economies; we then compute an upper bound for the effect of observed financial integration on economic growth. Section 6 concludes.

2. RELATED LITERATURE AND EMPIRICAL EVIDENCE

Research aiming at measuring benefits of financial integration usually proceeds by comparing two economies that differ only in their level of financial integration. However, there are at least three types of comparisons, and the measured benefits of financial integration will depend on the type of comparison that is undertaken. The comparison can be between an economy with financial autarky and its fully financially integrated counterpart. This is the approach followed by most papers based on the calibration of small theoretical models; it focuses on the potential gain of full financial integration (see e.g. Obstfeld, 1994; Athanasoulis and van Wincoop, 2000; Coeurdacier *et al.*, 2013). A second approach consists of comparing an actual economy with its fully financially integrated counterpart. This is the approach followed by Gourinchas and Jeanne (2006). Finally, a third approach consists of comparing the economic performance of an actual economy (with its current level of financial integration) with its counterpart under a lower level of financial integration or under financial autarky. This is the approach followed in econometric studies. This paper follows this approach as well.

In addition, when growth models are calibrated to measure the benefits of financial integration, it is likely that the results will depend on the main feature of the growth model:

- Evaluating the potential gain of financial integration by calibrating small theoretical models, with nonexistent or exogenous growth, rules out any large positive effect of financial integration on long-term growth. In a deterministic standard neoclassic growth model in which, by design, risk sharing does not bring any benefit and long-term growth is exogenous, Gourinchas and Jeanne (2006) show that the welfare gain from capital account liberalization is rather small (around 1% of consumption each year along the growth path of the economy). In the same setting, but allowing for capital varieties, Hoxha *et al.* (2013) show that financial integration benefits a country by speeding up convergence toward its steady state. In a two-country setting, Coeurdacier *et al.* (2013) obtain that faster capital convergence in riskier countries can be dampened by the reallocation of precautionary savings across countries. In the exogenous growth setting as well, Antràs and Caballero (2010) and Zhang (2014) show that financial frictions do matter for the effect of combined trade and financial integrations on welfare. Moreover, with imperfect enforcement of domestic debt, Broner and Ventura (2010) reveal that final integration has ambiguous effects on net capital flows and growth, and generates volatile capital flows and unstable domestic financial markets.
- In an endogenous growth model, financial integration may boost growth and generate large gains. Such an effect appears in Obstfeld (1994), when risk-sharing improves long-term growth. In a collateral-constrained borrowing

AK economy, Boucekkiné *et al.* (2014) show that more financial integration triggers stronger growth even though consumption initially falls when the economy opens up to financial flows. Finally, defining risk-sharing as country-specific deviations from world growth, Athanasoulis and Van Wincoop (2000) found that risk-sharing gains that would come with financial integration are huge.

As far as the effect of capital account liberalization on *volatility* is concerned, Kose *et al.* (2003) conclude by reviewing the literature on international business cycles that theoretical models (RBC models and NOEM models) do not provide a clear guide to the effects of financial integration on macroeconomic volatility. Tille (2005) confirms this conclusion. In a two-country NOEM model, he shows that the impact of integration is not universally beneficial (it depends on the degree to which exchange rate fluctuations are passed through to consumer prices). Moreover, in a two-country general equilibrium model with endogenous portfolio choice and collateral constraints, Devereux and Yu (2014) obtain that financial integration leads to a higher degree of global leverage, increasing the frequency of financial crises. However, because in their setting crises are less severe than in closed economies (see also Tille, 2012), welfare gain from financial market integration may be positive or negative.

The comparison of economies at different stages of their financial integration process provides mixed empirical evidence that capital account liberalization promotes long-run economic growth in developing economies (see the survey by Edison *et al.*, 2004). Performing econometric estimations, Edison *et al.* (2002) do not find any significant positive effect of financial integration on economic growth. However, Henry (2003) reports empirical evidence that stock market liberalizations (a component of capital account liberalization and financial integration) are followed by lower cost of capital, higher investment and higher growth. Bekaert *et al.* (2001, 2005) report that, on average, equity market liberalizations lead to a 1% increase in economic growth over a 5-year period. The same orders of magnitude appear in more recent literature (Kose *et al.*, 2007; Obstfeld, 2009; Schularick and Steger, 2010). This is also consistent with Bussière and Fratzscher (2008), who report that the opening of the capital account led on average for 45 industrialized and emerging market economies to 1.5% higher growth during the first 5 years after liberalization but that growth subsequently returned to or even below its pre-liberalization rate.

The empirical literature is also mixed regarding the effect of financial openness on macroeconomic volatility. For example, Razin and Rose (1994) find no evidence of a link between trade and financial openness and macroeconomic volatility. A paper by Easterly *et al.* (2000) concludes that neither financial openness nor volatility of capital flows have a significant impact on macroeconomic volatility. They show, however, that a higher level of development of the domestic financial sector (as measured by private credit to GDP) reduces growth volatility. Buch *et al.* (2005) do not find any consistent empirical relationship between financial openness and the volatility of output. Nevertheless, Bekaert *et al.* (2006) find a significant decrease in both GDP and consumption

growth variability after equity market liberalizations and Kaminsky and Schmukler (2008) report that financial liberalization in emerging markets fuels financial instability only in the short run while markets stabilize the economy in the long run. Poonpatpibul *et al.* (2006) observe for East Asia countries that financial integration may pose higher risks on economic stability via greater volatility of capital flows which can be magnified by increasing cross-border linkages. Finally, a recent paper by Hwang *et al.*, 2013 finds that on a set of 102 countries over the period 1971 to 2011, capital market openness increases output volatility in developing economies.

In this paper, we follow the approach that consists in comparing an actual economy to an economy that is identical in all respect but its level of financial integration. We do not rely on econometric estimations, but rather on the calibration on a set of emerging and developing economies of a theoretical AK growth model. Therefore, we provide a theoretical framework to understand the mixed empirical results reviewed above. Moreover, our model considers simultaneously the potential effects of FDI, of the openness of financial markets, and of risk sharing on both growth and volatility.

3. THE SMALL OPEN ECONOMY STOCHASTIC ENDOGENOUS GROWTH MODEL WITH PORTFOLIO CHOICE

To measure the gain from financial integration, we extend a standard AK stochastic growth model to account for financial integration:

- First, in the financially integrated economy, the representative agent has access to global financial markets. He or she can hold riskless foreign bonds (but no foreign risky capital) and contract debt either to consume or invest in domestic capital. Both foreign bonds and debt are denominated in foreign currency. The agent chooses the amount of debt and bonds that he or she holds. Depending on his or her net position, the agent pays or receives interest.
- Second, the financially integrated economy receives FDI, the amount of which is not decided by the representative agent. This FDI is converted into productive capital and used for production. The income generated by this FDI goes partly to the foreign owners; the rest stays in the country. An equilibrium condition ensures that for the foreign investors, the certainty equivalent of the return on FDI matches that of international riskless bonds.

Therefore, the model is able to account for cases in which some capital enters the domestic economy through FDI while domestic capital is reduced in that same economy through investment abroad. The rest of the model is a standard AK model with technological shocks. In addition, the representative agent consumes domestic and imported goods, foreign prices are subject to shocks, and part of the domestic production is exported. The trade balance, and current and capital accounts, simultaneously adjust to ensure balance of payment

equilibrium. Note that later in the paper the term ‘autarky economy’ refers to an economy that is in financial autarky but trades with the rest of the world. The model is presented below.

3.1. *Technology*

The small open economy produces one good using capital. The technology is AK , and temporary technological shocks perturb the production process. Over the period $(t, t + dt)$, the flow of output is:

$$dY = K(\mu_Y dt + \sigma_Y dz_Y), \quad (1)$$

where dz_Y is the increment of a standard Wiener process ($dz_Y = \eta(t)\sqrt{dt}; \eta(t) \rightarrow N(0, 1)$). Equation 1 asserts that the flow of output over the period $(t + dt)$ consists of two components: a deterministic component ($K\mu_Y dt$) and a stochastic one ($K\sigma_Y dz_Y$) reflecting the random influences that impact on production. Thus, as far as productivity is concerned, shocks are neither correlated nor persistent.

In the absence of financial integration, the whole stock of productive capital installed in the country is owned by the domestic representative agent.

With financial integration, additional productive capital (K^*) comes from FDI. This FDI, owned by foreign investors, is used for production. It adds to the stock of capital (K^d) owned by the representative agent so $K = K^d + K^*$. We define ϕ^* to be the ratio of foreign-owned capital to domestically-owned capital ($\phi^* = K^*/K^d$). ϕ^* is taken as given by the domestic representative agent.¹ In the autarky economy, $\phi^* = 0$.

In addition, when the economy is financially integrated, the representative agent can contract debt denominated in foreign currency (see below the wealth accumulation equation) and these capital inflows are an additional source for financing domestic investment; i.e. K^d may be larger under financial liberalization than under financial autarky, depending on the optimal portfolio choice.

3.2. *The utility function*

The representative household consumes a domestically produced good (C_D) and an imported one (C_M). We consider a recursive utility function that disentangles risk aversion and intertemporal substitution as in Svensson (1989) (see also Backus *et al.*, 2008):

¹ In order to model the behaviour of the foreign investor one would have to consider a multi-country model. This is not done in this paper.

$$(1 - \gamma)U_t = \left[\frac{C_{Dt}^\theta C_{Mt}^{1-\theta}}{L_0 e^{nt}} \right]^{\frac{\varepsilon-1}{\varepsilon}} dt + e^{(n-\rho)t} ((1 - \gamma)E_t U_{t+dt})^{\frac{1-\varepsilon}{\varepsilon}} \right]^{\frac{(1-\gamma)\varepsilon}{\varepsilon-1}}, \quad (2)$$

with $\varepsilon > 0, \varepsilon \neq 1$ and $\gamma \neq 1$, where U_t is the intertemporal utility at time t over an infinite horizon.² γ is the relative risk aversion coefficient of the domestic agent (and we suppose it is equal to that of the foreign investor), ε is the intertemporal elasticity of substitution, L_0 is the population size at the initial date which is assumed to be unitary ($L_0 = 1$), n is the population growth rate and ρ is the discount factor. Domestically produced and imported consumption are aggregated according to a Cobb–Douglas function, so $C_{Dt}^\theta C_{Mt}^{1-\theta}$ gives the aggregate consumption.

3.3. Trade, real and nominal exchange rates

Total consumption in terms of domestic currency depends on both the price of the imported good denominated in foreign currency and the exchange rate. Let P be the price of the imported good denominated in foreign currency. We assume that P follows a geometric Brownian motion:

$$\frac{dP}{P} = \mu_P dt + \sigma_P dz_P,$$

where dz_P is the increment of a standard Wiener process. Therefore, the price of the imported goods grows at a constant rate μ_P continuously perturbed by shocks. The instantaneous standard deviation of the growth rate is denoted by σ_P . We assume that productivity shocks and shocks on P are uncorrelated ($dz_P dz_Y = 0$).

Total consumption in terms of domestic currency or domestic goods (the price of the domestically produced good is taken as numeraire) is $C_D + EP C_M$, where E is the nominal exchange rate defined as the number of domestic currency units per unit of foreign currency. EP is, therefore, the price of the imported good in terms of domestic currency. The nominal exchange rate E evolves at a constant and deterministic rate μ_E :

$$\frac{dE}{E} = \mu_E dt,$$

The evolution of EP , the real exchange rate, is then given by:

$$\frac{d(EP)}{(EP)} = (\mu_P + \mu_E)dt + \sigma_P dz_P.$$

In the long run, $\mu_E + \mu_P = 0$ for purchasing power parity to hold. However, we do not impose such an assumption because this condition may not be satisfied in the period we consider for calibration.

² If the relative risk aversion is equal to the inverse of the intertemporal elasticity of substitution ($\gamma = 1/\varepsilon$), then intertemporal utility function reduces to the discounted sum of instantaneous utilities as in Merton (1969).

3.4. *Sharing income from production*

Income generated with capital owned by the domestic agent goes to the domestic agent (who still has to pay interest on his or her foreign debt). In addition, a fraction τ of the income generated with foreign-owned capital (FDI) goes to the domestic agent to account for any trickle-down effect;³ the rest of the income generated by FDI goes to the foreign owners.

Thus, before interest payments/revenues on foreign debt/claims and depreciation, the domestic agent income is given by:

$$[\mu_Y dt + \sigma_Y dz_Y] [1 + \tau\phi^*] K^d.$$

Foreign owners of FDI receive the fraction $(1 - \tau)$ of the income generated by their capital. Therefore, the revenue (net of depreciation) from their investment is:

$$(1 - \tau)(\mu_Y + \sigma_Y dz_Y) K^* - \delta K^* = [(1 - \tau)(\mu_Y + \sigma_Y dz_Y) - \delta] \phi^* K^d.$$

This income is stochastic. We impose the condition that for FDI owners, the certainty-equivalent return on risky domestic capital is equal to the riskless rate on foreign bonds (i^*):

$$(1 - \tau)(\mu_Y - \gamma(1 - \tau)\sigma_Y^2/2) - \delta = i^* + \mu_E, \quad (3)$$

where γ is the foreign investor's risk aversion, and μ_E is the expected rate of depreciation of the domestic nominal exchange rate against the foreign investor currency.

3.5. *Wealth accumulation, capital mobility and the flow of foreign direct investment*

- In the autarky economy, the representative agent has no access to foreign financial market, and the only way of saving is investment in risky domestic capital. Wealth evolution is then given by:

$$dW = dK = [(\mu_Y - \delta)K - (C_D + EPC_M)]dt + K\sigma_Y dz_Y.$$

- When the economy is financially integrated, the representative agent can hold equity claims on domestic capital and riskless foreign bonds ($B > 0$). The representative agent can also contract debt denominated in foreign currency ($B < 0$). Therefore, domestic wealth is split into two components: capital owned by domestic agents (K^d) and foreign debt/assets (EB):

³ It can be wages paid to residents.

$$W = K^d + EB.$$

Wealth evolution is as follows:

$$dW = \left[((1 + \tau\varphi^*)\mu_Y - \delta)K^d + EB(i^* + \mu_E) - (C_D + EPC_M) \right] dt + (1 + \tau\varphi^*)K^d\sigma_Y dz_Y.$$

4. SOLVING THE MODEL

The resolution of the model is given in the Appendix. We suppose here that the balanced growth path exists in this stochastic environment (see Boucekkine and Zou (2014) for the additive utility case)⁴. In this section, we present the main findings on portfolio allocation, growth, volatility, and, finally, the welfare gain from financial integration.

4.1. *Portfolio allocation*

Under financial autarky, there is no portfolio choice because the only asset available to the representative agent is domestic capital.

Under financial integration, maximizing the utility function subject to the wealth accumulation equation provides expressions for the share of the two assets (as well as for consumption of the imported good and domestically produced good) in the composition of the wealth of the representative agent. These shares are (see Appendix):

$$n_K = \frac{[(1 + \tau\varphi^*)\mu_Y - \delta - (i^* + \mu_E)]}{\gamma(1 + \tau\varphi^*)^2\sigma_Y^2} \quad (4)$$

$$n_B = \frac{EB}{W} = 1 - n_K,$$

As in any other portfolio choice, the optimal portfolio composition depends on expected returns and risk. The larger the uncertainty on domestic production, the less investors are willing to get into debt abroad in order to invest more in the domestic country (i.e. the smaller n_K). The share of domestic capital in the domestic agent's portfolio can be larger than 1, meaning that the domestic investor borrows abroad to invest in domestic capital. The fact that the economy benefits from FDI ($\tau > 0$) increases the deterministic part of the return on domestic capital for the domestic agent and, thus, his or her incentive to borrow abroad to invest at home. It increases as well the volatility of this return, thus mitigating the incentive to borrow.

Note that in this model, the balance of payments equilibrium is always satisfied (see Appendix).

⁴ Because we use a recursive utility, conditions for existence are likely to differ from those defined in Boucekkine and Zou (2014).

4.2. Growth

In the autarky economy, the deterministic part of the GDP growth rate is:

$$g^A = \mu_Y - \delta - A^A,$$

where A^A is the propensity to consume wealth, equal to: $A^A = \varepsilon\rho - n + (1 - \varepsilon)CEq^A$, where CEq^A is the certainty equivalent of the return on wealth. This expression for the marginal propensity to consume is standard. Note that, thanks to the recursive utility specification, it is clear that the effect on A^A of the certainty equivalent CEq^A depends on the intertemporal elasticity of substitution. When the intertemporal elasticity of substitution is less than 1, a higher CEq^A increases the propensity to consume, and, hence, reduces the growth rate of the economy. In turn, risk aversion does affect the relationship between risk and CEq^A :

$$CEq^A = \left(\mu_Y - \delta - \gamma \frac{\sigma_Y^2}{2} \right) - (1 - \theta) \left((\mu_P + \mu_E) - ((1 - \theta)(1 - \gamma) + 1) \frac{\sigma_P^2}{2} \right),$$

Thus, in the autarky economy, when the intertemporal elasticity is less than one, the higher the risk aversion (or the higher the total factor productivity volatility), the smaller the propensity to consume and the higher the growth rate of the economy.

When the economy is financially integrated, the deterministic part of the economy growth rate is:

$$g^L = [(1 + \tau\varphi^*)\mu_Y - \delta]n_K + (1 - n_K)(i^* + \mu_E) - A^L; \quad (5)$$

A^L , the constant propensity to consume wealth, is equal to:

$$A^L = \varepsilon\rho - n + (1 - \varepsilon)CEq^L, \quad (5')$$

where CEq^L is the certainty equivalent of the return on wealth, which depends on the portfolio allocation. It is equal to:

$$CEq^L = n_K \left((1 + \tau\varphi^*)\mu_Y - \delta - \gamma n_K (1 + \tau\varphi^*)^2 \frac{\sigma_Y^2}{2} \right) + (1 - n_K)(i^* + \mu_E) - (1 - \theta) \left((\mu_P + \mu_E) - [(1 - \theta)(1 - \gamma) + 1] \frac{\sigma_P^2}{2} \right). \quad (5'')$$

In the financially integrated economy, part of the certainty equivalent of the return on wealth comes from foreign debt/assets, and part of it comes from domestic capital income (net of the income that goes to foreign investors).

- In a net borrowing country ($n_K > 1$), the stock of physical capital installed in the economy is higher both because domestic agents borrow abroad to invest at home and because there are FDI flows. The component of the certainty equivalent of the return on domestic activity due to deterministic productivity increases, but the component linked to the stochastic part (which reduces CEq^L) rises as well. As a consequence, the impact of financial integration on growth is ambiguous.
- In the case of a net lender ($n_K < 1$), the impact of financial integration on growth is even more ambiguous because more wealth comes from foreign investors through FDI, but domestic agents now devote part of their wealth to invest abroad.

The condition for international financial integration to spur growth is that $g^L > g^A$. This condition is not met for any set of parameters:

- In the simplest case where the intertemporal elasticity of substitution is equal to 1,
 - If the country is neither a lender nor a borrower, financial integration spurs growth (one can show that $g^L - g^A = \tau\phi^*\mu_y > 0$) through FDI.
 - The derivative of $g^L - g^A$ to n_K is always positive, which means that the more debt the country holds, the higher its growth rate. Let us recall, though, that the optimal amount of debt is not a parameter but is endogenously determined within the model.
- When the intertemporal elasticity of substitution is different from 1, the effect of financial integration on growth is ambiguous and cannot be analyzed analytically. Therefore, we rely on calibration experiments in the next section.

4.3. Volatility

4.3.1. Volatility in the growth rate of wealth

Wealth volatility in a financially integrated economy (denoted vol^L) is:

$$vol^L = (1 + \tau\phi^*)^2 n_K^2 \sigma_Y^2.$$

Comparing this volatility with that of wealth in the autarky economy (denoted vol^A) gives:

$$\frac{vol^L}{vol^A} = (1 + \tau\phi^*)^2 n_K^2. \quad (6)$$

In the case of a net borrower country ($n_K > 1$), financial integration increases total wealth volatility because the country then becomes more sensitive to domestic shocks. Moreover, the larger the stock of FDI the higher the volatility. For countries that are net lenders ($n_K < 1$), current account liberalization may either increase or decrease wealth volatility.

4.3.2. Volatility in the growth rate of consumption

Solving the maximization problem provides expressions for the consumption of imported and domestic goods (see Appendix):

$$C_D^i = A^i \theta W$$

$$EPC_M^i = A^i (1 - \theta) W \quad \text{with } i = A, L.$$

The volatility of the growth rate of total nominal consumption ($C_D + EPC_M$) and that of domestic consumption are the same as that of wealth because they are both a constant part of wealth.

4.4. Welfare gain from financial integration

4.4.1. Total welfare gain from financial integration

The welfare gain from financial integration is computed as the percentage of current wealth that the domestic representative agent should receive to be as well off in the autarky economy as he or she is in the financially integrated economy.⁵ We denote this percentage by k .

The value functions for the optimal program or the indirect utilities of the two economies are as follows (see the Appendix):

$$V^A = (A^A)^{\frac{1-\gamma}{1-\varepsilon}} \left(\frac{\theta}{\theta(1-\theta) \frac{EP}{1-\theta}} \right)^{-(1-\gamma)(1-\theta)} \frac{[W(1+k)]^{1-\gamma}}{1-\gamma} e^{-(1-\gamma)nt}$$

$$V^L = (A^L)^{\frac{1-\gamma}{1-\varepsilon}} \left(\frac{\theta}{\theta(1-\theta) \frac{EP}{1-\theta}} \right)^{-(1-\gamma)(1-\theta)} \frac{W^{1-\gamma}}{1-\gamma} e^{-(1-\gamma)nt}.$$

One can show that:

$$k = \left[\frac{A^L}{A^A} \right]^{\frac{1}{1-\varepsilon}} - 1. \quad (7)$$

4.4.2. Splitting up the welfare gain from financial integration

To appraise whether the welfare gain from financial integration comes from FDI or from the openness to foreign debt/assets, we break down the total welfare gain computed previously.

To split the total welfare gain from financial integration, we consider three different economies. Two of them have already been considered above: the autarky economy and the actual economy. We consider a third economy that receives FDI but is closed to other capital flows. We then proceed in two stages as illustrated in Figure 1. First, we consider the switch from the actual economy to an economy with FDI but no access to global financial markets; this allows us

⁵ The definition we use is the compensating variation.

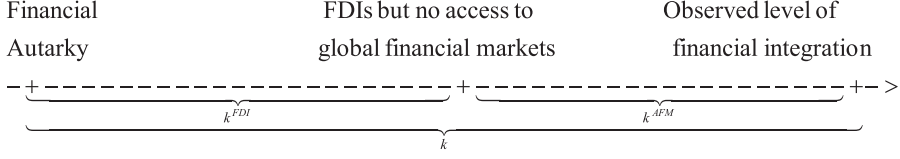


Figure 1. Splitting up the welfare gain from financial integration

to compute the welfare gain from access to global financial markets. Next, we consider the switch from the latter economy to autarky, and this gives us the welfare gain of FDI.

Let us note V^{PL} , the optimal value of the program of an economy with FDI but no other capital flows. One can show that it is:

$$V^{PL} = (A^{PL})^{\frac{1-\gamma}{1-\varepsilon}} \left(\frac{\theta}{\theta 1 - \theta} \frac{EP}{1 - \theta} \right)^{-(1-\gamma)(1-\theta)} \frac{W^{1-\gamma}}{1-\gamma} e^{-(1-\gamma)nt}$$

$$A^{PL} = \varepsilon p - n + (1 - \varepsilon) CE q^{PL}$$

$$CE q^{PL} = \left[(1 + \tau\phi^*)\mu_Y - \delta - \gamma(1 + \tau\phi^*)^2 \sigma_Y^2 / 2 \right]$$

$$-(1 - \theta) \left[\mu_P + \mu_E - ((1 - \theta)(1 - \gamma) + 1) \sigma_P^2 / 2 \right].$$

The welfare gain from access to financial markets is then computed as the percentage of wealth that the domestic representative agent should receive to be as well off in the economy where there is FDI but no access to global financial markets as he or she is in the actual economy. It is:

$$k^{AFM} = \left[\frac{A^L}{A^{PL}} \right]^{\frac{1}{1-\varepsilon}} - 1. \quad (8)$$

Finally, the welfare gain from FDI is the percentage of wealth that the domestic representative agent should receive to be as well off in the autarky economy as he or she is in the economy with FDI but no other capital flows. It is then:

$$k^{FDI} = \left[\frac{A^{PL}}{A^A} \right]^{\frac{1}{1-\varepsilon}} - 1. \quad (9)$$

The three welfare gains are such that:

$$(1 + k) = [1 + k^{FDI}] [1 + k^{AFM}].$$

5. MEASURING THE WELFARE GAIN FROM FINANCIAL INTEGRATION

5.1. *The data*

To measure the upper bound for the welfare effect of financial integration, we calibrate our model on 46 developing and emerging economies (see Table A in Appendix for the list of countries) over the period 1990–2010. Our aim is to measure the welfare gain of a country representative agent that would result from the observed level of financial integration of that country in the specific (and optimistic) case where no costly side effects of financial integration hurt the country.

Tables 1 and 2 contain common and country-specific parameters used in the calibration. Common parameters (Table 1) are set to standard values with a discount rate of 2%, an international interest rate of 4%, an intertemporal elasticity of substitution set at 0.5, and a risk aversion of 4. Robustness of our results to preference parameters and the international interest rate is checked for additional values indicated in Table 1.

Country-specific parameters (see Table 2) have been computed using the Penn World table 8.1 (see Feenstra *et al.*, 2013) and the External Wealth of Nations data set (updated and extended version of data set constructed by Lane and Milesi-Ferretti, 2007), taking mean values over the period 1990–2010. For our evaluation, the two most important parameters are ϕ^* , the ratio of foreign-owned capital to domestically-owned capital, and n_K , the share of domestic capital in the representative agent's wealth. The mean value of n_K is 1.1, just above unity and ranges from 0.87 to 1.36. Among the 46 countries we consider, only 7 (Cambodia, China, Iran, Namibia, South Africa and Venezuela) are net lenders on average over the period 1990–2010. The ratio of foreign-owned capital to domestically owned capital varies from 0.01 (in Nepal) to 0.32 (in Lesotho), which means that 24% ($=0.32/1.32$) of the physical capital installed in Lesotho is owned and managed by foreigners (on average over the period 1990–2010).

Finally, the last line of Table 2 reports the level of financial integration; it is computed as the ratio to country wealth of the sum of foreign capital (K^*) and the absolute value of the net debt position (EB): this ratio varies from 0.02 to 0.49 with a mean value of 0.22. We do not need this ratio to calibrate the model, but we will later use it to measure how the welfare gain of financial integration varies with the level of financial integration.

5.2. *Calibration issues*

There has been an ongoing debate in the literature (see Jones, 1995 and McGrattan, 1998) on whether the AK model is consistent with the data. Before

Table 1. Common parameters

Annual discount rate	ρ	0.02
Depreciation rate	δ	0.045
Intertemporal elasticity of substitution	ε	0.5; 0.9;
Risk aversion	γ	4; 2
International nominal interest rate	i^*	0.04; 0.06

Table 2. Country-specific parameters

		Source	Mean	Maximum	Minimum
Annual population growth rates (in percent)	n	PWT 8.0 mean over period 1990–2010	1.97%	3.56%	0.80%
Ratio of imported goods to absorption	$1 - \theta$	PWT 8.0 mean over period 1990–2010	20.7%	62.6%	5.5%
Annual productivity	μ_y	PWT 8.0 mean annual productivity (Y/K) over 1990–2010	0.32	0.63	0.15
Variance of productivity shocks (in percent)	σ_y^2	PWT 8.0 variance of annual productivity over period 1990–2010	0.09%	0.66%	0.01%
Trend in price of imported goods (foreign currency)	μ_p	PWT 8.0 annual mean over period 1990–2010	2.04%	4.19%	-.34%
Price of imported good volatility (in percent)	σ_p^2	PWT 8.0 variance of the annual growth rate in the price of imported goods over period 1990–2010	0.45%	2.17%	0.17%
Share of domestic capital in the agent's wealth	n_K	PWT 8.0 + EWN mean value over the period 1990–2010	1.11	1.36	0.87
Ratio of foreign owned capital to domestically owned capital	φ^*	PWT 8.0 + EWN over 1990–2010	0.08	0.32	0.01
GDP growth rate	g^L	PWT 8.0 mean over 1990–2010	4.7%	10.5%	1.7%
Level of financial integration		$ 1 - n_k + \phi^* n_k$ mean over 1990–2010	0.22	0.49	0.02

describing the calibration strategy, we might want to check that the AK-linear output is not rejected on the 46 countries under calibration. Indeed, the output to capital ratio shows no significant relationship with the trend in a basic panel regression on our set of countries over the period 1989–2011.

Our theoretical model has been solved under the hypothesis that the representative agent maximizes his or her intertemporal utility. In doing so, the representative agent allocates his or her wealth between domestic capital and debt/assets abroad according to his or her preferences, returns and risk. The representative agent also determines his or her savings and consumption according to his or her preferences. We had no difficulty calibrating the intertemporal choice of the domestic agents of the countries we studied. The portfolio choices were trickier to reproduce.

Actual data show that the volatility of emerging and developing economies, although higher than that of industrial economies, is low compared with the excess return of domestic investment for the representative agent. This should lead emerging and developing economies to borrow a lot abroad to invest at home, or, in our setting, a high n_K . This is not what we observe in the data. Numbers reported in Table 2 for actual n_K show that it is above but close to unity, much lower than what one would expect. Note that we compute n_K as the ratio of

domestic capital to wealth, where wealth is computed as total capital (K) less (i) debt (liabilities net of assets), (ii) portfolio (liabilities net of assets) and (iii) FDI (liabilities net of assets).

Our calibration strategy is then to stick to the n_K observed in the data and consider that this low level of indebtedness results from borrowing constraints that prevent emerging countries from holding their optimal portfolio (as in Boucekkine *et al.*, 2014). Note, however, that because portfolio choices and consumption-saving decisions are independent, the value function of the programs still holds under this borrowing constraint. Thus, the value function of the program can be used to evaluate the welfare gain from financial integration.

Calibration runs as follows. We used equation 3 and the system composed of equations 5–5'' to find the parameter τ , which measures the share of production using FDI that benefit the domestic agent, and the propensity to consume A^L . Note that condition 3 still holds when the domestic agent is constrained in their borrowings. Indeed, this condition is derived from the perspective of foreign agents owning FDI in the country who are not affected by the borrowing constraint. It is the expression of the optimal share n_K (equation 4) that is no longer valid under the borrowing constraint.

The growth rate of the economy (g^L), volatility of production (σ_Y) and of imported goods price (σ_P), the population growth rate (n), the ratio of imported goods to absorption ($1 - \theta$), the annual productivity (μ_Y), the trend in price of imported goods (μ_P), the ratio of foreign owned capital to domestically owned capital (ϕ^*) and the portfolio allocation (n_K) are taken from the data (see Table 2). We calibrated the model for each country.

Table 3 contains the outcome of this calibration process. Recall that the parameter τ measures the extent to which production with FDI stays in the country. Our calibration indicates that on average 49% of the production by foreign-owned plants goes to the domestic agent and ranges from 0% to 82%. The annual propensity to consume total wealth ranges from 5 to 61%, with a mean value of 26%.

5.3. Evaluating the welfare gain from financial integration

We now use the calibrated model to compute the welfare gain from financial integration. Recall that we compare actual economies with economies under financial autarky. The question we answer is the following: by how much should

Table 3. Calibrated parameters

		Mean	Maximum	Minimum
Share of production from foreign owned capital that goes to the domestic agent	τ	0.49	0.82	0.01
Propensity to consume wealth	A^L	26%	61%	5%

Note that parameters reported in this table are those derived with common parameters (Table 1) set at the following values: $i^* = 0.04$, $\gamma = 4$, $\varepsilon = 0.5$

the total wealth of the representative agent be increased for him or her to accept to switch back to financial autarky? This is what we call the welfare gain from financial integration. It is computed using equation 7. This gain is then split into two components: the gain from FDI (equation 9) and the gain from access to global financial markets (the ability to borrow and/or to invest abroad, equation 8). Finally, we compute the difference in the growth rates of the two economies (the actual one and the one in financial autarky) and their relative volatility (equation 6). Results are shown in Table 4.

For the average country of our sample, the average gain from financial integration is around 13.5% of the representative agent's wealth, and the gain comes roughly equally from FDI (5.8% of wealth) and from access to global financial markets (7.3%). Compared with autarky economies, we calculate that, on average, actual economies enjoy an additional 1.7 percentage points of annual growth. This comes at the cost of more volatility, which is 34% higher in actual economies compared with the autarky situation. As shown on Figure 2, countries are in general net borrowers, and, therefore, become more sensitive to domestic volatility when financial liberalization occurs (see also equation 6).

Figure 3 illustrates the dynamics of consumption in the two economies. The solid line refers to the actual economy as described in our model, and the dotted lines refer to the autarky economy. Let us consider what happens to the economy at the time the representative agent agrees to switch back to autarky and is compensated so as to keep his or her intertemporal utility the same. At the beginning, the representative agent is richer (his or her wealth increases by the compensating amount he or she receives), but there is less productive capital available in the autarky economy because it is closed to FDI. As a result, GDP is lower in the autarky economy, while gross national income (GDP less interest and dividend payments) is almost the same in the two economies (note that in the autarky economy, GNI is equal to GDP). Propensity to consume wealth is higher in the actual economy than in the autarky one, but because wealth is initially higher in the autarky economy, it turns out that initial consumption is higher too in the autarky economy. From this initial situation, all macroeconomic aggregates in each economy grow at the same rate, which is lower in

Table 4. *Welfare gain from financial integration*

	Whole sample		Level of financial integration		Region			
	Mean	Median	Low	High	Asia	Latin America	Middle East	Africa
<i># of countries</i>	46		23	23	13	10	8	15
k	13.5%	13.6%	12.3%	13.7%	15.2%	9.6%	16.8%	12.7%
k^{AEM}	7.3%	8.2%	7.3%	7.0%	8.6%	4.4%	10.4%	6.5%
k^{FDI}	5.8%	4.5%	4.7%	6.4%	5.8%	4.9%	5.7%	6.2%
$g^L - g^A$	1.7%	1.4%	2.1%	1.4%	2.0%	1.7%	1.6%	1.5%
Vol^L / Vol^A	1.34	1.34	1.33	1.29	1.35	1.22	1.42	1.36

Note: See Table A in appendix for a classification of countries according to their level of financial integration.

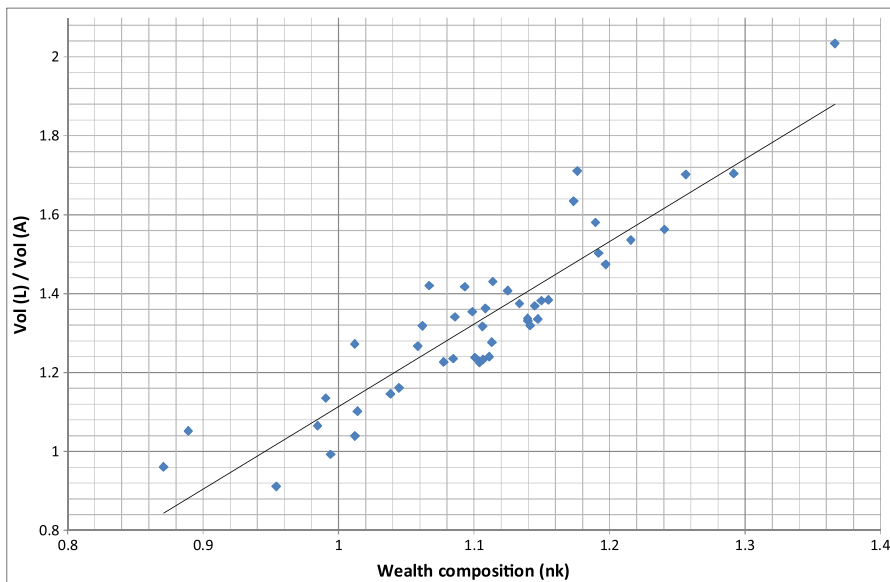


Figure 2. Increase in volatility and portfolio composition

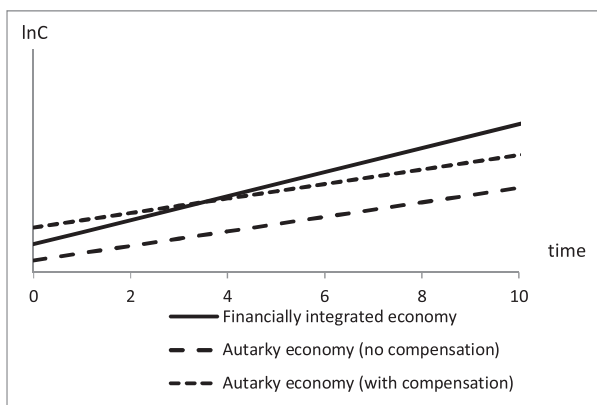


Figure 3. Dynamics of financially integrated and financial autarky economies

the autarky economy, and eventually the two economies diverge. The divergence process is slow. In our calibration, because the difference in the annual growth rates is not huge (an average of 1.7% per year), it takes approximately 3.5 years for consumption in the integrated economy to catch up with that in the autarky economy. The dashed line in Figure 3 illustrates the dynamics of the autarky economy in which no compensation is provided to the representative agent. This economy exhibits the same growth rate as the autarky economy with compensation paid, but starts at a lower level. The comparison of these two economies

gives us a measure of the compensation in terms of permanent consumption. It is straightforward to show that it is equal to the percentage compensation in terms of initial wealth. Thus, the welfare gain of financial integration can also be evaluated at around 13.5% of permanent consumption.

It is of interest to distinguish the welfare gain from financial integration by level of financial integration and by region. It is no surprise that the gain from financial integration is higher for countries that are more financially integrated, because we measure the gain from complete financial autarky to the actual level of financial integration. However, Figure 4 shows that some countries sharing the same level of financial integration do not exhibit the same potential gain. This underscores that the degree of financial integration is not the only component of the welfare gain from financial integration; the nature of financial integration (FDI and debt) and the capacity of the country to benefit from FDI (parameter τ) also matter.

Turning to the gain from financial integration by region reported in Table 4, we see that the welfare gain from financial integration is equal to 10% for Latin American countries compared with around 15% for Asian and 17% for Middle Eastern countries.

The case of China is interesting. According to our calculation, the welfare gain from actual financial integration is rather small in China: only 6.8% of current wealth. This comes from the fact that China is not very financially integrated. If the ratio of foreign capital to domestic capital owned by residents (7%) is only slightly below that of the sample average (8%), the share of domestic capital in total wealth (n_K) is 0.98 (compared to an average of 1.1 in our sample). As a consequence, the welfare gain of FDI is positive for China (around 8.9% of

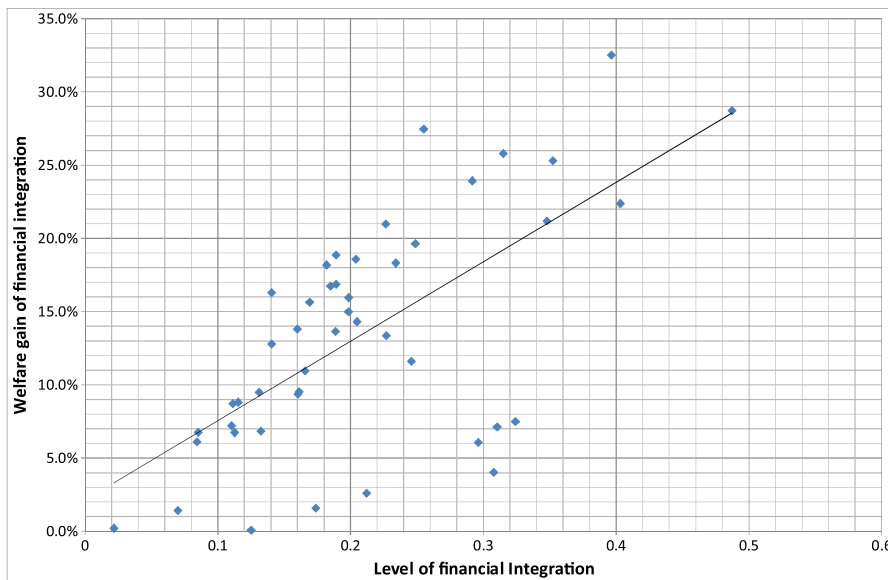


Figure 4. Gains of financial integration and level of financial integration

existing wealth) but the welfare gain associated with access to financial markets is negative (−1.9% of existing wealth) because the country is a net lender on international financial markets at a rate below the domestic return on capital.

5.4. Checking for robustness

5.4.1. Sensitivity to preference parameters and interest rates

To check for the robustness of the above evaluation of the welfare gain from financial integration, we start by modifying preference parameters (risk aversion and intertemporal elasticity of substitution) and international interest rates. Table 5 contains the results. The welfare gain from financial integration is a decreasing function of all these parameters. An international interest rate 2% higher reduces the overall evaluation of the welfare gain from financial integration by 2 percentage points of initial wealth (from 13.5% to 11.5%). A higher risk aversion translates into a smaller welfare gain. This comes from the fact that financial integration, and the foreign borrowing that accompanies it in most emerging economies, increases the volatility of gross national income. As a consequence, the more risk averse the representative agent, the smaller the gain from financial integration. In our calibration, changing the risk aversion parameter from 4 to 2 increases the welfare gain from 13.5% to 13.7%. Finally, a higher intertemporal elasticity of substitution reduces the sensitivity of the marginal propensity to consume with respect to financial integration. Therefore, the larger the intertemporal elasticity of substitution, the smaller the gains from financial integration.

5.4.2. Alternative calibration strategy

So far our calibration strategy has been to consider that, because of borrowing constraints, countries were unable to hold their optimal portfolio. As mentioned previously, given the model parameters and the relatively low volatility in most emerging countries, our model predicted that emerging countries would want to borrow a lot abroad to invest at home. This is not what is observed in the data, which show that emerging countries are indebted in reasonable proportions (with n_K slightly above 1). This discrepancy between observed and predicted

Table 5. Sensitivity to preference parameters and interest rate

	$i^* = 4\%$ $\gamma = 4$ $\varepsilon = 0.5$	$i^* = 6\%$ $\gamma = 4$ $\varepsilon = 0.5$	$i^* = 4\%$ $\gamma = 2$ $\varepsilon = 0.5$	$i^* = 4\%$ $\gamma = 4$ $\varepsilon = 0.9$
# of countries	46	46	46	46
k	13.5%	11.5%	13.7%	13.0%
k^{AFM}	7.3%	6.2%	7.4%	7.1%
k^{FDI}	5.8%	5.0%	5.9%	5.6%
$g^L - g^A$	1.7%	1.5%	1.7%	3.0%
Vol^L / Vol^A	1.34	1.32	1.34	1.34

portfolios could also come from the existence of a risk premium on foreign borrowing. Indeed, we have assumed so far that FDI investors' required rate of return was adjusted for risk (see equation 3), but not on lending that was considered as risk-free for the foreign investor. We now relax this hypothesis and calibrate a risk premium (RP) on emerging country borrowing such that the observed n_K is optimal. Under this risk premium assumption, wealth accumulation becomes:

$$dW = [((1 + \tau\varphi^*)\mu_Y - \delta)K^d + EB(i^* + \mu_E + RP) - (C_D + EPC_M)]dt + (1 + \tau\varphi^*)K^d\sigma_Y dz_Y,$$

and the optimal portfolio share is now given by:

$$n_K = \frac{[(1 + \tau\varphi^*)\mu_Y - \delta - (i^* + \mu_E + RP)]}{\gamma(1 + \tau\varphi^*)^2\sigma_Y^2}. \quad (9)$$

The growth rate of the financially integrated economy is:

$$g^L = [(1 + \tau\varphi^*)\mu_Y - \delta]n_K + (1 - n_K)(i^* + \mu_E + RP) - A^L, \quad (10)$$

with

$$A^L = \varepsilon\rho - n + (1 - \varepsilon)CEq^L, \quad (11)$$

and

$$CEq^L = n_K \left((1 + \tau\varphi^*)\mu_Y - \delta - \gamma n_K (1 + \tau\varphi^*)^2 \frac{\sigma_Y^2}{2} \right) + (1 - n_K)(i^* + \mu_E + RP) - (1 - \theta) \left((\mu_P + \mu_E) - [(1 - \theta)(1 - \gamma) + 1] \frac{\sigma_P^2}{2} \right).$$

Note that equation 3, which expresses the required return on FDI, remains the same.

To calibrate this new version of our model, we keep all the other parameters equal to their value in the previous calibration and calculate the RP that exactly solves equation 9. The risk premium that we obtain on foreign borrowing is given in Table 6. On average, it is around 18% and varies from 0 to 55%. It is smaller for more financially integrated economies (14%) than for less integrated economies (23%).

Table 7 shows that the welfare gain from financial integration is much lower (around 6% of initial wealth) when we introduce a risk premium on foreign borrowing. The decomposition of the welfare gain shows that the gain from FDI is unchanged compared with previous calibration. In contrast, the gain from access to global financial markets becomes a lot smaller, almost negligible. This is not surprising. The risk premium emerging countries have to pay on their debt reduces the benefit they obtain from borrowing. This was not the case in the

Table 6. Calibrated risk premium on foreign debt

Whole sample			Level of financial integration		Region			
Mean	Maximum	Minimum	Below median	Above median	Asia	Latin America	Middle East	Africa
18%	55%	0%	23%	14%	21%	21%	13%	16%

Note that the parameters reported in this table are those derived with common parameters (Table 2) set at the following values: $i^* = 0.04$, $\gamma = 4$, $\varepsilon = 0.5$

Table 7. Welfare gain from financial integration: Risk premium hypothesis

	Whole sample		Level of financial integration		Region			
	Mean	Median	Low	High	Asia	Latin America	Middle East	Africa
# of countries	46		23	23	13	10	8	15
k	6.0%	4.8%	4.9%	6.6%	6.5%	5.1%	6.2%	6.2%
k^{AFM}	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
k^{FDI}	6.0%	4.8%	4.8%	6.5%	6.0%	5.0%	6.1%	6.2%
$g^L - g^A$	0.8%	0.5%	0.9%	0.7%	0.9%	0.9%	0.6%	0.8%
Vol^L / Vol^A	1.34	1.34	1.33	1.29	1.35	1.22	1.42	1.36

previous calibration in which they only bear the riskless international interest rate augmented for currency depreciation.

The effect on growth is the following:

$$\frac{\partial g_L}{\partial RP} = \varepsilon(1 - n_K) + \frac{\partial g_L}{\partial n_K} \frac{\partial n_K}{\partial RP} = \varepsilon(1 - n_K) - n_K$$

$$\frac{\partial g_L}{\partial RP} \leq 0 \quad \text{if } n_K \geq 1.$$

Therefore, the risk premium reduces the growth rate in the financially liberalized country provided the latter is a net borrower. Effects can be decomposed as follows:

- (1) For a given portfolio, the certainty equivalent of the rate of return is smaller for a net borrower; it converts into
 - a direct negative effect on the growth rate (see equation 10)
 - an indirect effect on the growth rate through the propensity to consume (see equations 10 and 11). A smaller certainty equivalent of the rate of return leads to a lower (respectively, higher) propensity to consume if the intertemporal elasticity of substitution is smaller (respectively, larger) than unity, which, in turn, increases (respectively, reduces) the growth

rate. However, the direct effect always prevails and the indirect effect can only mitigate (respectively, strengthen) the negative effect of the risk premium on the growth rate.

- (2) There is a direct effect on the portfolio: the increase in the risk premium reduces the share of domestic capital in wealth (see equation 9), which hinders growth.

6. CONCLUSION

In this paper, we have calibrated a theoretical model in order to appraise the welfare gains from actual financial integration in developing and emerging economies. We provide an upper bound to the gains from financial integration because we focus on the potential benefits and neglect potential losses. Even if significant, potential benefits we have computed are not huge: they represent between 6 and 13.5% of existing wealth depending on the calibration strategy. Once potential losses are accounted for as well, which arise from the possible occurrence of sudden stops in capital inflows (or the insurance against them), it may well be that the net gains from financial integration are not significant. Therefore, our model provides a rationale for econometric findings. More precisely, we obtain that actual financial integration brings on average of between 0.8 and 1.7 percentage points of growth per year. Moreover, we identify gains accruing from FDI and those due to the access to global financial markets. FDI brings a welfare gain of approximately 6% of existing wealth in any country while accessing the global financial markets generates gains that range from 0 to 6% depending on the calibration strategy. Note that it can be very low for some countries.

A first extension of this work would be to consider the losses incurred through financial integration. In particular, it would be useful to model foreign risk and fluctuations in foreign inflows and to investigate the role of foreign exchange reserves. Results obtained could then be directly compared with those of econometrics studies. Another extension could be to observe the effect of FDI on domestic productivity and to account for the additional potential gains they generate.

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APPENDIX

The program to be solved is:

$$\max(1-\gamma)U_t = \left[\left[\frac{C_{Dt}^\theta C_{Mt}^{1-\theta}}{L_0 e^{nt}} \right]^{\frac{\varepsilon-1}{\varepsilon}} dt + e^{(n-p)dt} ((1-\gamma)E_t U_{t+dt})^{\frac{1-\varepsilon}{\varepsilon}} \right]^{\frac{(1-\gamma)\varepsilon}{\varepsilon-1}}$$

$$\text{s.t. } dW = \left[((1+\tau\phi^*)\mu_Y - \delta)K^d + EB(i^* + \mu_E) - (C_D + EPC_M) \right] dt + (dt + (1+\tau\phi^*)K^d \sigma_Y dz_Y).$$

The Bellman function associated with the program is:

$$(1-\gamma)V_t = \underset{\{K_t, B_t, C_{Dt}, C_{Mt}\}}{\text{Max}} \left[\left[C_{Dt}^\theta C_{Mt}^{1-\theta} \right]^{\frac{\varepsilon-1}{\varepsilon}} e^{-\frac{\varepsilon-1}{\varepsilon}nt} dt + e^{(n-p)dt} ((1-\gamma)E_t V_{t+dt})^{\frac{1-\varepsilon}{\varepsilon}} \right]^{\frac{(1-\gamma)\varepsilon}{\varepsilon-1}},$$

where V_t is the value function of the program. We guess a value function of the form:

$$V = A^{\frac{1-\gamma}{1-\varepsilon}} \left(\frac{\theta EP}{1-\theta} \right)^{-(1-\gamma)(1-\theta)} \frac{(\theta W)^{1-\gamma}}{(1-\gamma)} e^{-(1-\gamma)nt},$$

where A is a constant to be calculated.

$E_t[V(W_{t+dt})]$ can be calculated using Itô's lemma:

$$E_t[V(W_{t+dt})] = A^{\frac{1-\gamma}{1-\varepsilon}} \left(\frac{\theta EP}{1-\theta} \right)^{-(1-\gamma)(1-\theta)} \frac{(\theta W)^{1-\gamma}}{1-\gamma} e^{-(1-\gamma)n(t+dt)}$$

$$\left[1 + (1-\gamma) \left((\mu_Y(1+\tau\phi^*) - \delta) \frac{K^d}{W} + \frac{EB}{W} (i^* + \mu_E) - \frac{C_D + EPC_M}{W} \right) dt - \gamma(1-\gamma)(1+\tau\phi^*)^2 \left(\frac{K^d}{W} \right)^2 \frac{\sigma_Y^2}{2} dt - (1-\gamma)(1-\theta)(\mu_P + \mu_E) dt + (1-\gamma)(1-\theta)((1-\gamma)(1-\theta) + 1) \frac{\sigma_P^2}{2} dt \right]$$

Replacing it into the Bellman equation and using the fact that $\lim_{x \rightarrow 0} (1+x)^y = 1+xy$ and $\lim_{x \rightarrow 0} e^{xy} = (1+x)$ leads to:

$$(1\gamma)V_t = \text{Max}_{\{K, B, C_{Dt}, C_{Mt}\}}$$

$$\left[[C_{Dt}^\theta C_{Mt}^{1-\theta}] \frac{\varepsilon-1}{\varepsilon} e^{-\frac{-(\varepsilon-1)}{\varepsilon} nt} \frac{-1}{A \varepsilon} \left(\frac{\theta P}{1-\theta} \right) \frac{-(1-\varepsilon)(1-\theta)}{\varepsilon} \frac{\varepsilon-1}{(\theta W) \varepsilon} \right]$$

$$\left[1 + \frac{\varepsilon-1}{\varepsilon} \left((\mu_Y(1+\tau\phi^*) - \delta) \frac{K^d}{W} + \frac{EB}{W} (i^* + \mu_E) - \frac{C_D + EPC_M}{W} \right) dt - \frac{\gamma(\varepsilon-1)}{\varepsilon} (1+\tau\phi^*)^2 \right. \\ \left. \left(\frac{K^d}{W} \right)^2 \frac{\sigma_Y^2}{2} dt - \frac{(1-\theta)(\varepsilon-1)}{\varepsilon} \left((\mu_{P+} + \mu_E) - ((1-\gamma)(1-\theta) + 1) \frac{\sigma_P^2}{2} \right) dt + \left(\frac{n}{\varepsilon} - p \right) dt \right] \frac{(1-\gamma)\varepsilon}{\varepsilon-1}$$

Maximizing with respect to C_D and C_M leads to:

$$C_{Dt} = \theta AW \\ EPC_{Mt} = (1-\theta)AW.$$

Maximizing with respect to (K^d/W) and (EB/W) subject to the constraint that $K^d + EB = W$ leads to equation 7.

Replacing the optimal consumptions, capital stock and debt stock in the Bellman equation allows us to obtain the expression of the constant A :

$$A^L = \varepsilon\rho - n + (1-\varepsilon)CEq^L \\ CEq^L = n_K \left((1+\tau\phi^*)\mu_Y - \delta - \gamma n_K (1+\tau\phi^*)^2 \frac{\sigma_Y^2}{2} \right) + (1-n_K)(i^* + \mu_E) - (1-\theta) \\ \left((\mu_P + \mu_E) - [(1-\theta)(1-\gamma) + 1] \frac{\sigma_P^2}{2} \right).$$

It then provides equation 8 in the text.

The solution of the program is then:

$$C_{Dt} = \theta AW \\ EPC_{Mt} = (1-\theta)AW \\ n_K = \frac{[(1+\tau\phi^*)\mu_Y - \delta - (i^* + \mu_E)]}{\gamma(1+\tau\phi^*)^2 \sigma_Y^2} \\ dW = [((1+\tau\phi^*)\mu_Y - \delta)K^d + EB(i^* + \mu_E) - (C_D + EPC_M)]dt \\ + (1+\tau\phi^*)K^d \sigma_Y dz_Y.$$

The balance of payments equilibrium is always satisfied:

$$\underbrace{((\mu_Y - \delta)dt + \sigma_Y dz)K - dK - AWdt}_{\text{Trade balance}} - \underbrace{[(1-\tau)(\mu_Y dt + \sigma_Y dz) - \delta]\phi^* K^d + EB(i^* + \mu_E) + \phi^* dK^d - d(EB)}_{\text{Current account}} \\ \underbrace{\hspace{15em}}_{\text{Balance of Payments}} \\ = \underbrace{((\mu_Y - \delta)dt + \sigma_Y dz)K - AWdt - [(1-\tau)(\mu_Y dt + \sigma_Y dz) - \delta]\phi^* K^d + EB(i^* + \mu_E)}_{dW} \\ - \underbrace{(dK^d + d(EB))}_{dW} = 0, \text{ with } K = K^d(1 + \phi^*).$$

In the absence of uncertainty, risk aversion does not exist anymore and the program becomes:

$$\max U_0 = \frac{\varepsilon}{\varepsilon - 1} \int_0^{\infty} e^{(n-p)t} \left[\frac{C_{Dt}^{\theta} C_{Mt}^{1-\theta}}{L_0 e^{nt}} \right]^{(\varepsilon-1)/\varepsilon} dt$$

$$s.t. \quad dW = dW = \left[((1 + \tau\phi^*) - \delta)K^d \mu_Y + EB(i^* + \mu_E) - (C_D + EPC_M) \right] dt,$$

where ε is the intertemporal elasticity of substitution. The Bellman equation associated with the program is:

$$V_t = \underset{\{K, B, C_D, C_M\}}{\text{Max}} \left[\frac{\varepsilon}{\varepsilon - 1} (C_{Dt}^{\theta} C_{Mt}^{1-\theta})^{(\varepsilon-1)/\varepsilon} e^{\frac{1-\varepsilon}{\varepsilon} nt} dt + e^{(n-p)t} V_{t+dt} \right].$$

We guess a value function of the form:

$$V_t^A = A^{d-1/\varepsilon} \left(\frac{\theta EP}{1-\theta} \right)^{\frac{(1-\varepsilon)(1-\theta)}{\varepsilon}} \frac{\varepsilon}{\varepsilon - 1} (\theta W)^{(\varepsilon-1)/\varepsilon} e^{\frac{1-\varepsilon}{\varepsilon} nt},$$

where A^d is a constant to be calculated. One can compute:

$$V_{t+dt}^A = \frac{\varepsilon A^{d-1/\varepsilon}}{\varepsilon - 1} \left(\frac{\theta EP}{1-\theta} \right)^{\frac{(1-\varepsilon)(1-\theta)}{\varepsilon}} (\theta W)^{\frac{(1-\varepsilon)}{\varepsilon} nt} \left(1 + \left(\frac{\varepsilon - 1}{\varepsilon} \right) \left(\frac{dW}{W} - ndt \right) - \left(\frac{dE}{E} + \frac{dP}{P} \right) (1 - \theta) \right).$$

Replacing it into the Bellman equation and using the fact that $\lim_{x \rightarrow 0} (1+x)^y = 1 + xy$ and $\lim_{x \rightarrow 0} e^x = (1+x)$ leads to:

$$0 = \underset{\{n_K, C_{Dt}, C_{Mt}\}}{\text{Max}} \left[\frac{\varepsilon}{\varepsilon - 1} (C_{Dt}^{\theta} C_{Mt}^{1-\theta})^{\frac{\varepsilon - 1}{\varepsilon}} + A^{d-1/\varepsilon} \left(\frac{\theta EP}{1-\theta} \right)^{\frac{(1-\varepsilon)(1-\theta)}{\varepsilon}} (\theta W)^{1-1/\varepsilon} \right. \\ \left. \left(- \left(\frac{C_D + EPC_M}{W} \right) + ((1 + \tau\phi^*)\mu_Y - \delta)n_K + (1 - n_K)(i^* + \mu_E) - (1 - \theta)(\mu_E + \mu_P) \right. \right. \\ \left. \left. + \frac{n - \varepsilon\rho}{\varepsilon - 1} \right) \right].$$

Maximizing with respect to C_D and C_M leads to: $C_{Dt} = \theta A^d W$ and $EPC_{Mt} = (1 - \theta) A^d W$.

Maximizing with respect to n_K leads to $(1 + \tau\phi^*)\mu_Y - \delta = (i^* + \mu_E)$, which is the interest rate parity.

Replacing the optimal consumptions, capital stock and debt stock in the Bellman equation allows us to obtain the expression of the constant A :

$$A = \varepsilon\rho - n + (1 - \varepsilon)[i^* + \mu_E - (1 - \theta)(\mu_E + \mu_P)].$$

Table A. Set of 46 countries

23 countries with Financial integration below or equal to median		23 countries with Financial integration above median	
Argentina	Ecuador	Benin	Namibia
Bangladesh	Gabon	Central African Republic	Philippines
Bhutan	Guatemala	Costa Rica	Senegal
Botswana	Iran	Ethiopia	South Africa
Brazil	Nepal	Ghana	Sri Lanka
Burkina Faso	Niger	India	Syria
Cambodia	Pakistan	Indonesia	Tanzania
Cape Verde	Malaysia	Jordan	Thailand
China	Peru	Lebanon	Tunisia
Colombia	Venezuela	Lesotho	Turkey
Comoros	Yemen	Mexico	Vietnam
Dominican Republic		Morocco	
