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The Elusive Gains from International Financial Integration

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The Elusive Gains from International Financial Integration

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Abstract

Standard theoretical arguments tell us that countries with relatively little capital benefit from financial integration as foreign capital flows in and speeds up the process of income convergence. We show in a calibrated neoclassical model that conventionally measured welfare gains from this type of convergence appear relatively limited for developing countries. The welfare gain from switching from financial autarky to perfect capital mobility is roughly equivalent to a 1 percent permanent increase in domestic consumption for the typical non-OECD country. This is negligible relative to the welfare gain from a take-off in domestic productivity of the magnitude observed in some of these countries.

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Contents Page

I. Introduction

Ask an economist about the benefit of international financial integration, and what first comes to his or her mind is likely to involve, in one way or another, the efficiency of laissez-faire. A more open and competitive international capital market induces a more efficient international allocation of capital. A development economist, in particular, will point to the impact of capital flows from developed (capital-abundant) to developing (capital-scarce) countries on economic growth and income convergence. Indeed, one of the main motivations behind the push toward the international financial integration of developing countries has been to accelerate their growth by attracting foreign capital.[2]

We understand these benefits well enough in theory, but how large are they in practice? This paper presents a new piece of evidence, based on the calibration of a simple neoclassical growth model. There is an extensive literature measuring the welfare benefits of international financial integration in calibrated models, but so far it has focused on the benefits in terms of risk sharing.[3] Here we focus instead on the benefits that capital-scarce countries receive from inflows of foreign capital. To the best of our knowledge, this paper is the first one to estimate these benefits of international financial integration for emerging market economies in the neoclassical growth model.[4]

We present two versions of the neoclassical model. The first and simplest one is a variant of the Ramsey-Cass-Koopmans model where countries accumulate physical capital only. It serves to motivate and provide some intuition for our results. The second one proposes a higher level of detail and realism by introducing human capital accumulation in a "Macro-Mincer" framework. Our main finding is that while financial openness increases domestic welfare, and while this benefit can be significant for some countries, it is not very large on average. For the typical developing country, the welfare gain from switching from complete financial autarky to perfect capital mobility is equivalent to a permanent increase in consumption of about 1 percent. This benefit is of an order of magnitude smaller than the gains that development economists and

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[2]See Eichengreen and Mussa (1998, p.12): "The classic case for international capital mobility is well-known but worth restating. Flows from capital-abundant to capital-scarce countries raise welfare in the sending and receiving countries alike on the assumption that the marginal product of capital is higher in the latter than in the former. Free capital movements thus permit a more efficient global allocation of savings and direct resources toward their most productive uses." According to Fischer (1998, p.2): "Put abstractly, free capital movements facilitate an efficient global allocation of savings and help channel resources to their most productive uses, thus increasing economic growth and welfare."

[3]See Athanasoulis and van Wincoop (2000) for a discussion of this literature.

[4]Some papers have estimated the same type of benefit as we do here, but with a focus on developed economies. For example, Mendoza and Tesar (1998) find that the welfare benefit of integration is relatively small for the United States—less than 0.5 percent of permanent consumption.

policymakers seek to achieve. For example, we show that it is negligible relative to the welfare gain from a take-off in domestic productivity of the magnitude observed in some countries.

Interestingly, we find that the gains from international financial integration may be relatively small even for countries that stand to receive a lot of capital inflows. In the simple Ramsey model, for example, a country gains only 1 percent of current consumption from capital inflows that more than double its capital stock. This apparent disconnect comes from the essentially transitory nature of the distortion induced by imperfect capital mobility. A capital-scarce country that restricts the entry of foreign capital bears a distortion that is proportional to the wedge between the domestic and foreign returns on investment. Even if the capital account restriction remains in place forever, the distortion endogenously vanishes over time as the country accumulates capital domestically. The average distortion, as a result, is much lower than the initial distortion—and the initial capital inflows–might suggest.

We believe that our findings have important implications for the research agenda on financial globalization. This paper suggests that *if* the benefits of international financial integration are large, they must occur through channels that are not in the textbook neoclassical growth model. Moreover, these channels can explain large gains (in our metric) only if international financial integration raises the level of productivity or reduces the level of distortion in developing countries.[5] For example, our calibrations suggest that international financial integration would yield a welfare benefit more than 50 times larger than the benchmark neoclassical gain if it eliminated 25 percent of the productivity gap with the United States.[6] However, most of this benefit would occur because of the *indirect* effects of integration, not because of the increase in the size of capital flows per se.

This paper contributes to a growing literature on the benefits of capital account liberalization for developing countries. A number of papers have attempted to answer the same question as we do, but on the basis of cross-country regressions. The results are heterogeneous, ranging from no impact of capital account opening on growth (Rodrik, 1998) to a more or less significant positive impact (see Edison and others, 2002, for a review). At the optimistic end of the spectrum, Bekaert, Harvey, and Lundblad (2002) and Henry (2003) find that opening the stock market to foreign investors boosts growth by 1 to 2 percent for five years in a row. Such a result, however, is not obvious to translate in terms of domestic welfare. How permanent is the impact of capital account opening on growth? Is the level of output affected in the long run? What share of the output increase is transferred to foreign investors? These questions are crucial in assessing the welfare

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[5]There is a superficial analogy between our results and some conclusions of the literature on trade liberalization. In calibrated neoclassical models the gains from trade liberalization typically amount to less than 1 percent of GDP (de Melo and Tarr, 1992). This has led some authors to conclude that if free trade yields large welfare gains, it must be because of its indirect impact on productivity (Rutherford and Tarr, 2002).

[6]This could occur, for example, because of technological spillovers associated with foreign direct investment (FDI) or an improvement in the allocation of domestic saving induced by financial liberalization. These and other channels are discussed in more detail in the concluding section.

impact of capital account opening, and can be addressed only by looking at the data through the lenses of an explicit model.

Our results are consistent with the recent developments in the literature on growth and convergence in an international perspective. In contrast with early papers that stressed factor accumulation as a source of growth (Mankiw, Romer, and Weil, 1992; Barro, Mankiw, and Sala-i-Martin, 1995), the literature has moved toward the view that total factor productivity accounts for most of income differences across countries (Hall and Jones, 1999; Easterly and Levine, 2001).

This literature has not looked at the impact of international financial integration on growth and convergence. Our contribution here is twofold. First, our approach captures the different sources of cross-country inequality that have been discussed in the literature and combines them in the context of a single optimizing framework in which the rates of factor accumulation are endogenous. This endogeneity is crucial for our purpose, since the main role of financial integration here is to accelerate the accumulation of physical capital. Second, we present a "development accounting exercise" that highlights the relative contributions of factor accumulation, productivity, and a conditional convergence gap that financial integration eliminates. We show that although countries may be far from their steady state, conditional convergence plays a minor role compared to differences in distortions and productivity in explaining the development gap between poor and rich countries. One implication is that international financial integration can equalize the marginal return of capital across countries without closing the large gaps in productivity and income per capita between poor and rich nations.

The paper is structured as follows. Section II presents results based on a very stylized neoclassical model. Section III presents an extension of the model with endogenous human capital accumulation and various distortions, and interprets our results in the context of a decomposition of world inequality in output per capita. Section IV concludes with a discussion of the implications of this paper for future research.

II. A SIMPLE EXPERIMENT

Consider a small Ramsey-Cass-Koopmans economy that can accumulate physical capital using the savings of its residents and by attracting capital from abroad. The country is small relative to the rest of the world in the sense that the capital account regime has no impact on the world return on capital. Our "experiment" assesses the benefits of international financial integration for this economy by comparing two extreme cases: a state of *complete financial autarky* in which the country has to rely purely on domestic savings to accumulate capital, and a state of *perfect financial integration* in which the country can import or export capital at the (given) world interest rate.

We assume that there are no impediments to financial flows under financial integration. This maximizes the welfare benefits from integration, since capital movements will fully and immediately arbitrage away any difference in marginal returns to capital. While the associated dynamics are trivial, this represents, we believe, a simple and transparent case where the gains from international financial integration are potentially large.

Because of its theoretical simplicity, this experiment provides a useful benchmark to start with. The next section will incorporate the insights of the recent literature on convergence and growth in an international perspective, to obtain a more realistic measure of the benefits of international financial integration for a large sample of emerging economies. As we will see, our results are surprisingly robust to these extensions.

A. The Model

We consider a world with one homogeneous good and a number of countries. In this world, we focus on a subset of small developing countries that may or not open their capital account. Time is discrete and there is no uncertainty. The population grows at an exogenous rate n: $N_t = n^t N_0$ that is country specific. The population of each country can be viewed as a large family that maximizes the welfare function,

$$U_t = \sum_{s=0}^{\infty} \beta^s \, N_{t+s} \, u\left(c_{t+s}\right), \tag{1}$$

where c_t is consumption *per capita* and $u(c) \equiv c^{1-\gamma}/\left(1-\gamma\right)$ is a constant relative risk aversion (CRRA) instantaneous utility function with coefficient $\gamma > 0$. In the case where $\gamma = 1$, the utility function is $u(c) = \ln(c)$.

The domestic economy produces the homogeneous good according to the Cobb-Douglas production function,

$$Y_t = K_t^{\alpha} \left(A_t L_t\right)^{1-\alpha},$$

where K_t denotes the stock of domestic capital, L_t is labor supply and A_t is a labor-augmenting measure of productivity. Labor supply is exogenous and proportional to population ($L_t = N_t$). Factor markets are perfectly competitive. Labor productivity grows at a gross rate $g_t \equiv A_t/A_{t-1}$, which may differ across countries in the short run but converges towards the same value for all countries[7]

$$\lim_{t \to +\infty} g_t = g^*. \tag{2}$$

This is a common assumption in the empirical growth literature (Mankiw and others, 1992). The common asymptotic growth rate g^* reflects the advancement of knowledge, which should not be country specific in the long run. If growth rates of productivity differed permanently across countries, the world income distribution would diverge without bounds and the country or region with the highest long-run growth rate would overtake world output. Some mechanism, such

[7]We assume further that $\beta n g^{*(1-\gamma)} < 1$ so that the utility is well defined.

as innovation and technology transfers, must constrain the tendency toward infinite divergence (Eaton and Kortum, 1999; Parente and Prescott, 2000).

However, countries could differ in their growth rate of productivity in the short run, or in their levels of productivity A in the long-run. Differences in productivity growth underlie recent "growth miracles." Differences in productivity levels reflect, as Mankiw and others (1992) mention, "not just technology but resource endowments, climate, institutions, and so on" (p. 411). Hall and Jones (1999) ascribe these differences in productivity levels to differences in institutions and government policies, which they call "social infrastructure."

Under **financial autarky,** each country accumulates capital domestically. The neoclassical framework predicts that the economy will converge toward a balanced growth path in which capital, output, and consumption per capita asymptotically grow at the same rate as productivity. We denote with tildes the variables normalized by the level of productivity, i.e., $\tilde{x}_t = x_t/A_t$. It follows from the Euler equation for consumption, $u'(c_t) = \beta R_{t+1} u'(c_{t+1})$, that

$$\tilde{c}_t = (\beta R_{t+1})^{-1/\gamma} g_{t+1} \tilde{c}_{t+1}, \tag{3}$$

so that in the long-run the return on domestic saving is given by

$$R^* = g^{*\gamma}/\beta. \tag{4}$$

R^* is the *natural* level of the gross rate of interest. It is the same for all countries.

Taking the limit of the first-order condition for capital $R_t = \alpha \tilde{k}_t^{\alpha-1} + 1 - \delta_k$ (where δ_k is the depreciation rate of capital) gives the asymptotic level of productivity-adjusted capital

$$\lim_{t \to +\infty} \tilde{k}_t = \tilde{k}^* = \left(\frac{\alpha}{R^* + \delta_k - 1} \right)^{1/1-\alpha}, \tag{5}$$

which is also the same for all countries.

Under **financial integration,** domestic agents can lend or borrow at the gross world interest rate. We assume that the rest of the world is composed of developed countries that have already achieved their steady state. Under that assumption, the world interest rate is equal to the natural gross rate of interest, R^*, and financial integration does not "tilt" permanently consumption profiles.[8] The Euler equation, $c_t = (\beta R^*)^{-1/\gamma} c_{t+1}$, implies that domestic consumption per capita grows at rate g^* as soon as the country is financially integrated. The first-order equation for capital implies that $\tilde{k}_t$ jumps immediately to its long-run level $\tilde{k}^*$.

The assumption that the world interest rate and the natural interest rate coincide has one important implication. The long-run levels of capital and output per capita are the same under autarky and financial integration. These levels may differ across countries because of persistent differences

[8]We are interested in measuring the benefits of international financial integration that stem from capital scarcity, not from intrinsic and permanent differences in the natural rate of interest between countries.

in productivity levels, but they are not affected by the capital account regime. This is a general property of the neoclassical framework: the effect of integration is to *accelerate* the country's convergence towards a steady growth path that is determined by other factors.

We measure the gains from international financial integration as follows. Let us denote by U_{aut} and U_{int} the domestic welfare of the representative agent at time 0 under financial autarky and financial integration respectively. By the first welfare theorem we know that domestic welfare is higher under financial integration than under autarky. In the following discussions, we report the Hicksian equivalent variation μ, defined as the percentage increase in the country's consumption that brings domestic welfare under autarky up to its level under integration:

$$\mu = \left(\frac{U_{int}}{U_{aut}}\right)^{\frac{1}{1-\gamma}} - 1, \tag{6}$$

if $\gamma \neq 1$, and $\mu = \exp((1 - n\beta)(U_{int} - U_{aut})) - 1$ if $\gamma = 1$.

B. Calibration and Results

In order to compute a country's welfare gains from integration in year 0, we need the path of future productivities $(A_t)_{t\geq 0}$. We make the simple assumption that productivity grows at the long-run rate g^* from year 0 onwards. The gain from integration can then be computed for any initial capital-output ratio k_0/y_0 conditional on the values of the parameters given in Table 1. The parameters are calibrated by reference to United States data. We set $g^* = 1.012$ in line with long run multifactor productivity growth in the United States, and a population growth rate of 0.74 percent per annum, consistent with United States population growth. While the assumption that the capital share is constant across countries is certainly too strong, recent estimates by Gollin (2002) suggest that the Cobb-Douglas assumption is roughly appropriate, with an estimated capital share between 0.2 and 0.4. Accordingly we set $\alpha = 0.3$. We assume a rate of depreciation of physical capital equal to 6% per annum as in Heston and Summers (1991). With these assumptions, the world real interest rate is equal to $R^* = 1.0542$ and the steady state capital-output ratio k^*/y^* is equal to 2.63.

Figure 1 reports the welfare gains μ as a function of the initial capital-output ratio, along with a vertical line for the the steady state capital-output ratio.[9] The figure delivers a stark message: since the curve is very flat around k^*/y^*, a country must have a very low or a very high capital-output ratio to significantly benefit from international financial integration. The capital-output ratio must fall below 1.29 or exceed 4.38 for the gains from integration to exceed 2 percent of annual consumption. In order to get a rough order of magnitude, we use the Heston, Summers, and Aten (2002) Penn World Tables Mark 6.1 (PWT) to construct capital stocks in 1995 for 82 countries.[10] We find a capital-output ratio ranging from 0.23 for Uganda to 3.28 for Singapore,

[9]Countries with low initial capital also have low capital-output ratio since $k/y = \tilde{k}^{1-\alpha}$.

[10]See next section for more details on how we construct capital stocks.

with a population weighted sample average equal to 1.40. According to Figure 1, the potential welfare gain associated with this sample average is equal to 1.67 percent of annual consumption.[11]

As a first point of comparison, we note that this is of the same order of magnitude as the quantitative estimates of the benefits of international financial integration in terms of risk sharing. These estimates are based on calibrated models, comparable to ours since they are expressed in the same metric. The reported results vary enormously, with most papers finding gains from international risk-sharing smaller than 0.5 percent of consumption (e.g., Backus, Kehoe, and Kydland, 1992) and some studies reporting larger welfare gains (see, e.g., Obstfeld, 1994). The theoretical welfare gains from international risk-sharing are estimated to be somewhat larger when the model is calibrated with reference to developing economies because they are more volatile (see Pallage and Robe, 2004). Another point of comparison is the empirical public finance literature establishing the incidence of taxes (Mendoza and Tesar, 1998). This literature typically finds welfare effects that are a fraction of 1 percent.

As mentioned in the introduction, the empirical literature on the benefits of capital account liberalization often focuses on domestic output growth. We can use our model to revisit this issue. Table 2 reports the increase in output growth predicted by the model at various horizons and for values of the capital-output ratio between 0.23 and 2.0. The large increase in output growth at a one-year horizon reflects the absence of any friction in the capital market. More realistically, the table shows that at the 5-year horizon the gain in output growth can be substantial, in excess of 2.7 percent per year on average for capital-output ratios below 1.4. The empirical literature reports somewhat smaller gains. For instance, Bekaert et al. (2002) find a 1 percent higher growth rate of output after 5 years, following an equity market liberalization. This is comparable to the increase in growth that would result from integration starting from a capital-output ratio slightly higher than 2.0 in our model. In light of our calculations, such a growth improvement might have a small benefit in terms of domestic welfare.

C. Intuition

It may come as a surprise that the gains from international financial integration are so low, even for countries that stand to receive large capital flows. For example, a country with a capital ratio $\widetilde{k}/\widetilde{k}^*$ of 0.5 increases domestic welfare by only 1.06 percent of annual consumption by opening its capital account, even though the stock of domestic capital is doubled at the time the capital account is opened.

In order to understand this result, one has to bear in mind the essentially transitory nature of the distortion induced by imperfect capital mobility. A capital-scarce country that restricts the entry of foreign capital bears a distortion that is proportional to the wedge between the domestic and foreign returns on investment. Even if the capital account restriction remains in place forever, the distortion endogenously vanishes over time as the country accumulates capital domestically. The

[11]Next section will propose more refined estimates. Here, we simply want to offer a reasonable order of magnitude.

average distortion, as a result, is much lower than the initial distortion—and the initial capital inflows—might suggest.[12]

From that point of view, there is a significant difference between our results and those of the calibrated literature on the welfare effects of trade liberalization. The small welfare gains in that literature—sometimes referred to as the "Harberger constant"—arise from the elimination of a small but permanent "triangular" distortionary loss. By contrast, the distortionary loss induced by imperfect capital mobility is initially large but converges to zero over time, as countries converge toward the same steady-state level of capital under autarky as under integration. The distortionary loss is small *in average* even though it could be initially much larger. In particular, the intertemporal distortionary loss is much smaller than the size of the capital inflows unleashed by financial integration might suggest.

To make this point more formally, we derive a simple expression for the welfare gain from a *marginal* increase in international financial integration. Let us assume that in a capital-scarce country, a central planner authorizes the entry of a marginal amount of foreign capital $d\kappa_{t+1}$ at time t (by relaxing quantitative capital controls, say). This increases the equilibrium real wage and decreases the return on domestic savings. By the envelope theorem, we know that the net welfare gain from the marginal capital inflow is the same as if $d\kappa_{t+1}$ were invested at time t and the resulting increase in domestic net income were consumed in period $t+1$. The welfare gain at time $t+1$ can be written as[13]

$$dU_{t+1} = u'(c_{t+1})(R_{t+1} - R^*)d\kappa_{t+1}.$$

The marginal increase in period $t+1$ domestic net income is $dy_{t+1} - R^* d\kappa_{t+1}$, where the increase in domestic output, dy_{t+1}, is equal to the marginal return to capital, R_{t+1}, times the capital inflows, $d\kappa_{t+1}$. The welfare gain from a small capital inflow in terms of current consumption is equal to the return differential between the country and the rest of the world times the capital inflow.

One can view financial integration at time 0 as the result of an incremental process in which the social planner continuously relaxes the capital controls in all periods. Assume that at time 0 all the subsequent authorized capital inflows are increased by a small fraction of consumption, i.e. $d\kappa_{t+1} = c_{t+1}dc/c$. With log-preferences, the equivalent variation is approximately:[14]

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[12]Assuming a family with infinitely lived agents yields a welfare criterion that averages the short-term and the long-term impact of financial integration. The welfare analysis would be more ambiguous with overlapping generations—as the early and late generations would be affected in different ways by integration.

[13]Population growth is assumed away for simplicity.

[14]See Appendix I.

$$\mu \approx \beta \left(\hat{R} - R^*\right) \frac{dc}{c}, \tag{7}$$

where $\hat{R} \equiv (1-\beta) \sum_0^\infty \beta^t R_{t+1}$ represents the *permanent value* of the domestic interest rate.

For example, starting from a capital-output ratio of 1.4, the initial domestic return on capital is 15 percent, 10 percent above the world interest rate.[15] But the domestic return converges toward the world interest rate, and the permanent value $\hat{R}$, at 6.88 percent, is only 1.46 percent higher than the world interest rate. Equation (7) then implies that starting from autarky, a marginal capital inflow equal to 1 percent of domestic consumption yields a welfare benefit equivalent to 0.014 percent of consumption (0.96*0.0146). Thus, the benefit of a capital inflow in terms of welfare is a very small fraction of its face value.

The small size of the gains comes in part from the speed at which the return differential decreases over time, which is directly related to the conditional speed of convergence toward the steady state. As is well-known, the convergence speed in the benchmark Ramsey model is excessively high. With our parameters, the speed of convergence—measured as the fraction of the output gap that is eliminated every year—is 11.49 percent.[16] This is much larger than the 2—3 percent reported by Barro and Sala-i-Martin (1992), although inside the 8—13 percent range estimated by Caselli, Esquivel, and Lefort (1996), who correct some biases in earlier estimation methods. Given that the model's speed of convergence is close to the highest estimates obtained in the literature, we will test the robustness of our results to modifications of the model that reduce the speed of convergence. This will also be one of the motivations for introducing human capital in the model of the next section.

D. Robustness

How sensitive are our estimates to parameter assumption? For instance, our results are derived under log preferences. One could argue that lower elasticities of intertemporal substitution would increase the gains from financial integration by lowering welfare under autarky. However, a smaller elasticity of intertemporal substitution also makes households more reluctant to accumulate capital. This increases the long-run natural world interest rate $R^* = g^{*\gamma}/\beta$, lowers our estimates of the capital gap for a given initial capital stock, and, consequently, lowers the potential gains from financial integration. We report in Table 3 the welfare gains as we vary the Elasticity

[15] This seems consistent with some estimates of the return to investment in developing countries. For example, Isham and Kaufman (1999) find that the average economic rate of return on private projects financed by the World Bank is 14 percent.

[16] The speed of convergence defined locally around the steady state is equal to $(\delta_k + ng^* - 1)(1-\alpha)$, or 5.56 percent with the parameters in Table 1. This measure is not appropriate, however, since we want to consider potentially large deviations from steady state. The figure of 11.49 percent reported in the text is computed numerically from the nonlinear model, assuming an initial capital-output ratio of 1.61 corresponding to a capital gap k/k^* of 50 percent.

of Intertemporal Substitution (EIS) between 1 and $1/10$. As expected, lower values of the EIS are associated with higher equilibrium interest rates, and smaller capital gaps.[17] Overall, the gains do not decrease monotonically with the elasticity of intertemporal substitution. In fact, for an initial capital-output ratio of 1.4, the welfare gains decline for γ larger than three.

The capital share plays an important role in our calculations. It influences the speed of convergence of the economy toward its steady state as well as the equilibrium level of output per capita. Mankiw et al. (1992) argue that the neoclassical model performs relatively well, once one adopts a broad definition of capital. They suggest that the appropriate capital share may be closer to 0.6 than 0.3. With $\alpha = 0.6$, the convergence speed drops to 4.61 percent, much closer to the empirical estimates. Table 3 reports welfare estimates for that value of the capital share. We find larger estimates of the welfare benefits, especially for very low initial capital levels. The gains increase from almost 11 percent to 58 percent of annual consumption when the capital-output ratio is as low as 0.23, and from 0.4 to 1.2 percent when the initial capital output ratio is 2.0. Given the evidence on factor shares reported by Gollin (2002), it is somewhat unsatisfactory to assume that the share of physical capital is as high as 0.6 on average. Instead, in the next section we present a model where both physical and human capital can be accumulated, yielding smaller convergence rates.

Lastly, our benchmark analysis assumes the same population growth rate as in the United States. Yet, many industrializing countries have significantly faster population growth rates. Using the World Bank development indicators, we estimate an average population growth rate of 2.32 percent for non-OECD economies between 1985 and 1995. As Table 3 shows, the welfare gains are roughly one third smaller, as population growth dilutes capital accumulation.

III. Extending the Basic Model

We now augment the model of Section II in two ways. First, we introduce human capital accumulation. Second, we allow for domestic distortions in the accumulation of physical and human capital.

Human capital is a basic element in growth theory. Differences in educational attainment, or schooling rates translate into a more or less productive labor force and have long been described as a key element in cross-country income differences. Second, human capital makes the transition dynamics more realistic, both under financial integration—where the dynamics are no longer trivial—and under autarky —where the accumulation of human capital slows down the convergence toward the steady state. Finally, human capital accumulation is a channel through which domestic productivity is *endogenous* to the capital account regime. Faster accumulation of physical capital could accelerate the accumulation of human capital, in particular by increasing the real wage.

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[17]This puts some discipline on which elasticity of intertemporal substitution one should choose. For instance, with $\gamma = 10$, we find an implausible natural interest rate of 17.36 percent.

The motivation for introducing distortions in the accumulation of physical and human capital is to give a better account of observed cross-country differences in investment rates. The previous section assumed that differences between countries are summarized by their initial level of productivity A_0 and the growth rate of population n. This implies relatively small cross-country differences in investment rates. For instance, the model of the previous section predicts steady-state physical investment rates between 20.8 and 29 percent for non-OECD countries. This is at odds with the data, where average investment rates from 1985 to 1995 range from 2.80 percent (Madagascar) to 41.40 percent (Singapore). Similarly, distortions in the accumulation of human capital allow us to account for observed educational attainments ranging from 0.7 years (Mali) to 10.1 years (South Korea).[18]

A. Model

We assume that the labor employed in production L_t is homogenous and has been trained with E_t years of schooling, which we will interpret as educational attainment. As a result, the domestic economy produces according to a "Macro-Mincer" Cobb-Douglas production function:

$$Y_t = K_t^{\alpha} \left(A_t' H_t\right)^{1-\alpha},$$

where A_t' reflects the exogenous, nonhuman-capital-related, determinants of productivity and H_t denotes the amount of human-capital augmented labor used in production:

$$H_t = e^{\phi(E_t)} L_t.$$

The function $\phi'(E)$ represents the marginal return to schooling estimated in a Mincerian wage regression.

Human capital accumulation depends upon the fraction of time devoted to education, s_t, according to

$$E_{t+1} = (1 - \delta_e) E_t + \theta s_t, \tag{8}$$

where δ_e is a depreciation rate for human capital and θ captures the *efficiency of the domestic schooling* technology and accounts for steady state differences in educational attainment. This perpetual inventory specification is consistent with existing empirical work on human capital stocks (see Barro and Lee, 1993). Because the problem is not concave in the level of educational attainment, we must impose bounds on s to avoid corner solutions in which the country invests 100 percent or 0 percent of its time in education. We impose that $0 \leq \underline{s} \leq s \leq \bar{s} < 1$. Finally, labor market clearing implies $L_t = (1 - s_t) N_t$.

Investment in domestic capital is implicitly distorted at rate τ, so that the private return to domestic capital is $(1 - \tau) R_t$. We refer to τ as the *capital wedge*. This parameter allows us to match the observed disparity in saving rates across countries. Parameter τ is a shorthand for all the distortions that potentially affect the return to domestic capital: credit market imperfections,

[18] Easterly, Kremer, Pritchett, and Summers (1993) report that accumulation rates for physical and human capital are very persistent across decades.

taxation, expropriation, bureaucracy, bribery, and corruption. Different models would have different implications for the implicit rents generated by the distortion, $z_t \equiv \tau R_t k_t$. For simplicity, we assume that they are rebated in a lump-sum fashion to the representative agent. In this manner, we focus exclusively on the distortive aspects of the capital wedge.

The model with human capital is solved in Appendix I in the case where catchup is limited to human capital ($A'_t = A'_0 g^{*t}$). The main features of the equilibrium are preserved. Whether the capital account is open or closed, the economy converges toward the same steady growth path with a constant level of human capital per capita, and a level of physical capital per capita that grows at rate g^*.[19] In the long run, the fraction of time devoted to education, s^*, the educational attainment E^*, and human capital per capita h^* are all increasing functions of the schooling efficiency θ. Physical capital per capita is proportional to productivity A', and to human capital per capita h^*, with a coefficient of proportionality that is a decreasing function of the capital wedge τ.

Along the transition, the investment in human capital is bang-bang under financial integration in the sense that $s = \underline{s}$ ($s = \overline{s}$) if human capital is above (below) its long-run level. It follows that human capital converges to the steady state level in finite time.

To illustrate the effect of human capital accumulation, Figure 2 reports the convergence paths to the steady state for education, consumption, physical and human capital, for an economy calibrated to the United States when $k_0 = 0.5k^*$ and $E_0 = 0.6E^*$.[20] The convergence trajectories are very different depending upon the capital account regime. In this example, the country has initially relatively more human than physical capital. Under autarky, it is optimal to concentrate on accumulating physical capital. Hence the schooling rate s and consumption c are low, while capital accumulates rapidly. Under financial integration, by contrast, it is always optimal to accumulate human capital as rapidly as possible. Intuitively, the country can accumulate human capital without sacrificing domestic consumption by contracting a "student loan" with the rest of the world.

Figure 2 illustrates that financial opening need not be associated with large capital inflows, at least initially. In this particular example, there are no capital inflows or outflows at time 0. On the other hand, when human capital reaches its steady state, a large quantity of labor becomes available for production and attracts correspondingly large amounts of capital. The figure also illustrates that long run consumption under integration c_0 is lower than steady state consumption under autarky c^*.

Human capital accumulation slows down convergence toward the steady state. Figure 3 presents the convergence paths for output under autarky in the simple model of section 2 (black solid

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[19]Integration makes only one difference in the long run: domestic consumption is lower under integration than under autarky because of the flow of interest payments to the rest of the world. See Appendix I.

[20] The parameters are set to the U.S. economy: $\tau = 0.66\%$; $\theta = 1.28$; $n = 0.73\%$; $\delta_e = 2.76\%$. These values imply $\tilde{k}^* = 9.62$, $s^* = 0.29$ and $E^* = 13.49$. We also impose $\underline{s} = 0$ and $\bar{s} = 0.5$.

line) as well as the models of section 3 with and without domestic distortions (dashed and blue solid line respectively). To construct this figure, we set initial physical and human capital so that the initial output ratio is 0.9.[21] It is apparent that convergence is much slower with human capital accumulation, with or without distortions. The speed of convergence decreases from 11.16 percent in the model without human capital to 3.67 and 3.21 percent respectively in the model with and without domestic distortions. These convergence speed are reasonably close to the lower range of existing empirical estimates (Barro and Sala-i-Martin, 1992).

B. Calibration and Results

Our model captures the two main sources of cross-country inequality and convergence that have been discussed in the literature: first, the accumulation of physical and human capital (Mankiw et al., 1992; Chari, Kehoe and McGrattan, 1997)[22] and, second, total factor productivity (Hall and Jones, 1999; Klenow and Rodriguez-Clare, 1997). In addition, our model puts all these factors together in the context of a single intertemporal optimizing framework in which the rates of factor accumulation are endogenous. The endogeneity of the rates of accumulation is crucial for our pupose since the benefit of international financial integration is to accelerate the accumulation of capital.

Thus, we can calibrate the model by combining together the different sources of evidence that have been used in the previous literature. The country levels of productivity and (physical and human) capital are calibrated like in the development accounting literature—see Bils and Klenow (1990); Hall and Jones (1999). The rates of distortion τ and θ are calibrated by matching the historical rates of accumulation of physical and human capital.

We estimate the welfare gains of financial integration for 65 non-OECD countries with annual data in 1995.[23] Each country is characterized by a constant population growth rate n, an initial

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[21] The corresponding initial ratios are respectively: $k_0/k^* = 0.70$ for the model with physical capital only, $k_0/k^* = E_0/E^* = 0.90$ for the model without distortions, and $k_0/k^* = E_0/E^* = 0.82$ for the model with distortions.

[22] Mankiw et al. (1992) and Chari et al. (1997) argue that cross-country inequality is due to differences in the rates at which human and physical capital are accumulated. Chari et al present an intertemporal dynamic optimization model in which the accumulation of physical and human capital is affected by a distortion.

[23] The selection is based on OECD membership at the beginning of the time period, so our sample includes three current OECD members, Mexico, Korea, and Turkey. The 65 countries are Algeria, Argentina, Bangladesh, Barbados, Benin, Bolivia, Botswana, Brazil, Cameroon, Central African Republic, Chile, China, Colombia, Republic of Congo, Costa Rica, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Ghana, Guatemala, Guyana, Honduras, Hong Kong SAR, India, Indonesia, Islamic Republic of Iran, Israel, Jamaica, Korea, Lesotho, Malawi, Malaysia, Mali, Mauritius, Mexico, Mozambique, Nepal, Nicaragua, Niger, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka, Syria, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Uruguay,

level of capital per capita k_0, educational attainment E_0 enrollment s_0, and a productivity path $(A_t)_{t\geq 0}$. We measure n as the average rate of growth of the working age population between 1985 and 1995, where working age is defined as 15 to 64 years old. Data on total population and on the fraction of the population of age 15—64 is obtained from the 2002 *World Bank Development Indicators*.

The details of the calibration are presented in Appendix II. For human capital, we follow Hall and Jones (1999), and adopt a piecewise linear representation of the returns to schooling consistent with the empirical evidence in Psacharopoulos (1994). We construct estimates of the steady state and initial human capital, by the perpetual inventory method of Barro and Lee (1993). Briefly, we construct a measure of total educational attainment for people over age 25 using data on durations and educational attainment rates of primary, secondary and higher schooling. This provides a measure of E_0 and of s_0 in 1995. We assume further that $\underline{s} = 0$ and $\bar{s} = 0.5$.[24]

We construct measures of the initial capital stock k_0 using investment rates from the Heston et al. (2002) Penn World Tables, Mark 6.1 (PWT) and a perpetual inventory method as in Bernanke and Gürkaynak (2001).[25] The productivity level of a given country in a given year 0 can then be derived from its stocks of human and physical capital, its output and the Cobb-Douglas relationship $y_0 = (A'_0 h_0)^{1-\alpha} k_0^{\alpha}$.

The capital wedge τ and the schooling efficiency θ were calibrated for each country as follows. We construct the conditional steady state of each country $\left(\tilde{k}^*, E^*\right)$ by projecting forward the observed enrollment and investment rates. We then infer the values of τ and θ by fitting the steady-state accumulation rates and first-order conditions of the model to the country's conditional steady state. This assigns some of the differences in long-run output per capita to differences in physical and human capital accumulation rates.

One can then compute for each country the ratio of the capital installed in year 0 to the capital level that would prevail in the steady state, $k_0/k_0^* = \tilde{k}_0/(A'_0\tilde{k}^*)$. This capital ratio is a measure of the country's capital abundance conditional on human capital being at its long-run level $(E_0 = E^*)$. It is higher than 1 for the countries that have too much capital, and lower than 1 for

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Venezuela, Zambia, and Zimbabwe.

[24]The assumption that $\bar{s} = 0.5$ is consistent with the highest schooling enrollment rates observed in the data. It ensures that no country is constrained in steady state.

[25]Hsieh and Klenow (2003) and Cohen and Soto (2002) argue that one should construct capital stocks using nominal investment rates instead of PPP investment rates, since poorer countries face systematically higher relative prices for investment goods. Higher nominal investment rates yield comparatively larger capital ratios when there are no distortions—since the equilibrium capital stock k^* remains unchanged—and similar capital ratios in the presence of distortions—since both k and k^* are adjusted upwards. Using nominal investment rates, we estimate an average capital ratio of 0.63 with distortions and 0.49 without distortions. We find that the welfare gains are smaller. (The results are available upon request to the authors.)

the countries that have too little. Similarly, the ratio E_0/E^* measures the country's abundance in human capital relative to the long-run. Unlike physical capital, human capital cannot be imported and must be accumulated domestically by sacrificing labor.

Table 4 reports our estimates of relative human capital, E_0/E^*, as well as the projected steady-state attainment level E^* and the efficiency of the schooling system relative to the United States Table 5 reports our estimates of the capital ratio k_0/k_0^* together with the estimated capital wedge τ.

We find that non-OECD countries are below their steady state, with an educational attainment ratio of 0.66 and a capital ratio of 0.67. It is noteworthy that the capital ratio, at 0.67, remains low on average. Our results do not indicate, as is sometimes presumed, that emerging economies will not benefit from financial integration because they are very close to their steady state. However, it is interesting to note that Latin America is very close to its steady state, and that Africa is above it. We find that given its low productivity and its high rate of distortion, Africa is capital-abundant. Most of emerging countries' capital gap is located in Asia, more specifically, in China and India.

The average schooling efficiency is 0.74, significantly below one, while the capital wedge is moderate but positive, equal to 7.7 percent. The capital wedge is negative for the high income non-OECD countries because our method interprets the very large average investment rates of countries like Singapore (41 percent) and Korea (37 percent) as evidence of an implicit subsidy to investment (-4.7 percent and -4.0 percent respectively). Conversely, Mozambique and Uganda, countries with the lowest average saving rates (2.9% and 3% respectively), are associated with a large capital wedge (40 percent and 46 percent respectively).

Table 6 reports the welfare gains. Non-OECD economies benefit, on average, to the tune of 1.39 percent of consumption from a complete financial liberalization.[26] This number is our benchmark estimate of the benefit of international financial integration for non-OECD countries. This gain is larger than in the simple model without human capital, which would predict a gain of 0.39 percent of consumption for a capital ratio of 0.67 (equivalent to a capital-output ratio of 1.99). That human capital increases the welfare gains from integration should not come as a surprise. Integration reduces the sacrifice in terms of current consumption required to accumulate a given level of human capital. By accelerating human capital accumulation, it increases domestic intertemporal labor income and reduces the intertemporal wedge between the domestic and foreign returns to capital. Indeed, we find that human capital multiplies the gains from integration by more than three.

[26]The number for high income non-OECD countries is negative. This is so since the model with distortions does not satisfy the criteria of the first welfare theorem. Countries can be made worse off by international financial integration. Specifically, this happens when countries subsidize capital returns ($\tau < 0$). Capital inflows mean that the subsidy goes to foreign investors.

C. Is It Large? Some Comparisons

It is important to establish relevant points of comparison. After all, a welfare gain of 1.39 percent of consumption would be considered as significant in the literature estimating the benefits of international portfolio diversification or those of reducing taxes. This section proposes two other points of comparison that arise naturally in our model : first, the welfare gains from removing the distortions, and second, the benefit of a productivity catchup with the United States. We find that these gains are significantly larger than those from international financial integration. Taken at face value, this result could be taken as evidence that international financial integration yields relatively small gains. Another possible interpretation of our results is that international financial integration *could* yield large welfare gains, but only, in our metrics, if it reduced domestic distortions or increased domestic productivity, through indirect channels that are not in the standard neoclassical framework.

Table 7 reports the welfare gain from removing the distortions on physical and human capital accumulation, i.e., of setting θ to θ_{us} and τ to zero. Under autarky, the gain amounts to 32 percent of permanent consumption in the average non-OECD country. Unsurprisingly, the gain is larger in poorer countries, where the distortions are larger. The gains from removing the distortions are even larger under financial integration (40 percent in average), since other things equal, removing the distortions magnifies the countries' initial level of capital scarcity by raising their steady state levels of physical capital.

Another natural benchmark of comparison is the welfare benefit of an increase in domestic productivity. Clearly, the assumption that relative productivity remains constant is extreme and unrealistic. Figure 4 reports the change in relative productivity A'_0/A'^{us}_0 for non-OECD countries between 1960 and 1995.[27] While many developing countries fell behind in terms of relative productivity, a number of countries —such as Singapore, Hong Kong SAR, Mauritius, Cyprus, Israel, Korea—experienced a drastic improvement in productivity. These countries reduced their productivity gap with the United States by more than 25 percent over that time period, and by as much as 113% percent for Singapore. We now evaluate the welfare gains from such productivity catch-up.

To do so, we create "synthetic countries" for each line in Table 7. These are obtained by averaging output and capital per capita, investment rates, educational attainment, enrollment and population growth rates. For each representative country, we assume that productivity converges partly toward the world technology frontier (here, the United States) according to

$$\frac{A'_t}{A'^{us}_t} = \frac{A'_0}{A'^{us}_0} + x\frac{t}{35}\left(1 - \frac{A'_0}{A'^{us}_0}\right) \tag{9}$$

in the first 35 years ($t \leq 35$), after which the growth rate in productivity goes back to the U. S. level. The variable x represents the convergence in productivity expressed as a fraction of the

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[27]The figure only includes 60 countries. No data on human capital are available as of 1960 for Benin, China, Republic of Congo, Egypt, and Rwanda.

original productivity gap. The case $x = 0$ corresponds to no-convergence, and $x = 1$ corresponds to full convergence in 35 years.

Table 8 reports relative productivity in 1995, as well as the welfare gains from productivity catch-ups of 25 percent and 100 percent under financial integration and financial autarky. As a reference, the table also reports the welfare gains from financial integration without catchup.[28] Developing countries are much less productive than the United States, with an average relative productivity of 0.27, that increases with income. In that context, we find that the gains from a productivity catch-up are very large. Under financial autarky, a 25 percent reduction in the productivity gap yields welfare gains of 44 percent of annual consumption on average. These gains jump to 161 percent of consumption if the country completely catches up with the United States in terms of productivity. These gains are even larger under financial integration, again because the catchup increases the capital scarcity of the country (51 and 203 percent, respectively).

Thus, the gains from international financial integration are dwarfed by the potential gains from policies that aim at reducing the domestic level of distortion or increasing domestic productivity. One could argue, however, that opening the capital account is one of these policies. For example, a country could "import" foreign productivity through FDI (Borensztein, de Gregorio, and Lee, 1998), or the discipline induced by free capital mobility could induce the government to reduce the level of domestic distortions (Gourinchas and Jeanne, 2002). These indirect channels are not in the textbook neoclassical framework, in which productivity and distortions as exogenous to international financial integration, but they might be important in the real world.

From this perspective, another interpretation of our results is that international financial integration *could* yield large gains *if* it reduced the gap between developing countries and advanced countries in terms of distortions and productivity through non-neoclassical channels. As shown in Table 8, assuming that integration results in a 25 percent productivity catchup with the United States would multiply the welfare gains by a factor fifty, from 1 to 51 percent. But more than four fifths of these gains (44 percent out of 51 percent) would come from the productivity increase itself, and not from capital flows per se. Even in that scenario, increasing the size of capital inflows contributes relatively little to the improvement in well-being.

D. Prosperity and Capital Mobility: Development Accounting

What are the implications of our analysis for the world income distribution and for economic convergence between developing and developed countries? In principle, international financial integration could accelerate convergence in GDP per capita by raising the stock of physical capital and by stimulating the accumulation of human capital in less developed countries. The small size of the welfare gains suggests, however, that international financial integration does not significantly reduce the very large gaps between developing and developed countries.

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[28] The difference between the estimates in the first column of Table 8 and those in Table 6 is the difference between the welfare gain of the average and the average of the welfare gains. In practice, the difference is not very large.

Consider a country like Bangladesh. According to our calculations, although Bangladesh's output per capita would increase by 26 percent if it opened its capital account completely and foreign capital were free to rush in, it would still represent only about 7 percent of United States output per capita. Perhaps this should not come as a surprise, once we realize that the gross investment rate in Bangladesh has been only 9.46 percent from 1985 to 1995, that the implicit distortion on real returns to capital is 16 percent, and the education efficiency of Bangladesh relative to the United States stands at 0.72. In other words, financial integration would only bring Bangladesh much faster to a much impoverished steady state.

According to this interpretation, the difference between industrialized and emerging economies is *not* that the latter start with a large capital deficit that can be filled by capital inflows but rather that they are converging toward a much lower level of income. Although capital account opening can accelerate this convergence, the welfare benefit appears small when compared to the long-run inequality resulting from long run cross-country differences in productivity or distortion levels. This interpretation does not imply that countries are close to their steady state. Rather, their distance to the steady state, even though it might seem large in absolute, explains a relatively small part of the cross-country inequality in GDP per capita.

We develop this intuition by providing a decomposition of the gap in GDP per capita between advanced and developing countries. This decomposition is closely related to the decompositions of world inequalities that have been developed in the recent literature on "development accounting" (see Caselli (2003)). The main difference is that our decomposition is rooted in an intertemporal optimization model that nests four sources of cross-country inequality: a distortion in the accumulation of physical capital, another distortion for human capital, productivity differences, and the distance to the steady state. The last factor has not been measured in the development accounting literature, which generally takes a static perspective on cross-country inequality.[29]

Consider then, the ratio between a country's income per capita in some reference year—say 1995—and the steady-state income per capita in the United States: $y_0/y_0^{*,us}$.We can think of economic development as a process that increases this ratio by raising the standards of living in emerging countries (y_0) towards their steady-state levels in the developed world (y_0^{*us}) .

A key question for economic development consists in identifying the sources of the gap in GDP per capita between developing and advanced countries. Does this gap reflect the fact that emerging countries are far away from their steady state? Does it reflect a lack of domestic saving, possibly caused by a high capital wedge? Does it reflect high distortions or low returns in the accumulation of human capital? Or does it reflect low domestic productivity? To answer these questions, we

[29]For example, Hall and Jones (1999) decompose relative output per worker into a relative capital, relative human capital and relative productivity term. Implicitly, their method includes a relative convergence gap term (the ratio of the convergence gap relative to the U. S. convergence gap) that is allocated between the capital-output component and human capital components. Jones (1997) decomposes steady state relative output into its capital and productivity gap components. His focus on steady state output excludes a convergence term.

decompose the development ratio into three components as follows:

$$\frac{y_0}{y_0^{*,us}} = \frac{\tilde{y}_0}{\tilde{y}^*} \cdot \frac{\tilde{y}^*}{\tilde{y}^{*,us}} \cdot \frac{A'_0}{A_0^{us\prime}}, \tag{10}$$

where $\tilde{y}$ denotes output per efficient unit (y/A').

The first term reflects the fact that the country has not yet converged to its steady state. We refer to this term as the *convergence ratio*. This ratio converges to 1 over time, more quickly under financial integration than under autarky.

The second term reflects the cross-country differences in the efficiency of (physical and human) capital accumulation. We call it the *distortion ratio*. It can be further decomposed into a physical capital and human capital components. Countries with a small distortion ratio are poor because their domestic capital markets are distorted and/or because their human capital accumulation technology is very inefficient.

The third term in equation (10), the *productivity ratio*, reflects differences in productivity between the domestic country and the United States that are not accounted for by human capital. Countries with a low productivity ratio are poor because they have a lower productivity than the United States after controlling for human capital.

Table 9 reports summary development accounting statistics for each component in equation (10), in 1995. The first column reports the development ratio. It is small, with non-OECD countries at only 11 percent of the U. S. steady state income per capita. The second, fifth, and sixth columns report, respectively, the convergence, distortion and productivity ratios. Columns three and four further decompose the distortion ratio into its physical and human capital components. It is immediate that while the contribution of the convergence ratio is substantial (0.73), it accounts for a small fraction of the development ratio compared with the distortion (0.53) and productivity (0.27) ratios. These numbers imply that even with full convergence—so that the convergence ratio would be equal to one—the development ratio would still equal only 0.14 (0.53*0.27) of the United States steady state. Looking at the components of the distortion ratio, it is also apparent that differences in schooling efficiency (0.63) account for a larger share than differences in investment rates (0.83).

To summarize, if capital mobility simply brings faster conditional convergence, it will not succeed in closing the gap between poor and rich countries. Differences in standards of living arise mostly from differences in productivity and human capital, especially for the poorest countries.

Figure 5 presents additional evidence on the role of the convergence gap. In each panel, the horizontal axis reports the log development ratio $\ln(y_0/y_0^{*,us})$ against the log of each component in Table 9. As the figure makes clear, the convergence ratio is the only component that is not positively correlated with the development ratio.[30] In other words, while the poorest countries in

[30]An OLS regression yields a significant coefficient of -0.08 and an $\bar{R}^2$ of 0.11.

our non-OECD sample are, on average, those with the lowest productivity and the highest rates of distortion, there is no evidence that they are further away from their steady state than the richest non-OECD countries.

IV. Conclusion

This paper's main finding is that developing countries do not benefit greatly from international financial integration in a calibrated neoclassical growth model. We believe that this finding provides a useful theoretical benchmark for research on financial globalization. We conclude this paper by outlining what constitute, in our view, the most significant implications of our results for this research agenda.

First, our findings have implications for the recent debate on reforming the "international financial architecture." A commonly held view is that capital flows to developing economies are excessively low, and that the international financial architecture should be designed so as to increase the access of developing countries to the international financial market. This paper suggests that even if capital flows were below the efficient level because of *international* credit rationing, the potential gains from mitigating this inefficiency might be quite moderate. Countries have much more to gain from upgrading their domestic engines of growth and development (for example, by relaxing *domestic* credit rationing) than from attracting larger quantities of foreign capital.[31] The question is whether and how international financial integration affects the domestic development process, in one way or another.

There are various economic channels through which a developing financially open country could "import" foreign productivity (Prasad, Rogoff, Wei, and Kose, 2003). First, international financial integration could increase the productivity of developing economies by allowing inflows of foreign direct investment (FDI) in industries where foreign firms enjoy a productivity advantage.[32] One sector that deserves special emphasis and separate consideration in this regard, is banking. In this case, the superior efficiency of foreign banks in allocating domestic saving, or the competition they introduce in the domestic financial system, could accelerate domestic financial development and result in efficiency gains in the whole economy (Levine, 1996; Rajan and Zingales, 2003). This channel comes with important policy implications, since it would imply that the capital flows that need to be preserved are FDI, and not necessarily credit flows.

There are also more indirect channels through which international financial integration could affect the policies and governance of less developed countries. Opening the capital account could signal the quality of future policies (Bartolini and Drazen, 1997) or enhance the domestic

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[31] Of course, a country that increases its productivity also makes itself more attractive to foreign investors. Our claim is that a country benefits much more from the productivity increase itself than from the resulting capital inflows.

[32] See Borensztein et al. (1998) and Carkovic and Levine (2002) for evidence (and opposite conclusions) on the impact of FDI on growth.

government's commitment to good policies. International financial integration induces countries to have good governance and a high level of transparency in order to attract foreign investors *ex ante*, and to maintain these good policies *ex post* in order to avoid a capital flight (Gourinchas and Jeanne, 2002). On the other hand, it has been argued that far from inducing discipline, the disruption induced by volatile capital flows could have deleterious effects on domestic institutions, policies, and growth.

This paper has little to say on these channels since they are not in the textbook neoclassical growth model. The main message of this paper, in this regard, is that "the truth is elsewhere": *if* international financial integration has a large impact on the welfare of developing countries, it must be through channels that are not in the textbook model. This impact would occur, furthermore, mainly because of the indirect effects of integration, not because of the international reallocation of capital that the textbook model focuses on. In other words, one might have to leave the comfort of welfare theorems, and open the Pandora's box of development economics in order to really understand the benefits and costs of international financial integration for developing countries.

THE MODEL WITH HUMAN CAPITAL

This appendix presents the model with accumulation of human and physical capital.

A. Assumptions

1. The domestic economy produces a single homogenous good according to: $Y_t = K_t^{\alpha} (A_t' H_t)^{1-\alpha}$ where A_t' grows at a constant rate g^*.
2. Human capital-augmented labor satisfies: $H_t = e^{\phi(E_t)} L_t$.
3. The representative firm in the economy acts competitively on factor markets. Assuming that physical capital depreciates at rate $\delta_k \geq 0$, factor prices satisfy:

$$R_t = \alpha \left(\tilde{k}_t / h_t\right)^{\alpha-1} + 1 - \delta_k \quad \text{(A-1a)}$$

$$w_t = (1-\alpha) \left(\tilde{k}_t / h_t\right)^{\alpha}, \quad \text{(A-1b)}$$

   where R_t denotes the domestic gross real interest rate, w_t the normalized wage per efficiency unit of labor, and $\widetilde{k} = k/A'$.
4. The representative domestic agent is infinitely lived and has time separable preferences defined over sequences of consumption per capita $\{c_s\}_{s=t}^{\infty}$:

$$U_t = \sum_{s=t}^{\infty} \beta^s \, N_s \, u(c_s), \quad \text{(A-2)}$$

   where $u(c) \equiv (c^{1-\gamma} - 1) / (1-\gamma)$, and $u(c) = \ln(c)$ when $\gamma = 1$.
5. Human capital accumulation depends upon the fraction of time devoted to education, s_t, according to

$$E_{t+1} = (1-\delta_e) E_t + \theta \, s_t, \quad \text{(A-3)}$$

   where $0 < \underline{s} \leq s_t \leq \bar{s} < 1$. We adopt $\bar{s} = 0.5$ and $\underline{s} = 0$.
6. Labor market clearing imposes $L_t = (1 - s_t) N_t$.
7. There are two financial assets: the domestic capital stock k_t and a riskless foreign bond b_t that pays a constant gross world interest rate R^*, equal to the inverse of the growth-adjusted discount factor: $g^{*\gamma}/\beta$.
8. Investment in domestic capital is implicitly disorted at rate τ, so that the private return to domestic capital is $(1-\tau) R_t$. The implicit rents generated by the distortion, $Z_t \equiv \tau R_t K_t$, are rebated in a lump-sum fashion to the representative agent.
9. The (normalized) flow budget constraint of the household is

$$ng^* \left(\tilde{k}_{t+1} + \tilde{b}_{t+1}\right) = R^* \tilde{b}_t + (1-\tau) R_t \tilde{k}_t + w_t h_t + \tilde{z}_t - \tilde{c}_t. \quad \text{(A-4)}$$

B. Steady State

Under these assumptions, physical and human capital converge to steady state values that are independent of the capital account regime, and satisfy[33]

$$\begin{aligned} s^* &= 1 - \frac{\frac{R^*}{ng^*} + \delta_e - 1}{\theta \phi'(E^*)} && \text{(A-5a)} \\ E^* &= \frac{\theta}{\delta_e} s^* && \text{(A-5b)} \\ h^* &= (1 - s^*)\ e^{\phi(E^*)} && \text{(A-5c)} \\ \tilde{k}^* &= \left(\frac{s_k(\tau)}{\delta_k + n.g^* - 1} \right)^{1/1-\alpha} h^*, && \text{(A-5d)} \end{aligned}$$

where

$$s_k(\tau) = \alpha . \frac{\delta_k + n.g^* - 1}{\delta_k + R^*/(1-\tau) - 1} \tag{A-6}$$

is the domestic steady state investment rate for an economy with capital wedge τ.

C. Financial Autarky

Under financial autarky, the economy must accumulate capital domestically ($\tilde{b}_t = 0$ for all $t \geq 0$). The Bellman equation associated with the consumer program is

$$\begin{aligned} v\left(\tilde{k}_t, E_t\right) &= \max_{\{\tilde{c}_t, s_t\}} u(\tilde{c}_t) + \frac{ng^*}{R^*} v\left(\tilde{k}_{t+1}, E_{t+1}\right) \\ s.t.\ ng^*\, \tilde{k}_{t+1} &= (1-\tau) R_t\, \tilde{k}_t + w_t h_t + \tilde{z}_t - \tilde{c}_t \\ E_{t+1} &= (1-\delta_e)\ E_t + \theta\ s_t && (P) \\ h_t &= (1 - s_t)\ e^{\phi(E_t)} \\ \underline{s} &\leq s_t \leq \bar{s}\ ;\ k_t \geq 0 \\ k_0, E_0 &\geq 0 \text{ given,} \end{aligned}$$

where $v\left(\tilde{k}_t, E_t\right) = U_t\left(\tilde{k}_t, E_t\right)/A_t'^{1-\gamma} N_t$ denotes the normalized welfare function. In the log case, we define $v\left(\tilde{k}, E\right) = \left(U\left(\tilde{k}, E\right) - \ln(A')/(1-n\beta)\right)/N$.

A competitive equilibrium consists of (1) a consumption function $\widetilde{c}\left(\tilde{k}, E\right)$, an education policy $s\left(\tilde{k}, E\right)$ and a welfare function $v\left(\tilde{k}, E\right)$ that solves the consumer problem (P) given the domestic real interest R and wage w; (2) factor prices that satisfy equation (A-1); (3) markets that clear.

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[33] We assume that $1 - \bar{s} \leq \frac{\frac{R^*}{ng^*} + \delta_s - 1}{\theta \phi'(E^*)} \leq 1 - \underline{s}$. Equations (A-5) are obtained as the steady state solution to (A-7).

The first order conditions are

$$\begin{aligned}\tilde{c}_t^{-\gamma} &= \frac{1}{R^*} v_k\left(\tilde{k}_{t+1}, E_{t+1}\right) \\ \frac{1}{R^*} v_k\left(\tilde{k}_{t+1}, E_{t+1}\right) w_t\, e^{\phi(E_t)} &= \frac{ng^*}{R^*}\, v_E\left(\tilde{k}_{t+1}, E_{t+1}\right)\theta - \bar{\mu}_t + \underline{\mu}_t,\end{aligned}$$

where $\bar{\mu}_t$, resp. $\underline{\mu}_t$ are the Lagrange multiplier associated with the constraints $s_t \leq \bar{s}$ and $\underline{s} \leq s_t$ respectively.

Using the envelope conditions, the equilibrium conditions for consumption and education can be written (for an interior solution):

$$\begin{aligned}\tilde{c}_t^{-\gamma} &= \frac{(1-\tau) R_{t+1}}{R^*} \tilde{c}_{t+1}^{-\gamma} \\ \tilde{c}_t^{-\gamma} w_t\, e^{\phi(E_t)} &= \frac{ng^*}{R^*} \tilde{c}_{t+1}^{-\gamma} w_{t+1}\, e^{\phi(E_{t+1})} \left[\phi'\left(E_{t+1}\right)\left(1 - s_{t+1}\right)\theta + 1 - \delta_e\right].\end{aligned} \tag{A-7}$$

The first equation is the standard Euler equation for the intertemporal allocation of consumption.

The second equation characterizes the optimal intertemporal allocation of education. To understand the intuition behind this equilibrium condition, consider the following experiment. Suppose that at time t the household decides to increase the fraction of time devoted to education by Δs_t. At time $t+1$, it adjusts education to revert to the optimal plan by time $t+2$. The increase in education today reduces efficient labor supply by $e^{\phi(E_t)}\Delta s_t$. This implies a decline in current income of $w_t\, e^{\phi(E_t)}\Delta s_t$ and a marginal utility loss of $\tilde{c}_t^{-\gamma} w_t\, e^{\phi(E_t)}\Delta s_t$. This is the left hand side of the equilibrium condition. At time $t+1$, educational attainment equals $E_{t+1} + \theta\Delta s_t$. This increases efficient labor supply by $e^{\phi(E_{t+1})}\left(1 - s_{t+1}\right)\phi'\left(E_{t+1}\right)\theta\Delta s_t$. To revert to the optimal plan by $t+2$, education needs to be adjusted by $-\Delta s_t\left(1-\delta_e\right)$. This increases current hours by $e^{\phi(E_{t+1})}\left(1-\delta_e\right)\Delta s_t$. Adding these two terms, multiplying by the wage w_{t+1} and the marginal utility of wealth $\tilde{c}_{t+1}^{-\gamma}$ and discounting back to today at rate ng^*/R^*, gives the marginal utility gain on the right hand side of the equilibrium condition.

One can verify that the log-linearized dynamic system admits two eigenvalues outside the unit circle and is saddle-point stable. Starting from $\tilde{k}_0$ and E_0 the economy evolves along the stable arm of the dynamic system in $\left(\tilde{c}, s, \tilde{k}, E\right)$ and converges towards $\left(\tilde{c}^*, s^*, \tilde{k}^*, E^*\right)$.

We solve numerically this dynamic system for equilibrium consumption rules $\tilde{c}\left(\tilde{k}, E\right)$ and education rule $s\left(\tilde{k}, E\right)$ as well as the derivative of the value function $v_E\left(\tilde{k}, E\right)$, on a grid $\left(\tilde{k}_i, E_j\right)_{i,j}$ around the steady state $\left(\tilde{k}^*, E^*\right)$.

Denote $U_{aut}\left(\tilde{k}_0, E_0\right)$ the welfare of the representative agent with initial capital $\tilde{k}_0$ and human capital E_0. By assumption, $U_{aut}\left(\tilde{k}_0, E_0\right) = v\left(\tilde{k}_0, E_0\right) A_0'^{1-\gamma}$.[34]

D. Financial Integration

Assume now that the economy integrates itself financially with the rest of the world at time 0. Assume the economy is sufficiently small so as not to influence the world interest rate R^*. The consumer program is the same as (P), except that the closed-economy domestic budget constraint is replaced by an equality between the domestic and foreign returns to capital, $R_t = R^*/(1-\tau)$.

Equating domestic and foreign returns to capital pins down the ratio of physical to human capital-augmented labor input:

$$\begin{aligned} \tilde{k}_t &= \left(\frac{s_k(\tau)}{\delta_k + ng^* - 1}\right)^{1/1-\alpha} h_t \\ &\equiv \omega(\tau)\ h_t, \end{aligned} \tag{A-8}$$

and the constant domestic wage $w = (1-\alpha)\,\omega(\tau)^{\alpha}$.

Equation (A-8) implies that capital flows are determined by the ratio of physical to human capital, not by the amount of capital relative to steady state.

Since the world interest rate equals the growth-adjusted discount rate, consumption also jumps to a constant level, consistent with the intertemporal budget constraint:

$$\tilde{c} = (R^* - ng^*)\left(k_0 + \frac{\chi(\tau)}{R^*}\sum_{t=0}^{\infty}\left(\frac{ng^*}{R^*}\right)^t h_t\right), \tag{A-9}$$

where $\chi(\tau) = (1-\alpha(1-\tau))\,\omega(\tau)^{\alpha} + \tau(1-\delta_k)\,\omega(\tau)$. $\chi(\tau)\,h_t$ represents labor income net of transfers.

This consumption level differs from the steady state autarky consumption $\tilde{c}^*$. Subtracting $\tilde{c}$ from $\tilde{c}^*$, we obtain:

$$\tilde{c}^* - \tilde{c} = (R^* - g^*n)\left(\tilde{k}^* - \tilde{k}_0\right) + \left(1 - \frac{ng^*}{R^*}\right)\chi(\tau)\sum_{t=0}^{\infty}\left(\frac{ng^*}{R^*}\right)^t (h^* - h_t).$$

This expression has two terms. The first one obtains in a model with physical capital only. It represents the –growth-adjusted– annuity value of foreign debt if the country were to borrow immediately the amount $k^* - k_0$ to attain its steady state. Consumption is lower since the country needs to roll-over foreign debt permanently. The second term reflects the effect of the accumulation path for human capital on domestic labor income $\chi(\tau)\,h_t$. If human capital is increasing, the country will borrow against higher future labor income. This second effect tends also to depress long run consumption.

[34]For the log case, $U_{aut}\left(\tilde{k}_0, E_0\right) = v^a\left(\tilde{k}_0, E_0\right) + \ln(A_0')/(1-\beta n)$.

Convergence in h is not instantaneous, since human capital can only be accumulated domestically. Even if the economy starts with the correct amount of physical capital $\tilde{k}_0 = \tilde{k}^*$, consumption can be lower than in the autarky steady state if initial human capital is also below steady state, $h_0 < h^*$.

Denote welfare under integration as $U_{int}\left(\tilde{k}_0, E_0\right)$. It is immediate that it satisfies

$$\begin{aligned} U_{int}\left(\tilde{k}_0, E_0\right) &= v^i\left(\tilde{k}_0, E_0\right) A_0'^{1-\gamma} N_0 \\ &= \frac{u\left(\tilde{c}\right)}{1 - ng^*/R^*} A_0'^{1-\gamma} N_0 \end{aligned}$$

where $\widetilde{c}$ depends only upon the sequence of human capital-augmented labor inputs $\{h_t\}$ (equation (A-9)). Hence, maximizing $U_{int}\left(\tilde{k}_0, E_0\right)$ is equivalent to solving the following problem

$$\begin{aligned} W\left(E_0\right) &= \max_{\{s_t\}} \sum_{t=0}^{\infty} \left(\frac{ng^*}{R^*}\right)^t \left(1 - s_t\right)\, e^{\phi(E_t)} \\ & s.t.\ E_{t+1} = \left(1 - \delta_e\right) E_t + \theta s_t \\ & \underline{s} \leq s_t \leq \bar{s} \\ & E_0 \text{ given} \end{aligned} \qquad (Q)$$

The first order and envelope conditions associated with this problem are

$$\begin{aligned} e^{\phi(E_t)} &= \left(\frac{ng^*}{R^*}\right) W'\left(E_{t+1}\right)\theta + \underline{\mu}_t - \bar{\mu}_t \\ W'\left(E_t\right) &= \left(1 - s_t\right)\phi'\left(E_t\right) e^{\phi(E_t)} + \left(\frac{ng^*}{R^*}\right) W'\left(E_{t+1}\right)\left(1 - \delta_e\right) \end{aligned}$$

where $\bar{\mu}_t$, resp. $\underline{\mu}_t$ are the Lagrange multipliers associated with the constraints $\underline{s} \leq s_t \leq \bar{s}$.

One can show that the optimal schooling policy is bang-bang and oscillates around the steady state. The linearized system exhibits a negative root, so that the state variable E_t 'bounces' around its steady state value E^*. This feature of the discrete time problem would go away in the continuous time limit (in continuous time, a predetermined variable cannot 'jump' over the steady state). We directly use the solution to the continuous limit of the model that converges to the steady state in finite time.

The optimal education policy that solves problem (Q) then takes a simple form:

$$\begin{cases} s_t = \bar{s} & E_t < \underline{E} \\ s_t = \left(E^* - \left(1 - \delta_e\right) E_t\right)/\theta \quad \text{if} & \underline{E} \leq E_t \leq \overline{E} \\ s_t = \underline{s} & \overline{E} < E_t \end{cases}$$

where $\bar{E} = [E^* - \theta \underline{s}] / (1 - \delta_e)$ and $\underline{E} = [E^* - \theta \bar{s}] / (1 - \delta_e)$.[35]

E. Welfare Gains

To compare welfare under the two scenarios, we define the Hicksian equivalent variation $\mu\left(\tilde{k}_0, E_0\right)$ as the percentage increase in consumption that brings the welfare of the representative agent under autarky up to its level under integration. That is, $\mu\left(\tilde{k}_0, E_0\right)$ satisfies $U_{int} = U_{aut}(1-\mu)^{1-\gamma}$, implying

$$\mu\left(\tilde{k}_0, E_0\right) = \left(\frac{U_{int}\left(\tilde{k}_0, E_0\right)}{U_{aut}\left(\tilde{k}_0, E_0\right)}\right)^{\frac{1}{1-\gamma}} - 1$$

for $\gamma \neq 1$. In the log case, we obtain

$$\mu\left(\tilde{k}_0, E_0\right) = e^{(1-\beta n)\left(U_{int}\left(\tilde{k}_0, E_0\right) - U_{aut}\left(\tilde{k}_0, E_0\right)\right)} - 1.$$

F. Marginal Welfare Gains

Assume that at time 0 the capital inflow authorized at $t+1$ is increased by $d\kappa_{t+1} = c_{t+1} dc/c$. With log-preferences the discounted welfare gain at time 0 is equal to

$$dU_0 = \left(\sum_{t=0}^{+\infty} \beta^{t+1}(R_{t+1} - R^*)\right)\frac{dc}{c}, \tag{A-10}$$

and the resulting equivalent variation satisfies:

$$\sum_{t=0}^{\infty} \beta^t \ln(1+\mu) = dU_0,$$

so that, for small variations:

$$\mu \approx (1-\beta)\sum_{t=0}^{+\infty} \beta^{t+1}(R_{t+1} - R^*)\frac{dc}{c}.$$

Using the definition of the permanent value of the interest rate $\hat{R}$, equation (7) obtains.

[35] That $\underline{E} \leq E^* \leq \bar{E}$ derives from $\underline{s} \leq s^* \leq \bar{s}$.

G. Development Accounting

Using $\widetilde{y}_0 = \widetilde{k}_0^{\alpha} h_0^{1-\alpha}$, $k_0/y_0 = (\widetilde{k}_0/h_0)^{1-\alpha}$ and (A.5d), the convergence ratio can be written

$$\frac{\tilde{y}_0}{\tilde{y}^*} = \left(\frac{\delta + n + g^*}{s_k(\tau)} . \frac{k_0}{y_0}\right)^{\frac{\alpha}{1-\alpha}} \frac{h_0}{h^*}. \tag{A-11}$$

The distortion ratio is equal to

$$\frac{\tilde{y}^*}{\tilde{y}^{*,us}} = \left(\frac{s_k(\tau)}{\delta_k + g^*.n - 1} / \frac{s_k(\tau^{us})}{\delta_k + g^*.n^{us} - 1}\right)^{\frac{\alpha}{1-\alpha}} \frac{h^*}{h^{*,us}}. \tag{A-12}$$

The first term on the right hand side reflects steady state differences in capital-output ratio: $(k^*/y^*) / (k^{*us}/y^{*us})$. The second term reflects differences in steady state human capital accumulation $h^*/h^{*,us}$.

CALIBRATING THE MODEL

A. Constructing Human Capital Stocks

We adopt a piecewise linear representation of the returns to schooling consistent with the empirical evidence in Psacharopoulos (1994). The marginal return to education is set to 13.4% for the first four years of education, to 10.1% for the next four, and to 6.8% subsequently.

The concept of human capital we use is the average educational attainment for people over age 25, i.e., the average number of years of schooling in the population older than 25. This is a stock measure, as needed for the theory. To measure E_t, we rely on the Barro and Lee (2001) updated dataset (see also Jones (1997)). This dataset constructs educational attainment every five years from 1960 to 2000 for a sample of 138 countries, according to the following perpetual inventory method:

$$E_t = (1 - \delta_{25,t})\, E_{t-5} + \delta_{25,t} \sum_j \pi_{j,t-n_j} u_j, \tag{A-1}$$

where E_t represents educational attainment in year t, $\pi_{j,t}$ represents the educational attainment rate for cell j at time t—i.e., the fraction of a school-age cohort enrolled in education cell j– and u_j represents the duration of cell j, i.e. the number of years of education for that cell. n_j represents the number of years necessary for someone with education level j to reach age 25.[36] $\delta_{25,t}$ represents the depreciation rate for educational attainment and is equal to the fraction of the population aged 25-29 (see Barro and Lee (1993) for a derivation). Barro and Lee provide data on six educational categories: incomplete primary, primary, incomplete secondary, secondary incomplete higher and higher education.

Using equation A-1, steady state educational attainment E^* is defined as:

$$E^* = \sum_j \pi_j^* u_j.$$

We measure steady state enrollment rates π_j^* and durations u_j^* using the latest available data. Because this data is not directly available from the Barro and Lee dataset, we use data from the *UNESCO World Education Report, 2003,* that reports data on duration for primary, incomplete secondary, and secondary education as well as net enrollment rates for primary and secondary education and gross enrollment rates for tertiary education for the years 1998—2000 (or the latest available year when 1998—2000 are not available). We assume, as Barro and Lee do, that incomplete cycles have a duration equal to half the full cycle and that higher education lasts four years. Gross enrollment ratios refer to the total enrollment in a given education group, regardless of age, divided by the population of the age group which officially corresponds to that education cell. The net enrollment ratio only includes enrollment for the age group corresponding to the official school age of primary education. Defining PRI, SEC, and $HIGH$ as the UNESCO

[36] n_j depends on the enrollment age for cell j. We assume that $n_p = 15$, $n_s = 10$ and $n_h = 5$.

enrollment rates, we obtain:

$$\begin{aligned} \pi_p^* &= PRI - SEC \\ \pi_s^* &= SEC - HIGH \\ \pi_h^* &= HIGH. \end{aligned}$$

We split the UNESCO enrollment rates into complete and incomplete cycles using the Barro and Lee rates of completion for primary, secondary, and higher education.

Lastly, we annualize the depreciation rate and enrollment rates as follow: define s_t the annual investment in schooling that satisfies:

$$E_{t+1} = (1 - \delta_e) E_t + \theta s_t$$

as in the model. Assuming that s_t is constant between $t - 5$ and t, it follows that

$$E_{t+5} = (1 - \delta_e)^5 E_{t-5} + \frac{\theta}{\delta_e} s_t \left[1 - (1 - \delta_e)^5\right].$$

Identifying with (A-1), we obtain:

$$\begin{aligned} \delta_e &= 1 - (1 - \delta_{25,t})^{1/5} \\ s_t &= \frac{\delta_e}{\theta} \sum_j \pi_{j,t-n_j} u_j \\ &= \frac{1}{\theta} \frac{\delta_e}{\delta_{25,t}} \left[E_t - (1 - \delta_{25,t}) E_{t-5}\right] \\ s^* &= \frac{\delta_e}{\theta} \sum_j \pi_j^* u_j = \frac{\delta_e E^*}{\theta}. \end{aligned}$$

Given an estimate of E^* and δ_e, an estimate for θ is obtained from equation (A-5) as

$$\theta = \frac{\frac{R^*}{ng} - 1 + \delta_e \left[1 + E^* \phi'(E^*)\right]}{\phi'(E^*)}.$$

B. Constructing Steady State Capital Stocks

Using data from Heston et al. (2002) Mark 6.1, we measure the average investment share $\hat{s}_k$ in gross GDP from 1985 to 1995. We then assume that the observed average investment rate is a good approximation to the investment rate that would obtain in steady state:

$$\hat{s}_k = \alpha . \frac{\delta_k + n.g^* - 1}{\delta_k + R^* / (1 - \tau) - 1}. \quad \text{(A-2)}$$

This approach is similar to Mankiw et al. (1992) who assume constant saving rates in their tests of unconditional and conditional convergence. Similarly, the literature on calibrated business cycle models often interprets historical averages as equivalent to steady state values (see Mendoza and Tesar (1998) for an application to tax reform).[37]

The capital ratio then follows:

$$\ln\left(\frac{k_0}{k^*}\right) = \frac{1}{1-\alpha}\left[\ln\left(\frac{k_0}{y_0}\right) - \ln\left(\frac{k^*}{y^*}\right)\right] + \ln\frac{h_0}{h^*}. \qquad \text{(A-3)}$$

[37] It is important to emphasize that this assumption does not imply that countries are estimated to be close to their steady state. As a famous counterexample, consider the Solow model. It assumes a constant saving rate, but imposes no restrictions on the proximity of countries to their steady state.

Table 1. Common Parameters

β	γ	α	δ_k	g^*	n
0.96	1	0.3	0.06	1.012	1.0074

Table 2. Impact on Growth

Change in Output Growth (percent per annum)

	Horizon (Years)		
Capital Output Ratio	1	5	10
0.23	104.39	6.75	1.39
1.40	26.99	2.73	0.64
2.00	11.69	1.29	0.32

Note: The table reports the change in domestic output growth following financial integration.

Table 3. Robustness Checks

Equivalent Variation (μ) k/y	γ (1/EIS) 1	3	5	10	α 0.6	n 2.3
0.23	10.84	29.23	40.03	40.92	58.03	6.06
1.40	1.67	1.76	0.88	0.14	5.74	0.98
2.00	0.38	0.06	0.15	4.06	1.17	0.23
r^* (%)	5.42	7.96	10.57	17.36	5.42	5.42

Note: The table reports the equivalent variation μ for various parameter configurations.

Table 4. Human Capital Parameters and Estimates
(Population-Weighted Averages, 1995)

Steady State:	Relative Efficiency θ/θ^{us} Benchmark	Steady State Attainment E^* Benchmark	Attainment Ratio E_o/E^* Benchmark	No Distortion	Obs.
Non-OECD Countries	0.74	7.32	0.66	0.37	65
Low Income	0.66	6.47	0.57	0.28	24
Lower Middle Income	0.75	7.34	0.75	0.42	23
Upper Middle Income	0.97	9.85	0.57	0.43	13
High Income (non-OECD)	1.09	13.20	0.75	0.75	5
Africa	0.76	6.88	0.59	0.30	27
Latin America	0.93	9.24	0.59	0.41	22
Asia	0.71	7.07	0.68	0.37	16
Except China and India	0.82	7.94	0.58	0.35	63
China and India	0.68	6.86	0.72	0.38	2

Table 5. Capital Ratio and Capital Wedge
(Population-Weighted Averages, 1995)

Steady State:	Wedge (%) τ Benchmark	Capital Ratio k_o/k^*_o Benchmark	No Distortion	Obs.
Non-OECD Countries	7.7	0.67	0.16	65
Low Income	12.2	0.69	0.17	24
Lower Middle Income	4.5	0.60	0.31	23
Upper Middle Income	5.4	0.96	0.48	13
High Income (non-OECD)	-3.2	0.52	0.84	5
Africa	19.3	1.20	0.24	27
Latin America	7.4	0.99	0.43	22
Asia	6.2	0.55	0.26	16
Except China and India	10.0	0.90	0.33	63
China and India	6.0	0.51	0.23	2

Table 6. Benefits of International Financial Integration, 1995

Equivalent Variation μ (percent)	Mean	S.D.	Obs.
Non-OECD Countries	1.39	0.71	65
Low Income	1.57	0.51	24
Lower Middle Income	1.37	0.64	23
Upper Middle Income	1.21	0.92	13
High Income (non-OECD)	-1.14	0.91	5
Africa	0.87	1.12	27
Asia	1.51	0.57	16
Latin America	1.08	0.87	22
Except China and India	1.13	1.03	63
China and India	1.59	0.06	2

Note: The table reports the population-weighted average of the equivalent variation μ.

Table 7. Benefits of Eliminating Domestic Distortions, 1995

Equivalent Variation μ (percent) Steady State:	Integration		Autarky		
	Mean	S.D.	Mean	S.D.	Obs.
Non-OECD Countries	40	23	32	19	65
Low Income	57	24	46	21	24
Lower Middle Income	31	10	25	9	23
Upper Middle Income	13	5	10	5	13
High Income (non-OECD)	6	3	5	3	5
Africa	70	47	59	39	27
Asia	39	14	31	11	16
Latin America	22	19	18	17	22
Except China and India	41	34	34	28	63
China and India	39	13	31	10	2

Note: The table reports the population weighted average of the equivalent variation μ.

Table 8. Benefits of a Productivity Catch-Up

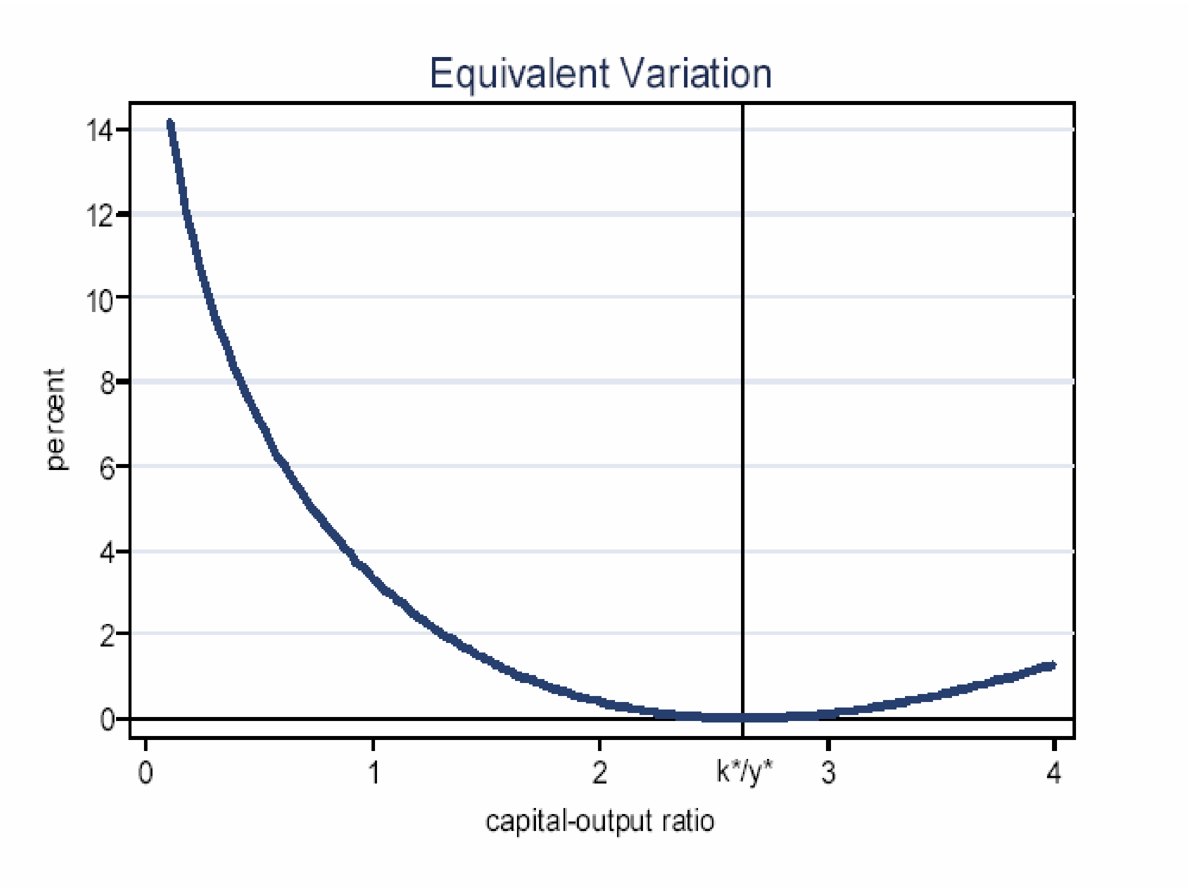
Productivity catch-up:	0%	25%		100%			
Capital account regime:	integration	integration	autarky	integration	autarky	Obs.	A_O/A_O^{us}
Non-OECD countries	1.03	51	44	203	161	82	0.27
Low Income	1.35	71	60	281	221	38	0.22
Lower Middle Income	1.27	53	45	209	165	25	0.26
Upper Middle Income	1.08	25	22	99	83	14	0.45
High Income (non-OECD)	-0.67	11	11	46	42	5	0.59
Africa	0.25	40	36	159	138	44	0.34
Asia	1.25	62	52	245	190	16	0.23
Latin-America	0.99	29	25	114	96	22	0.41
Except China and India	0.79	36	31	141	119	80	0.36
China and India	1.66	71	58	278	210	2	0.21

Note: The table reports the equivalent variation μ for the synthetic country corresponding to each group. Year is 1995.

Table 9. Development Accounting
(Population-Weighted Averages, 1995)

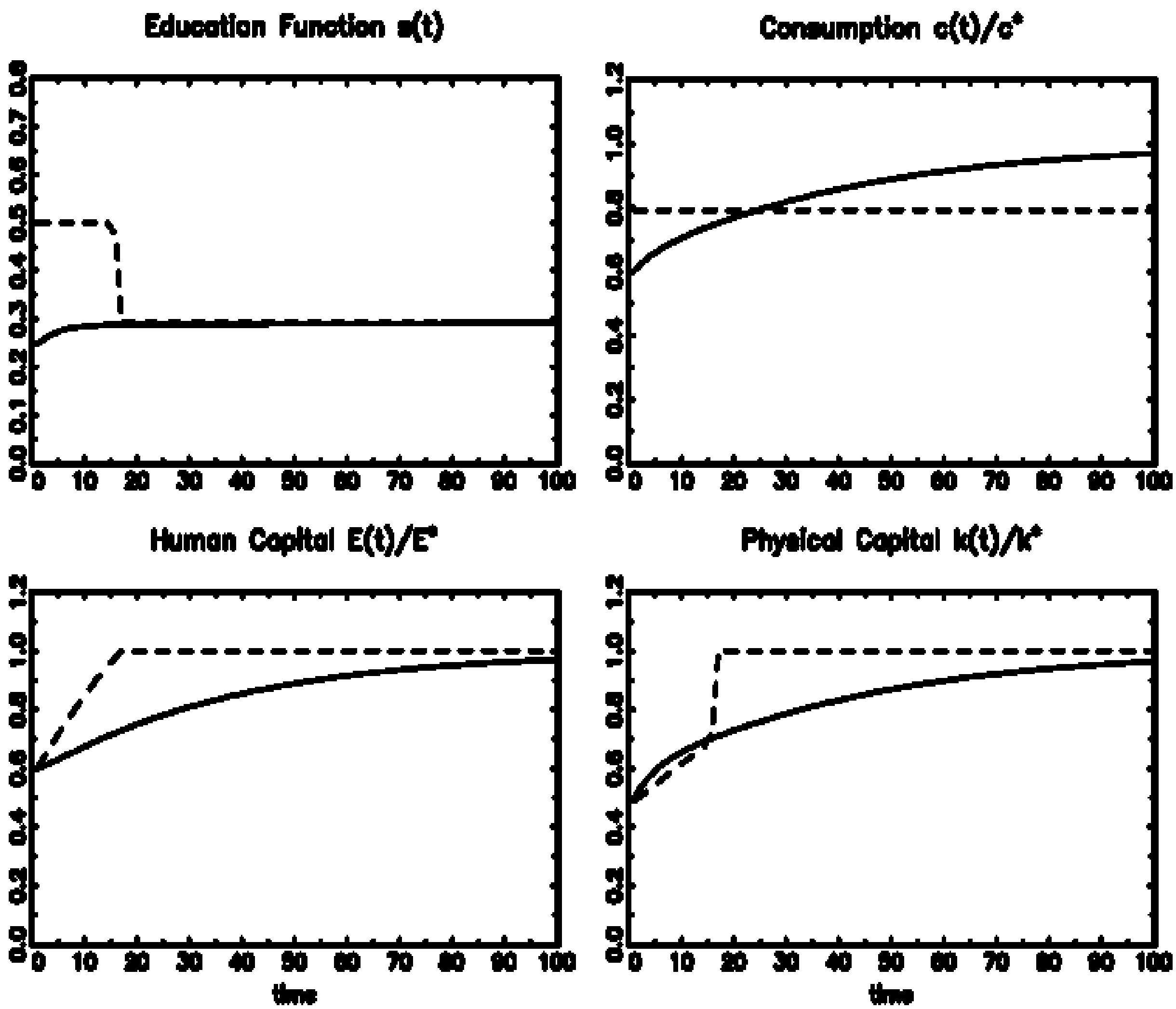
	Development	Convergence	Distortions			Productivity	
			Physical	Human	Total		
	$y_O/y_O^{*,us}$	$\tilde{y}_O/\tilde{y}^*$	Capital	Capital	$\tilde{y}^*/\tilde{y}^{*,us}$	$A'_O/A_O^{us'}$	Obs.
Non-OECD countries	0.11	0.73	0.83	0.63	0.53	0.27	65
Low Income	0.07	0.72	0.73	0.59	0.43	0.23	24
Lower Middle Income	0.11	0.72	0.90	0.64	0.57	0.26	23
Upper Middle Income	0.24	0.81	0.86	0.76	0.66	0.45	13
High Income	0.44	0.70	1.20	0.91	1.09	0.59	5
Africa	0.12	0.88	0.65	0.61	0.40	0.34	27
Asia	0.09	0.69	0.86	0.62	0.54	0.23	16
Latin America	0.21	0.83	0.82	0.73	0.60	0.42	22
Except China and India	0.15	0.80	0.80	0.66	0.54	0.35	63
China and India	0.07	0.67	0.86	0.61	0.52	0.21	2

Figure 1. International Financial Integration, Benchmark Case



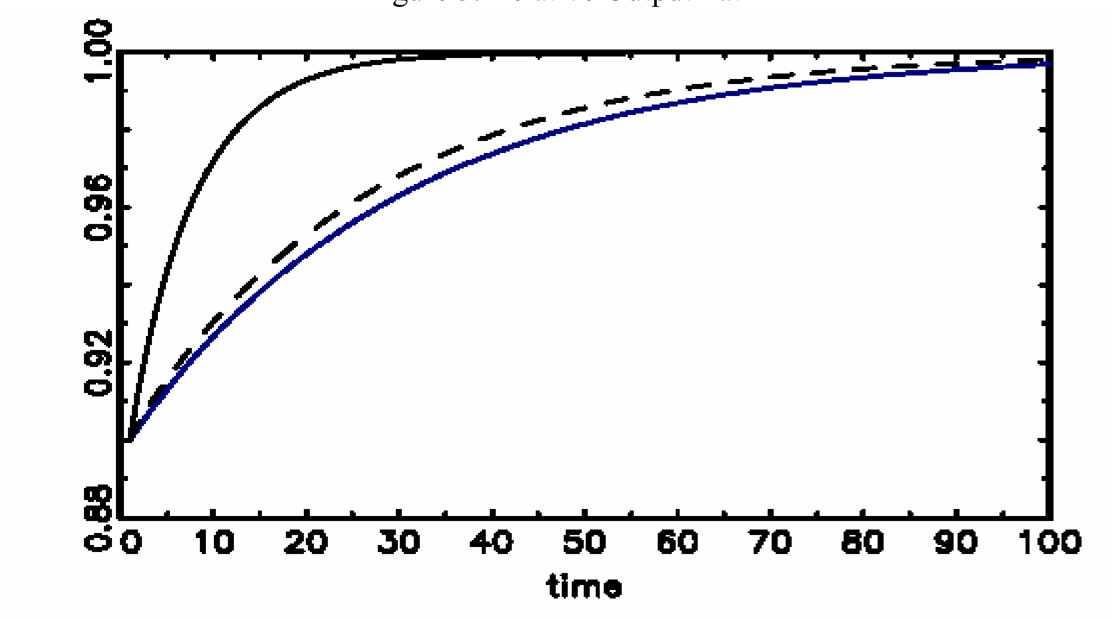
Note: The solid line corresponds to the theoretical gains from international financial integration as a function of the capital-output ratio *k/y*. Parameter values are given in Table 1.

Figure 2. Sample Convergence Trajectories



Note: The thick line corresponds to autarky and the dashed line to international financial integration. Initial Conditions: $k_0 = 0.5k^*$ and $E_0 = 0.6E^*$. Calibrated to the U. S. economy (see footnote 20 for parameter values).

Figure 3. Relative Output Path



Note: Upper Solid Line: model with physical capital only; Dashed Line: model with distortions; Lower Solid Line: model without distortions. Parameters are calibrated to the average developing country.

Figure 4. Relative Productivity Change, $A_0^{'} / A_0^{'us}$ (For non-OECD Countries, 1960—1995)

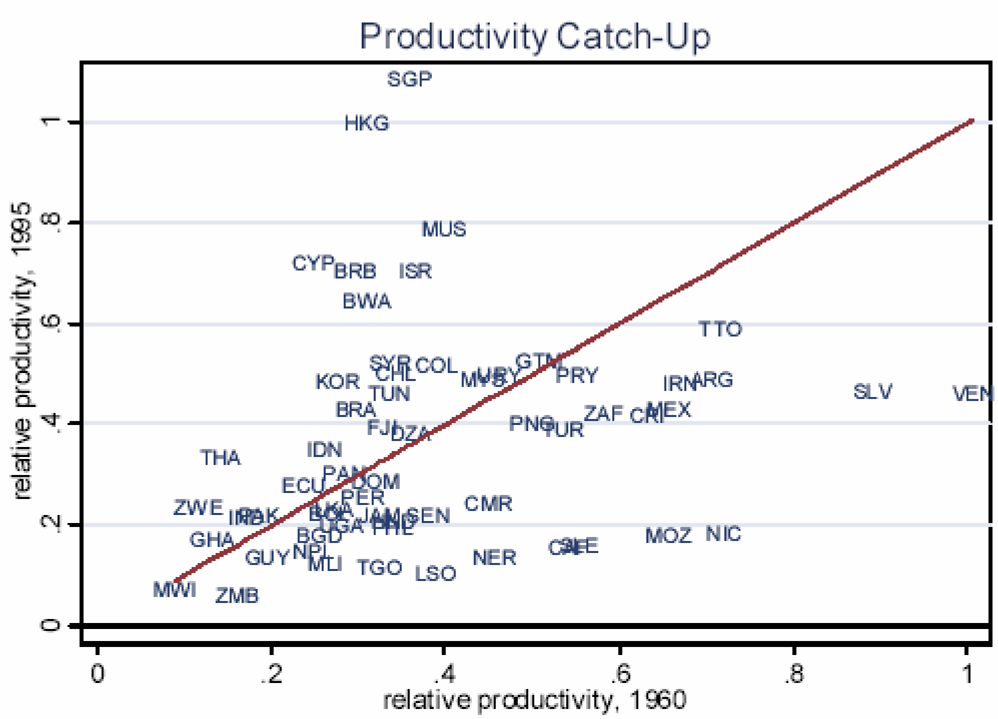
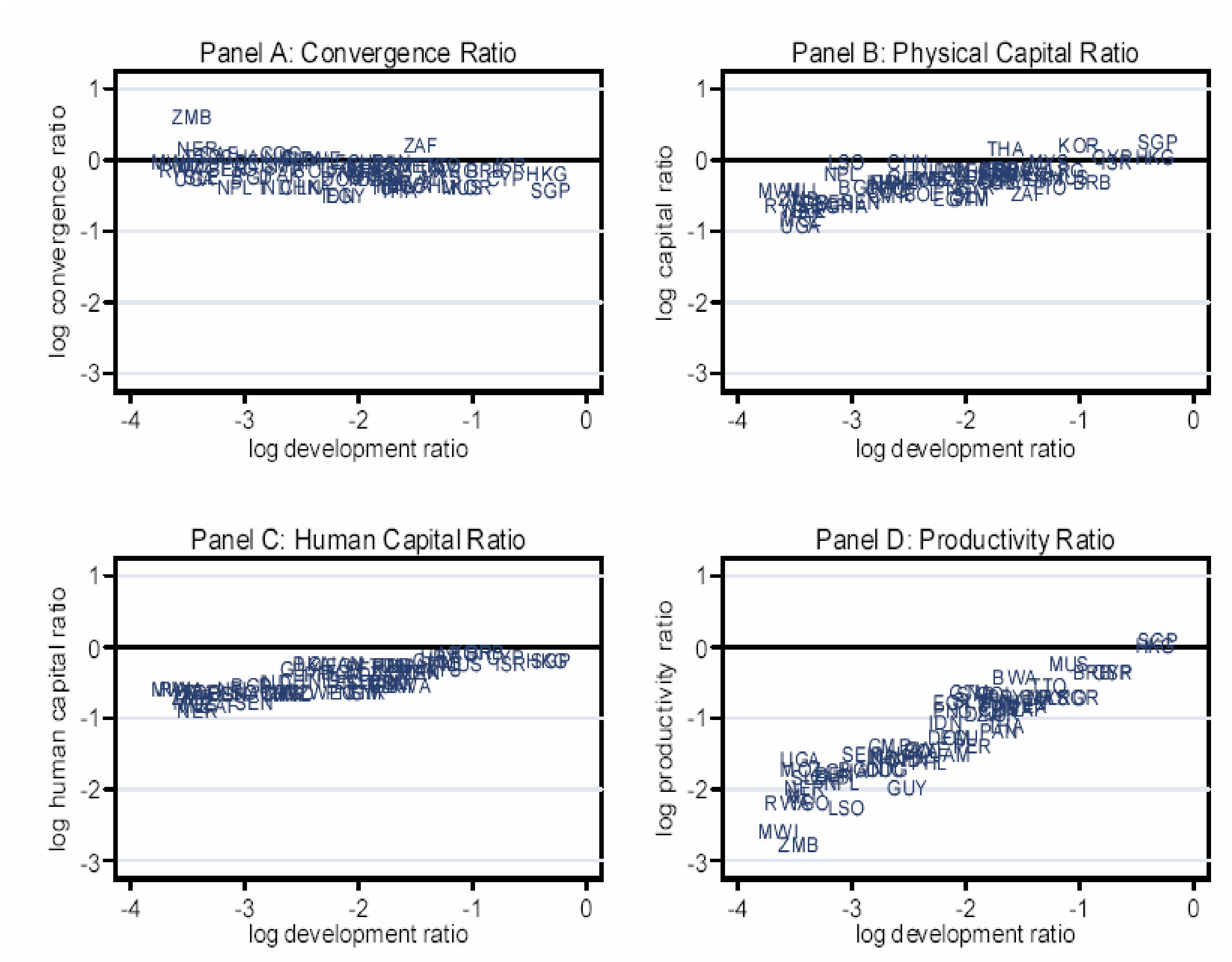


Figure 5. Development Accounting, 1995



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