The Welfare Gains of Financial Liberalization: Capital Accumulation and Idiosyncratic Risks*

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Abstract

When markets are complete, the welfare impact of financial openness is quantitatively limited (c.f. Gourinchas and Jeanne, 2006). In developing countries, however, financial markets suffer from frictions such as lack of contract enforceability and the absence of a full set of financial instruments. We show that when households face uninsurable idiosyncratic risks on income and borrowing constraints the welfare implications of financial liberalization are considerable. For instance, the average increase in welfare of a typical emerging market economy that switches from financial autarky to perfect capital mobility would be equivalent to a permanent increase in average consumption of roughly 5.4 percent. This is about 3.9 times larger than the welfare gains of the same policy under the complete markets environment. Since the average welfare gain hides important distributional implications, we also provide a rationality of why such large welfare gains might not be exploited. In our calibration, the median household in capital scarce countries is in favor of international financial integration, but if the pivotal voter is wealthy enough, such reform might not be implemented, since richer households have a vested interest on capital market closeness.

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1 Introduction

As emphasized by Kose, Prasad, Rogoff, and Wei (2006) the merits and effects of financial globalization have generated a passionate debate among researchers and policy makers. The empirical literature, based on cross country regressions, finds

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that financial liberalization is not a sufficient condition for rapid economic growth. Kose, Prasad, and Taylor (2009), for instance, show that financial openness can have positive effects on growth when certain conditions (e.g., creditor's protection) are met. There are other key factors for growth, and financial integration *per se* does not deliver a higher rate of economic growth.[1] Henry (2007) criticizes the use of cross country regressions to test the effects of liberalization on economic growth, since liberalizing the capital account of a capital-poor country will only temporarily increase the growth rate of income per capita and cross countries growth regressions implicitly test for a permanent change in growth rates. Empirical studies (see Henry, 2007, for an overview) that use policy experiment approaches and firm level data show that capital market liberalization has, in general, effects on investment and growth that are consistent with the neoclassical growth theory. Levchenko, Rancière, and Thoenig (2008), for instance, using industry level data show that financial liberalization has a positive effect on capital accumulation and economic growth.[2] Rancière, Tornell, and Westermann (2008) point out that financial liberalization leads to more rapid growth in middle-income countries, but does not have the same effect in low-income countries. For similar results, see also Quinn and Toyoda (2008).

These recent empirical results on financial liberalization and growth go against the hypothesis of marginal productivity of capital equalization across countries, as proposed by Caselli and Freyer (2007). They observe that even if capital markets are integrated the marginal productivity of physical capital might be higher in poor countries if the relative price of capital goods is higher in poor than rich countries. The idea is that agents in poor countries do not invest more even with lower borrowing costs if the relative price of capital goods is higher in these countries. As Acemoglu (2009) points out, the calculation of marginal productivity of capital from Caselli and Freyer (2007) requires comparable measures of quality-adjusted differences in capital stock across countries, which might not hold in practice. In addition, notice that their hypothesis would not work if financial deregulation of domestic markets and the liberalization of capital account allow external investors to take advantage of low wages in these countries with imported capital goods and technology.

[1] See Kose, Prasad, Rogoff, and Wei (2006) for a review of the literature on growth and financial openness. Recently, using panel data techniques Bonfiglioli (2008) shows that international financial integration has a positive direct effect on total factor productivity, but the effects on capital accumulation are insignificant.

[2] In a recent paper, Gupta and Yuan (2008) show also using firm level data that liberalization reduces financing constraints, and industries that are more externally dependent and face better growth opportunities grow faster following capital market liberalization. They show that the growth impact of stock market liberalization is larger if it is accompanied by competition enhancing reforms, such as price liberalization and reduction in entry barriers.

From a simple (theoretical) growth perspective, for a given level and growth rate of total factor productivity (TFP), international financial integration enables capital scarce countries to raise capital inflows with positive effects on investment and the speed of convergence. It also benefits capital abundant countries by allocating their savings into more productive investment.[3] In an influential article, Gourinchas and Jeanne (2006) show in a standard neoclassical growth model that financial openness increases the speed of convergence towards the steady state with a positive effect on domestic welfare. Such benefits, however, seem to be quantitatively limited.[4] Why are the welfare gains small? For a country that is very close to the steady state consistent with the world interest rate, the gain from financial integration is second order, since the cost of foreign borrowing is very close to the return. Only countries that are far away from the steady state would have significant benefits on opening the capital account, but even for such countries the removal of barriers to capital flows would generate only a temporary increase in capital accumulation relative to autarky. Gourinchas and Jeanne (2006) posit that: "*For the typical non-OECD 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.*" According to them, international financial integration would lead to important quantitative effects only if it can "import" foreign productivity, or decrease economic distortions (i.e., if it increases TFP), as also pointed out by Obstfeld and Taylor (2004).

In this paper, we also investigate the quantitative welfare implications of international financial integration in a neoclassical growth model. We, however, consider an economy with heterogenous agents and incomplete markets in the same spirit of Aiyagari (1994) and Huggett (1993). In this environment, households face uninsurable idiosyncratic shocks on their labor productivity and there are endogenous borrowing constraints of the type considered by Kehoe and Levine (1993). Although Kehoe and Levine (1993) introduced participation constraints in a complete markets framework, we use it in an incomplete markets environment as in Ábrahám

[3]There is also a literature on financial integration and output volatility. See Kose, Prasad, Rogoff, and Wei (2006) for a review of this literature. The theoretical literature shows that financial integration might allow poor countries to diversify their narrow production bases and therefore reduce macroeconomic volatility. However, it can increase specialization in open middle income countries, increasing output volatility. Financial integration could also expose countries to world interest rate shocks. Aizenman, Chinn, and Ito (2008) show that depending on the level of financial development, financial liberalization might reduce or increase output volatility. We will abstract from the effects of financial integration on output volatility and will emphasize its role on convergence and consumption smoothness.

[4]They also show that results are robust to the introduction of human capital, and perform other robustness exercises.

and Cárceles-Poveda (2010). We also investigate the case of the Aiyagari (1994) natural borrowing limit but results are similar and therefore we report results with only the endogenous borrowing constraint. In fact, our quantitative results are robust to any form of borrowing constraint, including the *ad-hoc* fixed restriction. There is no aggregate uncertainty in our framework. Openness in the capital market allows households to borrow in international markets – at lower cost for initially capital scarce countries. Households borrow and save at the new lower rates, and the inflow of capital raises average labor income. These effects are all present in the deterministic growth model.

However, when households face idiosyncratic shocks on their labor productivity there is an additional motive for households to engage in intertemporal trade. Given the economy-wide average productivity and its trend, some households might be experiencing good shocks while others might be facing negative shocks. The latter might need to borrow to insure against shocks on their productivity. The integration of the economy into international capital markets decreases borrowing costs in capital scarce countries and allows current borrowers to increase their consumption possibility frontier. A lower interest rate also loosens borrowing constraints, with positive welfare effects on borrowers. The two effects might even increase the value function of current savers, since with positive probability they may need to borrow in the future due to the possibility of facing negative income shocks. However, with a lower interest rate rich households will also be affected negatively, since interest income will be lower. Notice that our results depend on the hypothesis that financial openness will lead to capital inflow and consequently will decrease the interest rate and will increase wages in relative capital scarce countries, as in Gourinchas and Jeanne (2006). This might not occur if the complementary inputs to physical capital (e.g., human capital) are relatively low (e.g., Lucas, 1990, Caselli and Freyer, 2007) or/and if complementary institutions which protect creditors are not present (e.g., Mendoza, Quadrini, and Ríos-Rull, 2007).

We show that the introduction of uninsurable idiosyncratic risks on labor productivity boosts aggregate welfare effects. For an economy with the average capital to output ratio of a large sample of non-OECD economies, aggregate welfare increases by at least a factor of 3.9 when compared to the complete markets Arrow-Debreu economy.[5] In addition, heavy savers lose while borrowers have large welfare gains from international financial integration. In the benchmark case, at the top quintile

[5]Hoxha, Kalemli-Ozcan, and Vollrath (2009) also find large welfare gains of financial liberalization using an Arrow-Debreu environment. In their model, countries are different in their fundamentals (e.g., rate of technical change and subjective discount factor) and not only on the level of capital scarcity.

of wealth distribution households have an average welfare loss of about 0.6 percent, while households at the lower quintile of the wealth distribution have an average welfare gain of 8.5 percent of consumption equivalent to the baseline level.

We also show that in capital scarce countries the median household is in favor of a reform that integrates a close financial economy to the international capital market. Consequently, if the political power depends on the vote of the median household, then countries would implement such a reform. However, if the political power is unequal and its concentration depends positively on wealth (as argued by Engerman and Sokoloff, 2005, and others), then financial integration might not occur and will be less likely the closer the economy is to its long run equilibrium. Therefore, we provide a political argument to explain why there might exist aggregate unexploited gains from international financial integration.[6] In fact, our results are consistent to the empirical evidence on democracy and financial liberalization. Quinn (2000) and Quinn and Toyoda (2007) show that sustained democratization produces sustained liberal international financial regulation.

There is a vast literature on the welfare implications of financial integration. Most of this literature focuses on how financial integration might lead to risk sharing among countries and evaluate the benefits of cross country risk sharing.[7] Interestingly, Athanasoulis and van Wincoop (2000) find large benefits from risk sharing. The gain for a 35-year horizon, corresponding to a welfare equivalent permanent increase in consumption, is 6.6 percent when based on a set of 49 countries. Recently, Townsend and Ueda (2009) analyze how capital market openness can affect financial deepening, in a similar way to Greenwood and Jovanovic (1990) and Acemoglu and Zilibotti (1997), by reducing transaction costs. They also find large welfare effects. We emphasize different mechanisms on how financial integration might affect welfare. We focus on two distinct channels: (i) the first one, which is similar to the one studied by Gourinchas and Jeanne (2006), corresponds to how financial integration allows capital scarce countries to grow faster towards the long run equilibrium, decreasing the interest rate and increasing the average wage; and (ii) the second channel, which is through the ability of households to insure against idiosyncratic risks by reducing borrowing costs and loosening borrowing limits. Both channels benefit the poor, but the welfare of those households whose income depends heavily

[6]Wright (2005) also provides a reason for the existence of large unexploited gains from international financial integration. He shows that market incompleteness can lead to a coordination problem, such that investors (foreign and domestic) might disagree on how a firm should be operated. In another vein, Gourinchas and Jeanne (2005) model how international capital mobility affects the incentives for countries to adopt reforms that can enhance productivity.

[7]See, for instance, Athanasoulis and van Wincoop (2000), Lewis (2000) and Obstfeld (1994).

on the return of financial assets might decrease.[8] We show that the combination of the two effects can generate large welfare gains from financial liberalization. The rationality is the following. Holding all other things constant, financial liberalization decreases the interest rate and increases the wage rate in a capital scarce economy. This is effect (i) and its welfare implication in a complete markets economy is quantitatively small. However, when there are idiosyncratic shocks on labor income, the impact on the marginal utility of consumption of the same variation in labor productivity is larger for relatively poor households than for relatively rich households. Since labor income corresponds to a large fraction of total income for poor households, financial liberalization can lead to large welfare effects for relative poor households. Wealthy households might experience welfare losses but the aggregate welfare effects are positive and large because of the relative higher marginal utility of poorer households. One important point is that the welfare gains from financial deepening, which is endogenously determined within the model, is relatively small; accounting for at most one fifth of the average welfare gains.

Incompleteness of markets is especially relevant in the context of a developing economy, which is likely to show a much lower level of financial sophistication than, say, the US economy. Although when formal insurance mechanisms are not in place, there are alternative informal arrangements[9] in which households insure against idiosyncratic income shocks (see, for instance, Townsend, 1994), the recent empirical evidence has pointed out that informal insurance mechanisms are often weak. In particular, poor households in developing countries have substantial difficulties to insure against idiosyncratic risks (see Morduch, 1999, Ravallion and Chaudhuri, 1997). The hypothesis of incomplete markets therefore looks more plausible than the availability of a complete set of Arrow-Debreu securities. We see our exercises as complementary to those implemented by Gourinchas and Jeanne (2006). In fact, they emphasize in their concluding remarks the importance to depart from the Arrow-Debreu environ-

[8]Mendoza, Quadrini, and Ríos-Rull (2007) find the opposite. In their exercises, financial globalization hurts the poor in countries with less developed financial markets. In countries with depressed financial markets, liberalization will increase borrowing costs and therefore produce distributional effects in opposite direction to ours. Notice that our results are not contradictory to theirs, since our exercise is different. In their model, the only difference among countries is the *ad hoc* borrowing constraint. In a closed economy, countries with tighter borrowing constraints have lower interest rate. When these countries open their financial capital market, the interest rate rises instead of falling. In our model, borrowing constraints are either the endogenous or the natural one, and as in Gourinchas and Jeanne (2006) the only difference among countries is the level of capital scarcity. Notice that as our economy develops over time, the level of financial development (borrowing limits) also increases.

[9]Some of these mechanisms are individual and community actions, such as drawing down savings, selling of physical assets, exchanges of gifts and loans, expanding income-generating activities such as increasing child labor and female labor participation (c.f., Jacoby and Skoufias, 1997).

ment to evaluate the effects of international financial integration.[10] We do this by considering an economy with incomplete markets and endogenous borrowing limits. We believe that such modeling strategies are important for our understanding of how financial liberalization might affect welfare in developing countries when the complementary institutions emphasized by Kose, Prasad, and Taylor (2009) are in place. They also allow us to investigate how the effects of international financial integration are distributed across all households.

The paper proceeds as follows. Section 2 describes the model economy and defines the competitive equilibrium. Section 3 describes the model calibration and contains policy experiments designed to evaluate the welfare effects of international financial integration. It also analyzes the political economy of capital market openness. Section 4 concludes. The appendices contain some robustness exercises and how we computed the transition and steady state of the model economy.

2 The model

The model economy is characterized by a standard neoclassical growth model based on Aiyagari (1994), with infinite-lived households who are *ex-ante* identical. Households face idiosyncratic shocks on their labor productivity but there is no aggregate uncertainty. This allows us to study the effects of financial integration on welfare in a world where individuals use financial assets to smooth consumption not only over time, but also across different states. The production sector is represented by a technology that exhibits constant returns to scale. The produced good can be used for consumption or investment. Below we describe the economy in detail.

2.1 The production sector

At any time period t there is a production technology that converts capital, K_t, and efficient units of labor, $A_t L_t$, into output Y_t according to:

$$Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}. \tag{1}$$

Parameter $\alpha \in (0,1)$ corresponds to the capital income share. Capital depreciates at rate $\delta \in (0,1)$, and labor productivity, A_t, grows at constant rate $1+g = \frac{A_{t+1}}{A_t}$, with $A_0 = 1$. Households competitively rent units of efficient labor and capital to

[10] Marcet and Marimon (1992) also investigate the welfare effects of capital market openness in a non Arrow-Debreu environment under enforcement, informational, and commitment problems. Depending on the friction considered, financial openness can also lead to large aggregate welfare implications.

firms. Input rental prices are given by their marginal productivity:

$$w_t = (1-\alpha)K_t^{\alpha}A_t^{1-\alpha}L_t^{-\alpha}, \tag{2}$$

$$r_t^K = \alpha K_t^{\alpha-1}(A_tL_t)^{1-\alpha}\,. \tag{3}$$

Because the production function is homogeneous of degree one, profits are zero, and firm ownership is unimportant. We therefore assume a representative firm.

2.2 The household sector

The economy is inhabited by a continuum of infinitely lived and *ex-ante* identical households with measure one. The household size, N_t, grows at exogenous rate $1+n = \frac{N_{t+1}}{N_t}$. We normalize the initial population to one. Each household supplies inelastically N_t units of labor per period, and faces idiosyncratic shocks on labor productivity. A household with shock z_t receives labor income $w_tN_tz_t$. We assume that z_t follows a finite state Markov process with support $\mathcal{Z}$ and transition probability matrix $\mathcal{P}(z,z') = \Pr(z_{t+1}=z'|z_t=z)$. The Markov chain generating z_t has just one ergodic set, no transient states and no cyclically moving subsets. Each household has preferences defined over stochastic processes for consumption per household member, c_t, given by the following utility function:

$$\mathrm{E}_0\left[\sum_{t=0}^{\infty}\beta^t N_t u(c_t)\right]\,, \quad \beta\in(0,1)\,. \tag{4}$$

The one-period utility function is represented by

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}\,, \quad \sigma>0\,.$$

Households do not have access to state-contingent contracts but can sell and buy financial assets in the form of a debt contract. At each period t, households are distinguished by their labor productivity shock, z_t, and asset holdings, a_t. A household's one-period budget constraint is given by:

$$N_tc_t + a_{t+1} \leq (1+r_t)a_t + w_tN_tz_t\,, \tag{5}$$

where $r_t = r_t^K - \delta$ and δ is the capital depreciation rate.

For computational purposes, we transform variables in order to make the economic system a stationary one. The transformations are standard: aggregate variables, Y and K, are divided by AN, and per capita variables and factor prices

that grow over time in the balanced growth path at the rate g are divided by the technology level, A. Therefore, we define:

$$\hat{Y} = \frac{Y}{AN}; \quad \hat{K} = \frac{K}{AN}; \quad \hat{c} = \frac{c}{A}; \quad \hat{a} = \frac{a}{AN}; \quad \hat{L} = \frac{L}{N}; \quad \hat{w} = \frac{w}{A}.$$

Define $\underline{\hat{a}}$ as the overall lower bound on assets per efficiency unit of labor. We assume an upper bound on assets per efficiency unit of labor, $\hat{\overline{a}}$, such that if assets are larger than $\hat{\overline{a}}$ households would choose to decrease asset holdings. Define $X = [\underline{\hat{a}}, \hat{\overline{a}}] \times \mathcal{Z}$ and let χ be the associated Borel σ-algebra. For each $B \in \chi$, $\lambda(B)$ corresponds to the mass of households whose individual state vectors lie in B. The household's value function depends not only on the current idiosyncratic state and asset holding, but also on aggregate variables such as the wage and the interest rate, which are affected by the current measure λ_t. To compute such measure in the next period, the households need to know the current period's entire measure λ_t, and an aggregate law of motion, which we will call H, such that $\lambda_{t+1} = H(\lambda_t)$. We will define $H(\cdot)$ shortly.

For the borrowing limit, we consider the endogenous one.[11] We follow Kehoe and Levine (1993) and assume that the penalty for those who default in their debt is the exclusion from future intertemporal trade. The borrowing limit is defined such that it is never in the household's best interest to default. In order to define the endogenous borrowing limit, it is necessary to calculate the utility under financial autarky. In case of default, households are excluded from intertemporal trade. Then, the value of the household problem under autarky is

$$\underline{v}(z_t, \lambda_t) = u(\gamma\, \hat{w}_t\, z_t) + \tilde{\beta}\, \mathrm{E}[\underline{v}(z_{t+1}, \lambda_{t+1})|z_t]\,,$$

where $\tilde{\beta} = \beta(1+n)(1+g)^{1-\sigma}$ and $\gamma \in (0,1)$ accounts for a pecuniary loss due to the default stigma, as in Chatterjee, Corbae, Nakajima, and Rios-Rull (2007) and others. Ábrahám and Cárceles-Poveda (2010) show that this limit exists for all z_t providing u is unbounded below. Given that we model the labor productivity process as a finite approximation of an AR(1) process, for any productivity level there is always a non-negative probability that next period the household is in the productivity state with the strictest borrowing limit. Since we do not allow for defaults, we use the strictest credit limit for all productivity states.

[11] As mentioned previously, results are roughly unchanged when we use the natural borrowing limit, as in Aiyagari (1994). For the sake of space, we only show the results with the endogenous borrowing limit. Results with the natural borrowing limit are available upon request. In subsection 3.5, we make the point that the quantitative results do not depend much on the form of the borrowing constraint.

In order to use the standard notation in dynamic programming we denote future variables by superscript prime (e.g., $\hat{a}_{t+1} = \hat{a}'$). The value function of a household with net worth $\hat{a}$ and labor productivity z is defined by the following maximization problem:[12]

$$v(\hat{a}, z, \lambda) = \max_{\hat{a}'} \quad u(\hat{a}(1+r) + \hat{w}z - (1+g)(1+n)\hat{a}') + \tilde{\beta}\,\mathrm{E}[v(\hat{a}', z', \lambda')|z] \qquad (6)$$

subject the endogenous borrowing limit,

$$v(\hat{a}', z', \lambda') \geq \underline{v}(z', \lambda')\,, \qquad \forall z' \in \mathcal{Z}\,, \qquad (7)$$

and

$$\lambda' = H(\lambda)\,. \qquad (8)$$

Constraint (7) guarantees that households will honor their promises and they will not default on their debt. Value function $v(\hat{a}, z, \lambda)$ is non-decreasing in $\hat{a}$ and value function $\underline{v}(z, \lambda)$ is independent of $\hat{a}$. Therefore, equation (7) defines a lower bound $\underline{\hat{a}}^{\mathrm{EB}}$, such that $\hat{a}' \geq \underline{\hat{a}}^{\mathrm{EB}}$. We assume that the overall lower bound defined above is such that $\underline{\hat{a}} < \underline{\hat{a}}^{\mathrm{EB}}$.

2.3 Equilibrium

Let $x = (\hat{a}, z)$ be the individual state vector of a particular household. The policy function associated with problem (6) is $\hat{a}' = h(x, \lambda)$. Given policy function $h(x, \lambda)$ we can compute $\hat{c} = h_{\hat{c}}(x, \lambda)$ using the budget constraint. Define $Q(x, \lambda, B; h)$ as the endogenous transition probability of the households' state vector. It describes the probability that a household with state $x = (\hat{a}, z)$ will have a state vector lying in B next period, given the current asset distribution λ and decision rule h. Therefore,

$$Q(x, \lambda, B; h) = \sum_{(h(x,\lambda), z') \in B} \mathcal{P}(z, z')\,.$$

The aggregate law of motion implied by transition function Q is an object $T(\lambda, Q)$ that assigns a measure to each Borel set B. It can be computed as

$$T(\lambda, Q)(B) = \int_X Q(x, \lambda, B; h) d\lambda\,. \qquad (9)$$

[12]Here we used budget constraint (5) into the one-period utility function. Since our focus is not only on the stationary equilibrium, but also on the transition to this equilibrium, we should also include an index of time in the value function and aggregate measure. For the sake of notation, we omit it.

Note that $\lambda'(\cdot) = T(\lambda, Q)(\cdot)$. We now define a recursive competitive equilibrium and a stationary equilibrium.

Definition 1 *A **recursive competitive equilibrium** for this economy consists of value function $v(\hat{a}, z, \lambda)$; policy functions $\hat{a}' = h(x, \lambda)$ and $\hat{c} = h_{\hat{c}}(x, \lambda)$; vector of prices $(\hat{w}, r^K, r)$; initial distribution λ_0; and aggregate forecasting rule $H(\lambda)$, such that:*

1. *Given prices, initial distribution and aggregate measure, policy function $\hat{a}' = h(x, \lambda)$ solves $v(\hat{a}, z, \lambda)$;*

2. *Factor prices are determined competitively, according to (2), (3), and $r = r^K - \delta$.*

3. *Markets clear:*

$$\hat{L} = \int_X z d\lambda \tag{10}$$

$$\int_X h(x, \lambda) d\lambda = \hat{K}' \tag{11}$$

$$\int_X h_{\hat{c}}(x, \lambda) d\lambda + (1+g)(1+n)\hat{K}' = \hat{K}^\alpha \hat{L}^{1-\alpha} + (1-\delta)\hat{K}\,. \tag{12}$$

4. *Distributions are consistent with individual behavior: $H(\lambda)$ coincides with $T(\lambda, Q)$.*

Definition 2 *A **stationary equilibrium** is an equilibrium where the probability measure λ is stationary, i.e., $\lambda(B) = T(\lambda, Q)(B)$ for all $B \in \chi$.*

3 Quantitative experiments

The purpose of the quantitative analysis is to provide a numerical assessment of the welfare and distributional effects of financial integration. The quantitative exercises require us to calibrate the theoretical model. We must determine values for a set of parameters, which are related to: (i) preferences; (ii) technology; (iii) the stochastic process of labor productivity; and (iv) initial distribution.

Given that we are studying the transition of economies considerably away from the steady state, we cannot directly compare steady-state outcomes. Our exercise is not possible without computing the entire transition path of the economy. This is a cumbersome task which involves keeping track of the whole assets and idiosyncratic shocks distribution. The welfare of any policy change is assessed through direct

computation of the value functions in the two situations (with and without financial markets liberalization) given the same initial distribution of assets and shocks.

3.1 Calibration and benchmark economy

Below we describe how we set parameter values. The model period is taken to be one year.

Calibration For comparison purposes, we set parameter values for technology, population growth, and labor productivity growth similar to those chosen by Gourinchas and Jeanne (2006). One important point is that the interest rate in the long run is depressed relative to the deterministic neoclassical growth model because each household has an additional self-insurance (or precautionary) incentive to save. These additional savings increase the capital-labor ratio and reduce the equilibrium interest rate. Therefore, in order to make the interest rate of the model with idiosyncratic risks similar to the one defined by the deterministic model we decrease the value of the subjective discount factor β. Otherwise, welfare differences from the two models might be driven by the difference between the respective long run marginal productivity of capital, which will be larger in the model with *ex-post* heterogenous households. Consequently, to make the numbers comparable we chose β such that the two models generate the same interest rate in the long run, hence the same capital to output ratio.

As a robustness check, in appendix A we also report the welfare implications of capital market integration when all parameters are identical to the calibration reported by Gourinchas and Jeanne (2006), except for the introduction of labor productivity shocks. This is also important since when β decreases households value relatively more the present than the future, which might also affect welfare. As we show, the two effects (distance to the steady state and lower value of β) almost cancel each other, and results are roughly the same.

It remains to define the income labor process and the initial distribution. For the idiosyncratic process, we followed Krueger and Perri (2005).[13] We use a finite approximation of process

$$\ln(z') = \rho \ln(z) + \epsilon' , \tag{13}$$

[13]We also have results for the case where the idiosyncratic shocks have a persistent component and an iid component, as in Heathcote, Storesletten, and Violante (2008). They were quantitatively consistent with those reported here, but more computationally demanding since their process is a composition of an iid component and an autoregressive component.

where ϵ' is normal iid with zero mean and variance σ_ϵ^2. We set ρ equal to 0.98, the value used by Krueger and Perri (2005). These authors show that the cross-section variance of idiosyncratic income is 0.719, after removing the effects of observables. We therefore set σ_ϵ^2 to 0.0285.

The pecuniary cost parameter γ is set by equating the level of credit to output ratio in the model to the observed US level. Since in our model there is only unsecured debt, we use total revolving credit as reported in table G.19 of the Federal Reserve Board Statistics and Historical Data pages. This table reports all short- and medium-term credit extended to individuals not secured by real estate. Revolving credit does not include auto loans, loans for mobile homes, education, vacations, and some other items. Nonrevolving credit can be secured or unsecured, so we excluded it from our measure. The average US level is 7.7 percent of GDP in the last 5 years; we target 8 percent in the calibration. Table 1 contains the calibrated parameter values.

For the initial distribution of assets and labor shocks, we consider the unconditional invariant distribution associated with an economy with about a quarter the TFP of a developed economy. We then set the TFP equal to the developed economy level and compute the transition under the assumption that there is no financial integration. The capital to output ratio will go from the initial (low) value to the steady-state level, which is equal to the world level. We analyze the transition from the moment the capital to output ratio is roughly 1.3 on. For each level of the capital to output ratio, we compute the welfare gain by comparing the value function under no financial integration with the utility under perfect financial integration, which, for each household, is just the value function under exogenous price levels equal to the world levels. In appendix B we do some robustness exercises using different assumptions about the initial asset distribution.

Benchmark economy Table 2 reports statistics for the US economy and model. The model has less earnings inequality than the data, but observe that not all inequality in the data comes from idiosyncratic shocks to labor productivity. Part is also due to differences in individual characteristics, such as schooling and experience.

Table 2 shows that the model with the endogenous borrowing limit produces a Gini index of 87 percent, while in the data it is 78 percent. In addition, the first row of table 2 shows that in the data, the top 1 percent of households have 29.6 percent of all wealth. Under the borrowing constraint with permanent exclusion, the top 1 percent of households hold only 16 percent of total wealth and the bottom

Table 1: Parameter values, benchmark economy: values similar to those in Gourinchas and Jeanne (2006).

Parameters	Calibration	Comment/Observations
σ	1	Risk aversion coefficient
α	0.30	Capital income share
$\beta_{\text{deterministic}}$	0.96	Subjective discount factor
$\beta_{\text{endogenous}}$	0.9545	Subjective discount factor
δ	0.06	Depreciation rate
g	0.012	Growth rate of labor productivity
n	0.0074	Population growth rate
ρ	0.98	Autocorrelation of idiosyncratic productivity from Krueger and Perri (2005)
σ_ϵ^2	0.02847	Variance of innovations in productivity based on Krueger and Perri (2005)
γ	0.85	Pecuniary loss on wages due to credit default set to have credit to output ratio of 8 percent

20 percent have more negative wealth than in the data.[14] This model misses the top and bottom tails of the distribution, but does a reasonable job in the middle.[15]

3.2 Welfare in the model with complete markets

In the absence of labor productivity shocks or if there are complete asset markets, our economy is identical to the standard neoclassical growth model used by Gourinchas and Jeanne (2006). We therefore first replicate their main quantitative results. In this economy capital to output ratio in the long run is equal to 2.63 and the interest rate is equal to 5.4 percent. In order to focus on the impact of international financial integration on consumption smoothing, we assume that this number corresponds to the world interest rate. Part I of table 2 already reflects that assumption.

We reproduce figure 1 in Gourinchas and Jeanne (2006). (See figure 1.) This figure presents the welfare gains[16] measured by the equivalent variation from international financial integration as a function of the initial capital to output ratio. The

[14]The model with a natural borrowing limit produces roughly the same level of inequality, but it still does not match the tails of the asset distribution. Importantly, it tends to have too much credit: the model has ratio of credit to output of 34 percent, far above our estimate of 7.7 percent in the US economy and the 8.2 percent level with the endogenous borrowing limit model.

[15]Quadrini and Ríos-Rull (1997) and Castañeda, Díaz-Giménez, and Ríos-Rull (2003) note that this is a common feature of neoclassical growth models with heterogeneous households and uninsurable idiosyncratic shocks to earnings. Quadrini (2000), for instance, shows that entrepreneurs accumulate more assets because they face risk associated with business activities and higher returns on savings than workers. Therefore, entrepreneurs play an active role in shaping the wealth distribution.

[16]As Gourinchas and Jeanne (2006), we calculate the consumption equivalent for the benchmark

Table 2: Selected statistics: US data and benchmark. Data for the US economy are from Castañeda, Díaz-Giménez, and Ríos-Rull (2003) and authors' calculations.

	Capital to output ratio	Revolving credit to output ratio (%)	Wealth Gini (%)	Income Gini (%)	Percentage wealth in the top 1%	5%	10%	in the bottom 20%	60%
US data	3	7.7	78	63	29.6	54	66	-0.39	7.1
			Part I: $\sigma = 1$						
Deterministic model	2.63								
Model with idiosyncratic shocks (endogenous constraint)	2.63	8.2	87	58	16	50	72	-3.9	-3.5
			Part II: $\sigma = 2$						
Deterministic model	2.37								
Model with idiosyncratic shocks (endogenous constraint)	3.26	8.4	81	56	12	42	63	-1.9	0.8

vertical line corresponds to the long run level of the capital to output ratio. This figure shows that a country must have a very low capital to output ratio to significantly benefit from international financial integration. The capital to output ratio must fall below 1.29 for the gains from integration to exceed 2 percent of annual consumption. Using the Heston, Summers, and Aten (2006) Penn World Tables 6.2, we construct the capital to output ratio for 157 non-OECD countries in 2000.[17]

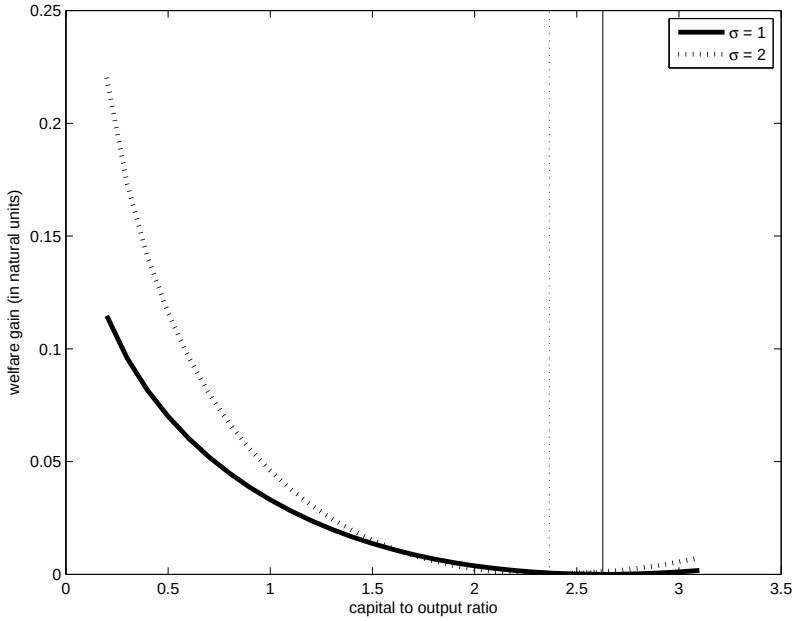

Figure 1: Welfare gains from international financial integration and the capital to output ratio. The welfare measure corresponds to the equivalent variation.

The average capital to output ratio for this sample is 1.47 and the population-weighted average is 1.91.[18] Because differently parameterized models have different

economy and for the economy after the policy change. This is

$$(1+\mu)^{1-\sigma} v^{\text{Closed}} - v^{\text{Lib}} = 0\,.$$

[17]In order to construct the capital to output ratio in 2000, we calculate:

$$\left(\frac{K}{Y}\right)_{2000} = \frac{\left(\frac{I}{Y}\right)_{2000}}{\delta + n + g},$$

where $\left(\frac{I}{Y}\right)_{2000}$ corresponds to the average investment rate from 1990 to 2000, $\delta = 0.06$, $g = 0.012$, and n is the average population growth from 1990 to 2000. See Klenow and Rodriguez-Clare (1997) for a similar approach. For some transition countries, because of data availability, we use the average from 1995 to 2000.

[18]Caselli and Freyer (2007) find that the return from investing in capital in the developing economies is more than twice as large as in the developed economies. However, when they consider natural resource endowments and differences in the price of capital, the average difference in the marginal product of capital between poor and rich countries disappears. Nevertheless, even using

capital to output steady-state ratios, we define *capital abundance* as the capital to output ratio in terms of its steady-state level. Therefore, the capital abundance of the average non-OECD country is $\frac{1.47}{2.63} = 0.56$, while the population-weighted figure is 0.73 . At a level of capital abundance of 0.56 , the gains from capital openness are 1.4 percent of consumption equivalent when $\sigma = 1$ and 2.3 percent when $\sigma = 2$.

This analysis is important to show that welfare gains from international financial integration emphasized by standard growth arguments are not substantial. Our goal, however, is to: (i) investigate how welfare benefits change when we introduce individual risks but not aggregate uncertainty; and (ii) study the distributional implications from financial integration: who are the winners and losers of such reform?

3.3 Welfare in the model with incomplete markets

As in the deterministic model, the economy with idiosyncratic shocks on labor productivity also implies that international financial integration raises capital inflows in capital scarce countries. Capital inflows increase the speed of convergence towards the long run equilibrium and allow households to better smooth consumption over time. With openness in the capital market, households can borrow in international markets to anticipate future increases in labor productivity due to capital accumulation, a feature also present in the standard deterministic growth model.[19]

Transition For a detailed account of the procedure to calculate the full transition of the economy under autarky, see appendix C. Panel (a) of figure 2 depicts the evolution of the interest rate of the economy under autarky as it approaches the steady state. The parameters are those reported in table 1. The transition is relatively fast, taking about 15 years to cover 90 percent of the gap between an interest rate of roughly 16 percent and the steady-state rate of 5.4 percent. Figure 2 also shows the transition for complete markets case when the initial capital abundance is exactly that of the incomplete markets case. Despite the incomplete markets and borrowing constraints, we see that the two paths are barely distinguishable. This

these two corrections there is some important variation in the data. The marginal productivity of capital, for instance, in Singapore (or Botswana) is twice as large as in Switzerland. See also the discussion of this issue in the introduction.

[19]This section reports the results on transition and welfare effects of international financial integration in a model with the endogenous borrowing constraint (Kehoe and Levine, 1993). The results for the model with the natural borrowing limit (Aiyagari, 1994) are roughly similar to the ones presented in this section, except in terms of the total amount of credit, which is much larger. This unrealistic aspect of the model leads to higher welfare gains. We therefore present the more conservative results of the model with endogenous credit limits. All the results for the natural borrowing limit case are available upon request.

result suggests that the representative household model is quite accurate if one is mostly interesting in the convergence of aggregate quantities, as noted previously by Ríos-Rull (1994). Therefore, any welfare gains to heterogeneous households of international financial integration above those of the deterministic case must come from an improvement in the allocation of resources across individuals.

Panel (b) of figure 2 plots the interest rate against capital abundance in each period for the model with idiosyncratic shocks. Each circle corresponds to one period in the model. Initial capital abundance is slightly above 0.5 for an interest rate of about 16 percent. The figure shows the expected negative relationship between interest rate and capital abundance, but also suggests that capital scarceness is rapidly eliminated through aggregate savings.

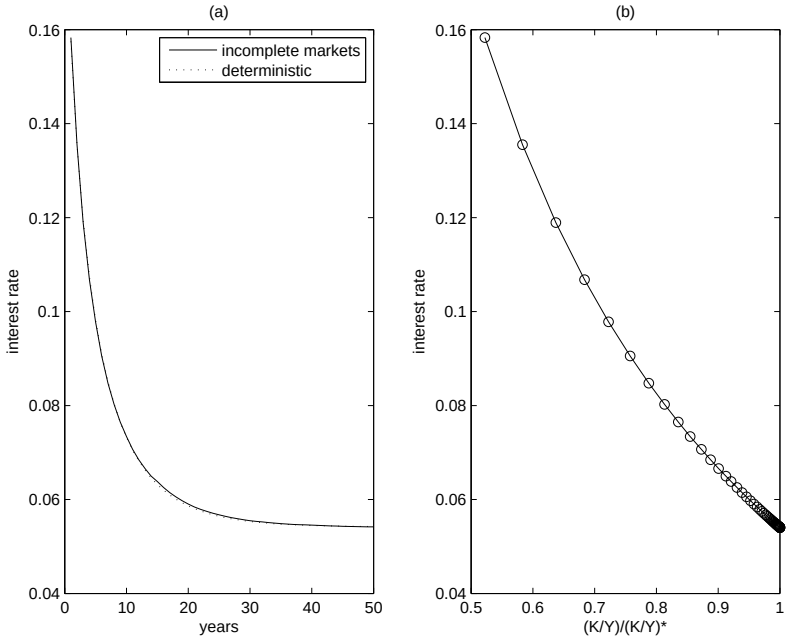

Figure 2: Transition of the interest rate. Each circle represents a period. Model with endogenous borrowing limit.

One important dimension of the model is the amount of credit in the economy. Figure 3 documents one important prediction of the model that fits the available data (Levine, 1997): financial integration leads to financial deepening, that is, as the economy integrates financially, the amount of credit increases and credit constraints become slacker. Panel (a) of the figure depicts the endogenous credit limit as a function of capital abundance. We see that the total amount of credit that households can borrow goes from 16 percent of the average yearly wage, when capital abundance is 0.53, to about one quarter. Given that the wage also increases along the transition, in absolute terms this increase of the borrowing limit is even more

pronounced: the credit limit roughly doubles.

Financial deepening is also evident in panel (b) of the same figure, where total credit as a fraction of output is depicted against capital abundance. This measure starts at a low level of roughly 3.5 percent and goes to the steady-state level of 8.2 percent. This is a strong increase. Again, in absolute terms the increase in the amount of credit is even larger. Panel (b) of figure 3 also documents another important feature of the transition. Contrary to what happens with prices, aggregate capital and even the borrowing limit, the transition of the amount of credit is quite slow. For instance, after 15 years total credit as a percentage of output is still roughly 6 percent (from an initial value of roughly 3 percent), that is, less than 60 percent of the gap between the initial value and the steady-state value. This contrasts with a figure above 90 percent of the gap covered in the same time when we consider the interest rate. This behavior suggests that, for relatively poor individuals, the initial increase in wages alleviates the need for debt. As this increase in wages falls, households start resorting more and more to debt in order to smooth consumption. The increase in the average wage delays the need for credit.

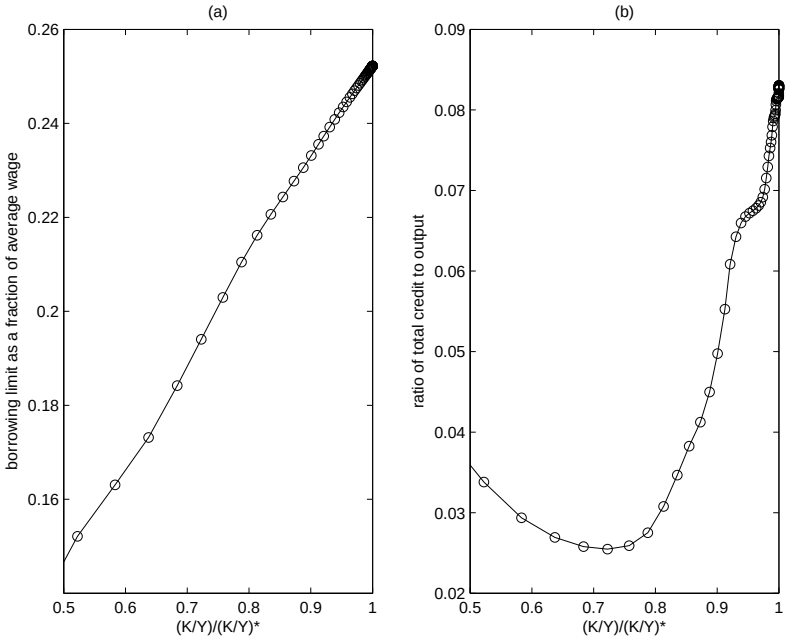

Figure 3: Transition of borrowing limits and total credit. Each circle represents a period. Model with endogenous borrowing limit.

Welfare We now turn to the welfare effects of international capital openness. Figure 4 displays a three dimensional graph of the welfare gains. The welfare gains are on the z-axis, while the x-axis and y-axis contain capital abundance (the capital

to output ratio as a fraction of its steady-state level), $\frac{K}{Y}/(\frac{K}{Y})^*$, and household net worth, $\hat{a}$, respectively. Quantitatively, households with a negative net asset position benefit from this policy, while welfare decreases for some current savers. Notice that the more scarce is capital in the economy the larger are the effects of openness of capital markets on welfare. For some households, the effects are sizeable. For a country with the observed average capital to output ratio of non-OECD economies (roughly 0.56 of the steady-state level), the welfare gains for some households with negative asset position can reach about 10 percent of their consumption under autarky. For households with positive net wealth, the welfare loss can reach about the same order of magnitude. The average effect depends on the welfare gains/losses of each household.

The international financial integration of a capital scarce economy increases capital accumulation, the average wage and welfare. When households face idiosyncratic shocks on their labor productivity there is also an additional effect. Given the economy-wide average productivity and its trend, some households might be experiencing good shocks while others might be facing bad shocks. The latter might need to borrow to insure against such shocks. Therefore, in an economy where households can trade intertemporally and face idiosyncratic shocks on labor productivity there is, at each point in time, a mass of households with positive and negative net asset position. The integration of the economy to international capital markets decreases borrowing costs in capital scarce countries and allows current borrowers to increase their consumption possibility frontier. This certainly increases the welfare of such households. In addition, borrowing constraints loosen. These two effects might even positively affect the welfare of current savers, since with positive probability they may need to borrow in the future due to the possibility of facing future bad labor productivity shocks. However, with a lower interest rate rich households will also be affected negatively, since interest income will be lower.

Figure 5 displays the average welfare measure[20] of an economy with the endogenous borrowing constraint that switches from financial autarky to perfect capital mobility for each level of initial capital abundance. The most salient feature of the curve is that, unlike figure 1, the curve is not flat in the vicinity of the steady-state capital to output level. This is an important point. Gourinchas and Jeanne (2006) note that figure 1 delivers the stark message that the welfare curve is very flat around

[20] We assume a benevolent planner who assigns equal weight to each household:

$$(1+\mu)^{1-\sigma}\int v^{\text{Closed}}(\lambda)d\lambda - \int v^{\text{Lib}}(\lambda)d\lambda = 0.$$

For a similar approach see also Mendoza, Quadrini, and Ríos-Rull (2007).

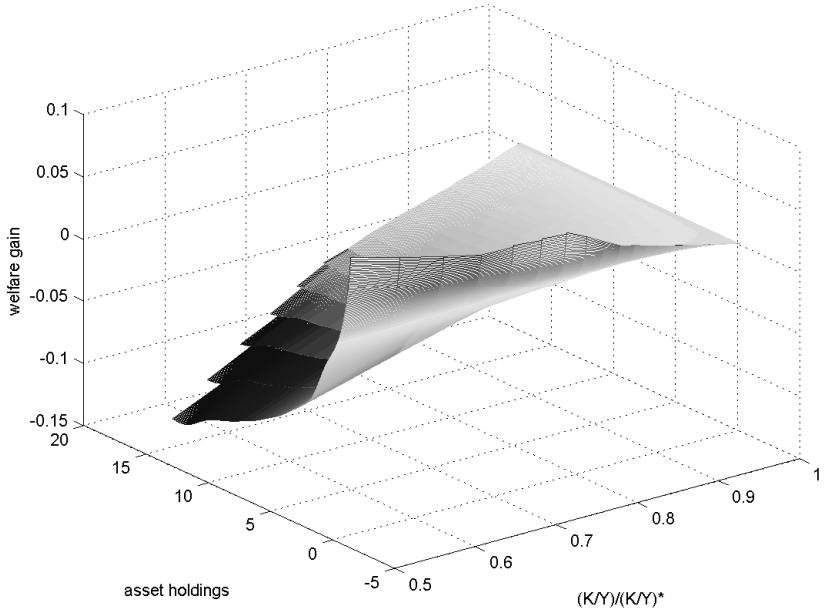

Figure 4: Welfare gains per asset holdings and capital abundance. Parameter values as in table 1. Asset holdings are asset levels normalized to their steady-state average. Endogenous borrowing constraint.

the steady-state capital to output level. Therefore, the welfare effects of international financial integration are second-order. In contrast, with incomplete markets the curve is actually not flat around the steady state; moreover, it hides important differences across households. This suggests a first-order effect of international capital integration on welfare.

The average welfare gain of a country with the observed capital abundance of a typical non-OECD country is about 5.4 percent of consumption equivalent of the autarky level. This is about 3.9 times larger than the welfare gain of the same policy in a deterministic version of the neoclassical growth model. In addition, for the average welfare gain to exceed 2 percent of the benchmark consumption, the capital to output ratio should be lower than 2.1, instead of 1.29 as in the deterministic case. Therefore, even for small differences in capital scarcity (or rate of returns as in Caselli and Freyer, 2007), the welfare gains of international financial integration might be quantitatively significant. Similar results are found when the natural borrowing constraint is in effect.[21]

Figure 5 also reports the welfare gains of households with the average level of asset holdings and average productivity. These welfare gains are lower than the

[21]The detailed results for the natural borrowing limit case are available upon request; they generally yield higher welfare gains, while producing unrealistically high levels of borrowing.

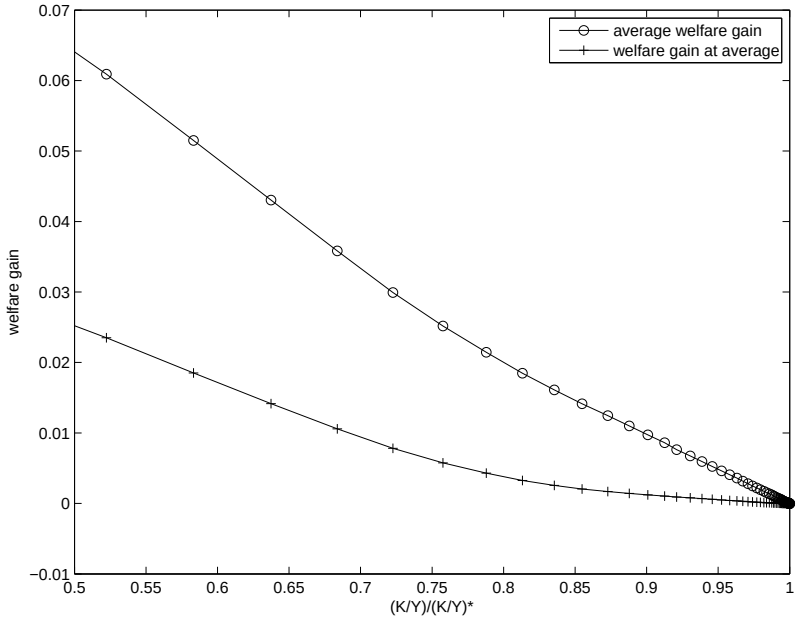

Figure 5: Average welfare gain versus capital abundance. Also depicted: welfare gain of households with the average asset value and average productivity versus capital abundance. Model with endogenous borrowing limit.

average welfare gains, but they are still positive and are slightly larger than the aggregate welfare gains of financial openness for economies without idiosyncratic shocks on labor productivity. For example, the welfare gain of the average household of the typical non-OECD country is 1.87 percent, while in the deterministic economy the comparable figure is 1.4 percent. This model replicates the main results of the deterministic economy in the sense that the welfare gains of the average household are comparable to those of the representative household of the deterministic model, while at the same time uncovering discrepancies in gains once we look at different levels of asset holdings and productivity.

Figure 6 displays the average welfare gain of net savers and net borrowers, as well as the welfare gain of households in the top and bottom quintiles of the asset distribution, for different levels of capital abundance. Depending on the net asset position, households might incur in welfare losses or gains when the countries open their financial capital markets. At the average level of the capital to output ratio of non-OECD economies, current savers on average have a gain in welfare of about 3 percent of their consumption equivalent of the benchmark level, while current borrowers have an average welfare gain of about 8 percent. If we look at households in the top quintile, we see that they have a loss of about 0.6 percent of consumption equivalent, while households in the bottom quintile have a welfare gain of 8.5 percent.

The previous figure shows that welfare gains are unevenly distributed. To fur-

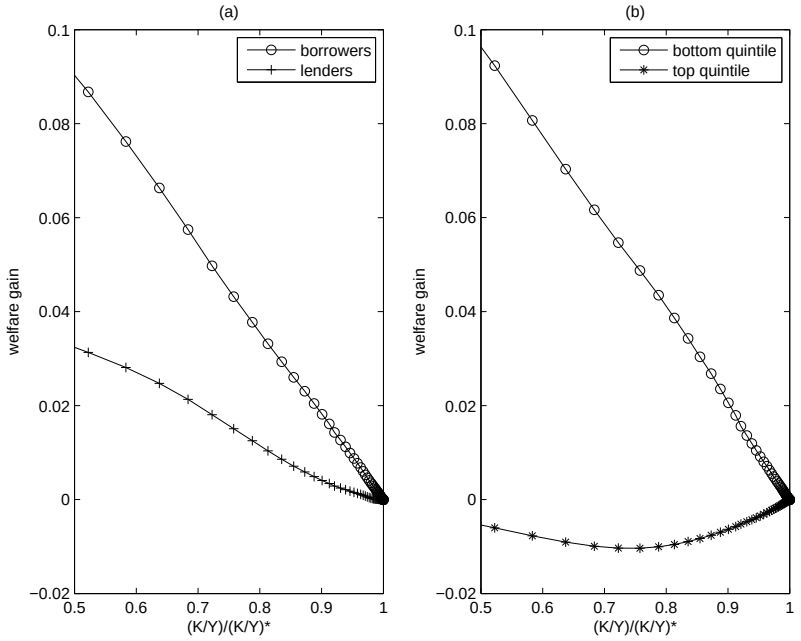

Figure 6: Panel (a): average welfare gain of net savers and borrowers versus capital abundance. Panel (b): average welfare gain of households in the top and bottom quintiles of the asset distribution. Model with endogenous borrowing limit.

ther investigate this distributional difference in welfare gains, figure 7 displays the welfare gain of households by percentile of asset holdings, for an economy with a capital abundance of 0.56 relative to the long run level, the average of non-OECD countries. In the logarithm utility case, we see that gains are about 8 percent up to the 20th percentile, then decline smoothly until they become negative after the 90th percentile. We therefore see that gains are very large for the poorest households, and negative only for a small fraction of the population.

3.4 Sensitivity to the risk aversion coefficient

We next investigate the quantitative implications of changing the risk aversion coefficient. In brief, we conclude that when risk aversion becomes higher, the welfare effects of international financial integration are larger, as expected since a large coefficient of relative risk aversion implies a stronger preference for consumption smoothing.

Calibration As a robustness exercise, we decrease the elasticity of intertemporal substitution (increased the coefficient of relative risk aversion), by assuming that σ

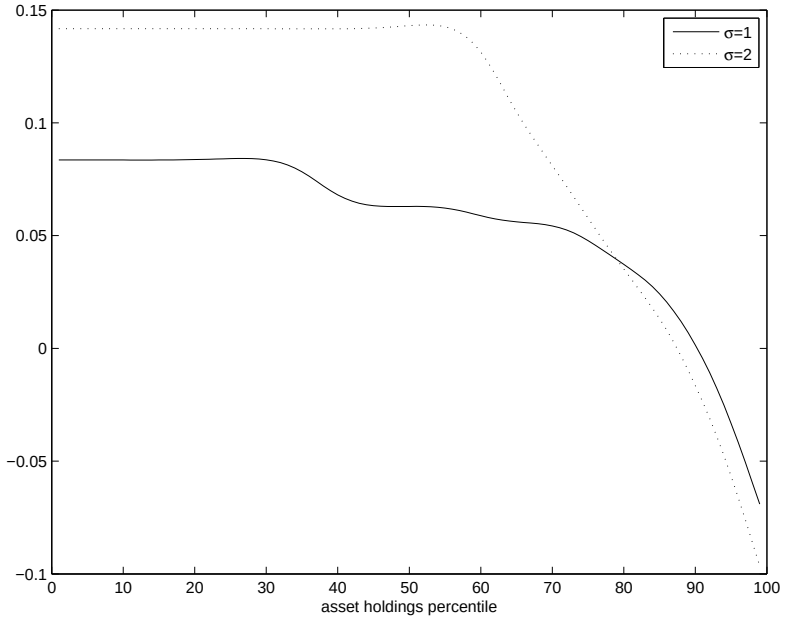

Figure 7: Welfare gain by percentile of asset holdings, in natural units.

is equal to 2 instead of 1.[22] In the case of the endogenous borrowing constraint, we also choose the pecuniary penalty γ so that the credit to output ratio is roughly 8 percent. We accomplish this by setting $\gamma = 0.9$. All the remaining parameters are kept identical to those reported in table 1.

From part II of table 2 we observe that the model produces lower inequality than in the data, but it does a better job at the lower tail of the wealth distribution. Figure 1 shows that in the deterministic model welfare gains from international financial integration are higher when the coefficient of relative risk aversion is equal to 2 instead of 1 if the capital to output ratio is far from its long-run equilibrium. A higher coefficient of relative risk aversion implies that households value more consumption smoothing, and capital market openness allows households to borrow such that consumption jumps from its initial level to its long run value. With $\sigma = 2$, at the observed average capital to output ratio of non-OECD economies the welfare gain of switching from complete financial autarky to perfect capital mobility is roughly 2.3 percent of consumption equivalent to its benchmark value, instead of

[22]Gourinchas and Jeanne (2006) also do some sensitivity analysis with respect to the elasticity of intertemporal substitution (EIS). It has long been recognized in the macroeconomics literature (e.g., King and Rebelo, 1990) that the welfare effects of economic policies critically depend on the elasticity of intertemporal substitution (EIS), where $\sigma = \frac{1}{\text{EIS}}$. In addition, there is a large literature on empirical estimates of the EIS and a large range of estimates. The point is that individual data estimates tend to be higher (higher than 2) than the aggregate data — time series — estimates (lower than two and close to one). See Guvenen (2006) for a discussion. See Gourinchas and Parker (2002) for a model-based estimation of the EIS.

1.4 as in the economy in which $\sigma = 1$.

When we introduce uninsurable shocks on labor productivity, the quantitative effects change substantially when we compare the economies with σ equal to 2 and 1. A large σ implies that households value more consumption smoothing, and a lower interest rate makes borrowing costs and consumption smoothing less costly, especially for those at the lower tail of the wealth distribution. A lower interest rate also relaxes borrowing constraints, increasing welfare. Figure 8 reports the average welfare impacts of capital market liberalization per capital abundance for the two cases. When $\sigma = 2$ the average welfare gain is about 7.4 percent of consumption equivalent for a country with the observed mean of capital abundance of non-OECD countries. This is about 48 percent larger than when the coefficient of relative risk aversion is equal to 1. Moreover, for the average welfare gain to exceed 2 percent, capital abundance has to be smaller than 0.85, which translates to a capital to output ratio of 2.24 only (this compares with 2.1 in the $\sigma = 1$ case).

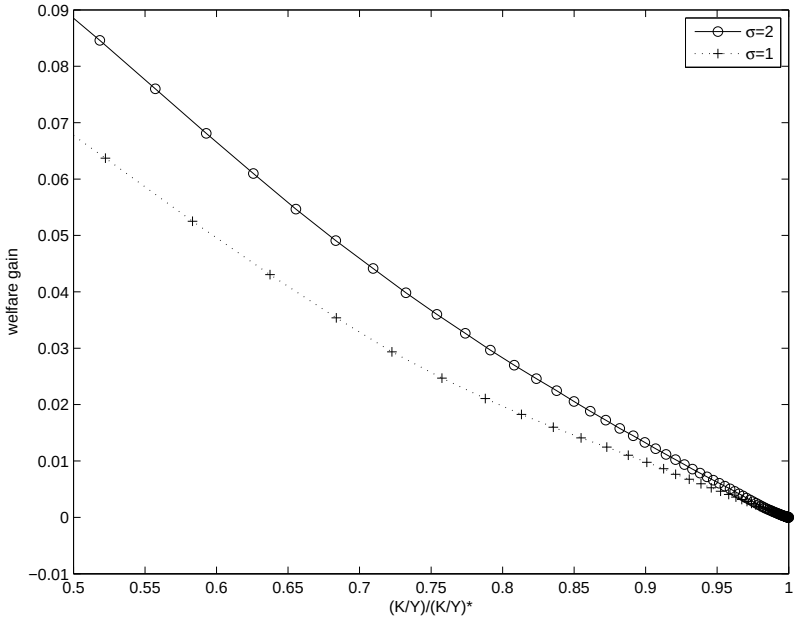

Figure 8: Average welfare gain versus capital abundance for two values of σ. Model with endogenous borrowing limit.

The distribution of the average welfare gains among lenders and borrowers looks similar to those of figure 6. There are only shifts in the numbers of welfare benefits of capital market liberalization.[23] For instance, when there are endogenous borrowing constraints, at the average capital to output ratio of non-OECD countries the average welfare gain of capital market openness for borrowers is about 11.5 percent

[23]For the sake of space, we do not report that graph here.

of the benchmark consumption, while when σ was equal to 1 it was about 8 percent. There is also a smaller welfare gain for lenders when $\sigma = 2$ than when it is equal to 1 at the previous level of capital abundance.

Figure 7 shows that, for $\sigma = 2$, welfare gains are higher than the logarithm case for most households. The difference is larger in the lower tail, and slightly negative in the upper tail of the wealth distribution. This justifies the fact that average welfare gains increase as σ increases.

3.5 The role of financial deepening

As documented in figure 3, the model displays financial deepening, since borrowing limits increase as the economy converges to the steady state. Here we investigate the role of borrowing constrains in the welfare effects of international financial integration. We consider two fixed *ad-hoc* borrowing constraints. The first one is defined as the borrowing limit that prevails in the benchmark calibration of section 3.1 when the capital to output ratio is equal to the observed average of the capital to output ratio in emerging economies, 1.47. We then let the economy adjust without changing the credit limit. This value is equal to 52 percent of the benchmark's long run endogenous limit. The second one is the extreme case where the borrowing limit is zero, that is, no lending is allowed. These are important exercises, since table 2 shows that there is more borrowing in the calibrated model than in the data. Therefore, the quantitative welfare results might be driven by the large mass of agents who are borrowing.

Consider the first case. When a capital scarce economy opens its capital market, capital flows in, decreasing the interest rate. Unlike in section 3.1, however, borrowing constraints are not affected.[24] The results are presented in table 3. The comparable results of part I in table 2 are reproduced here for convenience. In the long run, there is less borrowing and inequality in this model. Credit falls to about half the previous value, while the other indicators are slightly changed. These results suggest that the effect of relaxing borrowing constraints is not large, that is, financial deepening does not influence the macroeconomic allocation except at the very left tail of the asset distribution. In the case where the borrowing limit is zero, credit is, as expected, zero, and the other indicators follow the trend described above.

As for welfare, figure 9 provides the average welfare gain of international financial integration under the fixed *ad-hoc* borrowing constraints defined above. We can

[24]Since results do not change much, we do not provide simulations for the economy with a large coefficient of relative risk aversion, $\sigma = 2$.

Table 3: Selected statistics: US data, benchmark and two *ad-hoc* borrowing constraints. Data for the US economy are from Castañeda, Díaz-Giménez, and Ríos-Rull (2003) and authors' calculations.

	Capital to output ratio	Revolving credit to output ratio (%)	Wealth Gini (%)	Income Gini (%)	Percentage wealth in the top 1%	in the top 5%	in the top 10%	in the bottom 20%	in the bottom 60%
US data	3	7.7	78	63	29.6	54	66	-0.39	7.1
Benchmark model (endogenous constraint)	2.63	8.2	87	58	16	50	72	-3.9	-3.5
Ad-hoc borrowing limit (52 percent of benchmark's long run level)	2.63	4.2	85	57	15	49	70	-1.5	-0.5
Ad-hoc borrowing limit (no lending)	2.64	0	82	57	15	48	69	0.5	1.9

observe that the average welfare gain is quite similar to the case of the endogenous borrowing limit. For the first case, at the average capital abundance of emerging market economies, the average welfare gain is now roughly similar to what we found previously.

While extreme, the case where there is no lending is more interesting. At a capital abundance of 0.56, the welfare gain is roughly 4.5 percent, below the benchmark gain of 5.4 percent. Given that such allocation prevents any borrowing and that the welfare gain is still substantial, this suggests that the source of most of the welfare gains observed in incomplete markets models is the decrease in interest rate and increase in wages. In fact, allowing households to borrow in an incentive compatible manner only gives them a small additional gain of roughly 1 percentage point, while opening up capital markets benefits the bulk of households in this economy through higher wages and lower interest rates. Financial deepening accounts for at most one fifth of the average welfare gain of international financial integration. When the borrowing limit is zero, households with low, but non-negative asset holdings, benefit a lot if the economy integrates internationally, as they are heavily credit constrained.

To rationalize the previous result, it is important to understand that increasing the average level of labor income w is especially important under idiosyncratic risk. The reason is the following: given that labor productivity is very persistent, the dispersion of wage income is large. Households are very heterogeneous in this dimension. Positive shocks on wage income have a much higher positive impact on utility (higher marginal utility of consumption) when the household is relatively poor than when it is rich. This is reinforced by the fact that the share of labor income of household's total income is larger for poorer households. Therefore, the gains from international financial integration are not only due to the higher expected income, but also to the smaller variation of marginal utility that this higher level of income allows. This feature is in contrast with the complete markets model, where shocks are perfectly insured and financial integration has no distributional impact across households.

3.6 The political economy of capital market openness

From the exercises above we can learn two important lessons: (i) when households face idiosyncratic shocks on their labor productivity, international financial integration decreases the cost of borrowing, improving therefore the ability of households to insure against such shocks. In our calculations, comparing to the model that abstracts from uninsurable productivity shock, the average welfare gains can increase

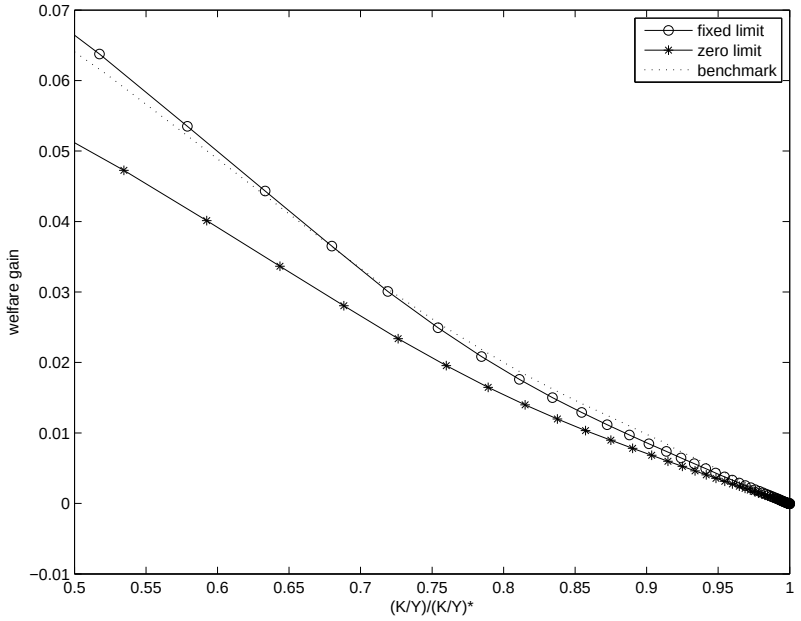

Figure 9: Average welfare gain versus capital abundance for two *ad-hoc* borrowing constraints and the benchmark model. The fixed limit is defined as 52 percent of the long run endogenous limit of the benchmark calibration. Model with endogenous borrowing limit.

by, at least, a factor of 3.9; and (ii) the average welfare measure hides important distributional effects: while there are some losses among net savers in the top quintile, there are large gains among borrowers. International financial integration benefits mainly the poor. However, would the pivotal voter benefit from such a reform on the capital market?

In this section we analyze, based on the previous results, the political economy of international financial integration. Figure 10 reports the difference between the fraction of individuals that benefit more than 0.1 percent of consumption from a policy that switches the capital market from being closed to open, and the fraction of those who oppose it, defined as those households whose losses are higher than 0.1 percent of consumption. We call this quantity *net political support* of the reform. The fraction of households that benefit from international financial integration corresponds to: (i) households with negative wealth; and (ii) households with positive wealth, but in which the gains of a higher wage and lower borrowing cost[25] compensate the welfare losses of lower interest income.

In panel (a) of figure 10 we can see that, for the benchmark case, political support is a decreasing function of capital abundance. The closer the economy is to

[25]All households have a positive probability of facing persistent negative shocks (including those with positive net wealth) on their productivity and therefore might have to rely on borrowing to smooth consumption.

its long run equilibrium (higher capital to output ratio), the lower will be the loss in interest income due to capital market openness. This explains why the fraction of individuals that benefits from capital market openness decreases with the capital to output ratio. Observe that when the coefficient of relative risk aversion is equal to one, then for an economy with the observed average level of capital to output ratio, the model with endogenous borrowing limit implies that the net political support of a policy that switches the economy from complete financial autarky to perfect capital mobility is 82 percent.

In order to investigate the robustness of this result further, we consider the political consequences of financial integration in an economy with higher inequality. We increase the standard deviation of innovations in the labor productivity process by 50 percent. The result is depicted in panel (a) of figure 10. When the inequality in wages is higher, for most of the range of capital abundance net political support for openness is smaller than under the benchmark. For instance, at the 0.9 relative capital to output ratio level, net political support is 10 percentage points lower when inequality in labor income is 50 percent larger than in the benchmark economy. For capital abundance lower than 0.63, net political support for openness is roughly similar to the benchmark case. When wage dispersion is higher, the precautionary motive for saving is stronger. At low capital abundance, openness is very beneficial because it allows households facing low income shocks to smooth consumption more effectively, while not affecting households with high income shocks significantly, as most have not accumulated a great deal of assets. As capital becomes more abundant, higher wage dispersion implies that a large fraction of households accumulated more assets than they would have accumulated were wage dispersion lower. Therefore, opposition to openness tends to become higher.

When the coefficient of relative risk aversion is equal to 2 instead of 1, net political support for openness is as expected also lower than in the benchmark case. The reason is that a higher coefficient of relative risk aversion implies higher precautionary saving.

Given our calibration, the median household is therefore in favor of a reform that integrates a closed financial economy to the international capital market, at the average level of capital abundance. Consequently, if the political power depends on the vote of the median household, then the typical non-OECD country would implement such a reform. However, if the political power is unequal and its concentration depends on wealth (as argued by Engerman and Sokoloff, 2005, and others), then financial integration might not occur. Notice that this result is consistent to the empirical evidence on democracy and financial liberalization. Quinn (2000) and

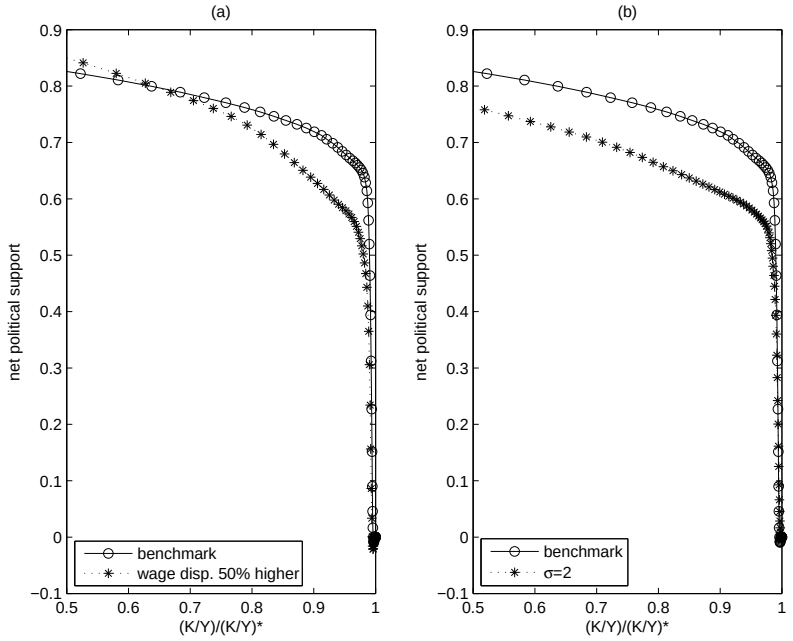

Figure 10: Difference between fraction of households that benefit more than 0.1 percent of consumption equivalent from international financial integration, and fraction of households whose losses are larger than 0.1 percent of consumption equivalent. The benchmark parameters are those of table 1. Model with endogenous borrowing limits.

Quinn and Toyoda (2007), for instance, show a positive relation between democracy and financial liberalization and that sustained democratization produces sustained liberal international financial regulation.

4 Concluding remarks

This paper investigates the welfare effects of financial deregulation of domestic capital markets and the liberalization of the capital account on developing countries. This question has been investigated previously in the literature (e.g., Gourinchas and Jeanne, 2006) in a neoclassical growth model with complete markets and focusing in other channels to which financial liberalization affects the economy (e.g., Townsend and Ueda, 2009). What we add to this literature is to consider the effects of capital market openness in an environment in which agents face income shocks and there is not a full set of securities and therefore insurance against such shocks is imperfect. This is particularly important in developing countries, which present lower level of financial sophistication and development, and imperfect insurance to labor income shocks. We show that:

1. The introduction of uninsurable idiosyncratic risks on labor productivity boosts

aggregate welfare effects. For an economy with the average capital to output ratio of non-OECD countries, welfare increases by at least a factor of 3.9 compared to the complete markets Arrow-Debreu economy.

2. We also show that the average welfare gain hides important distributional implications. We show that, in general, the median household is in favor of international financial integration, but if the pivotal voter is wealthy enough such reform might not be implemented, since richer households have a vested interest on capital market closeness.

   We explain why this is the case. Financial integration in capital scarce countries leads to capital inflow, which increases the average marginal productivity of labor and decreases the domestic interest rate. Income from interest decreases, hurting the welfare of rich agents. The increase in the average productivity of labor increases the welfare of all agents, but in particular of those with low asset position and low consumption, whose marginal utility of consumption is relatively higher.

3. Finally, we show that the welfare effects of financial deepening displayed endogenously in the model is quantitatively small, accounting for at most one fifth of the average welfare gains.

We believe that our results contribute to the existing literature on the welfare effects of international financial integration. It also contributes to the policy discussion on capital controls. Recently, the International Monetary Fund (IMF) has published a policy staff position note[26] discussing the circumstances under which controls on capital inflows to emerging market economies can be a legitimate component of a toolkit of macroeconomic policies going against the previous view of the IMF on the issue. Although in this IMF policy report the justification for capital controls is to avoid excessive exchange rate appreciation and to reduce financial vulnerability, a low benefit of financial liberalization on welfare through the investment and growth channel can give more support to capital controls. What our results show is that it might be misleading to conclude that financial liberalization has a small effect on welfare, as the benefits of capital market integration are concentrated mainly on relatively poor agents whose total income depends heavily on the proceedings from labor.

Further studies should also consider the effects of capital market openness when institutions differ across countries. In our model countries are similar with respect

[26]See Ostry, Ghosh, Habermeier, Chamon, Qureshi, and Reinhardt (2010).

to their institutional quality, but capital would flow in to capital scarce countries only if there is sufficient creditor protection in these countries. For instance, low enforcement of financial contracts depresses the capital market, making borrowing constraints tighter and lowering the interest rate (e.g., Antunes, Cavalcanti, and Villamil, 2008). Therefore, capital market openness in economies with poor institutional quality may induce capital to flow out of developing countries (e.g., Mendoza, Quadrini, and Ríos-Rull, 2007). It will be important to investigate the tradeoff between institutional quality and capital scarcity in the analysis of the welfare effects of international financial integration, but this is clearly not the goal of this article.

Another policy implication of our analysis is related to the optimal tax structure during capital market liberalization. Garcia-Milà, Marcet, and Ventura (2008), for instance, show that poor households might experience large welfare losses if capital income taxes were eliminated. This is because, during the transition, a decrease in the capital income tax will lead to an increase in the labor tax and on the interest rate, hurting therefore poor households that have a large wage/wealth ratio. Greulich and Marcet (2008) show in a standard growth model with heterogeneous households that the optimal tax reform is to cut labor taxes and leave capital taxes very high in the short and medium run. Only in the very long run would capital income taxes be zero. Since in our model capital market openness benefits heavily the poor, financial liberalization might compensate the poor when the government decides to cut capital income taxes. Therefore, a zero tax on capital income might be optimal not only on the long run but also on the short run.

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A Sensitivity to β

In this appendix we assess the robustness of the results in the body of the paper with respect to different hypotheses concerning the calibration of the model. In particular, we investigate whether (i) the adjustment in the discount factor β to yield the same steady-state capital to output ratio of the deterministic model, or (ii) the different steady-state capital to output ratio predicted by the model when we change the coefficient of risk aversion, drive the results presented in section 3. In brief, the answer is no. We might have not adjusted β so that the steady-state capital to output was 2.63, and we might have adjusted β to have that same capital output ratio for the calibration with $\sigma = 2$. The results would have been the same, or larger.

Unadjusted β Figure 11 depicts the average welfare gains of international financial integration when β is kept at the same value of the deterministic model. The penalty parameter is adjusted to $\gamma = 0.89$ so that the credit to output ratio is equal to 8 percent. The long run capital to output ratio in this case is 2.77 . We see that the average gains are uniformly almost the same. The higher time preference (when compared to the benchmark) encourages savings, but this increase is almost exactly offset by the fact that a lower interest rate provides less incentives to save. The adjustment made in the text so that the long run capital to output ratio is the same as in the deterministic case does not drive the results in terms of welfare gains.

Changing the coefficient of risk aversion In figure 1 we can see that when the coefficient of relative risk aversion σ increases but we do not adjust β, then the long run level of the capital to output ratio decreases from 2.63 to 2.37 . With incomplete markets, the long run capital to output ratio goes from 2.63 to 3.26 (see part II of table 2). Because the predictions of the two calibrations yield very different values for the long run capital to output ratio, and hence the interest rate, it is important to eliminate the possibility that the different long run capital to output ratios are driving the results. In this appendix, we consider the welfare implications of capital market liberalization when, beyond changing σ from 1 to 2, we also change β so that the steady-state capital to output ratio is 2.63 . This is accomplished by setting $\beta = 0.9332$. To ensure a credit to output ratio of around 8 percent we set $\gamma = 0.725$. Figure 12 depicts the welfare gains of international financial integration using this calibration for the version with endogenous constraints. Also shown are the results for the original calibration of table 2.

At the average observed level of the capital abundance of 0.56, the welfare gains

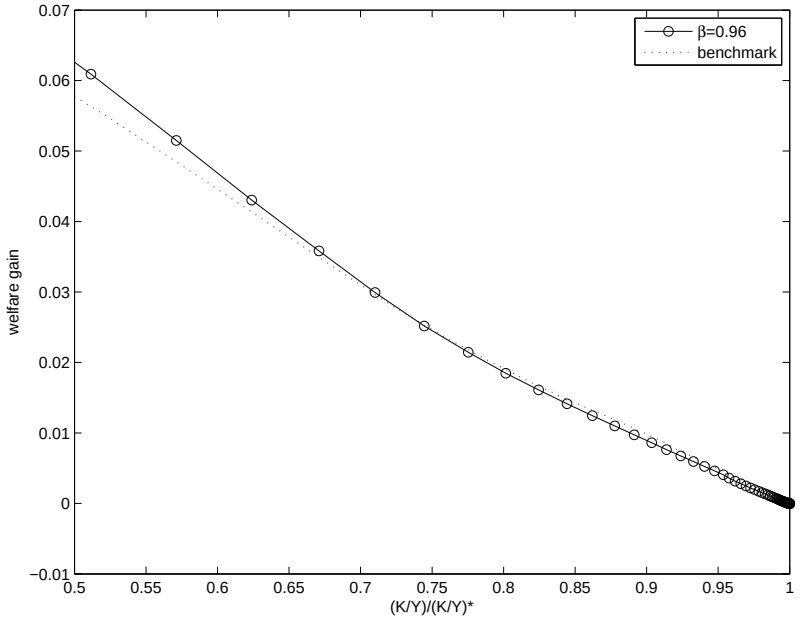

Figure 11: Average welfare gain versus capital abundance when $\beta = 0.96$ and γ is adjusted so that the model has a long run credit to output ratio of 8 percent. Also depicted: benchmark calibration ($\beta = 0.9545$). Model with endogenous borrowing limit.

are now 1 percentage point higher, from 7.4 percent of consumption equivalent to 8.4 percent. As capital abundance approaches 1, the welfare gains become quantitatively very similar to those in the calibration where we did not adjust β to match the capital to output ratio of the deterministic case. Therefore, our results on section 3.3 concerning the effects of higher risk aversion are not driven by changes in the long run capital to output ratio and the interest rate.

B Sensitivity to the initial distribution

This appendix provides a robustness test for the initial distribution used in calculating the transition presented in section 3. In the benchmark, we use the steady-state distribution λ_0 of an economy with TFP equal to one fourth of the world TFP and calculate the full transition. Here we experiment the welfare gains under three different assumptions about the initial distribution. First, we use a distribution equal to λ_0 except that all borrowers are considered to have zero assets. The mass of borrowers is imputed to the lowest, non negative asset level. Second, we perform a mean-preserving shrinkage of the initial distribution. We do that by multiplying the difference between each household's asset holdings and the average level by 0.75, and adding that amount to the average level. Third, we do a mean preserving spread

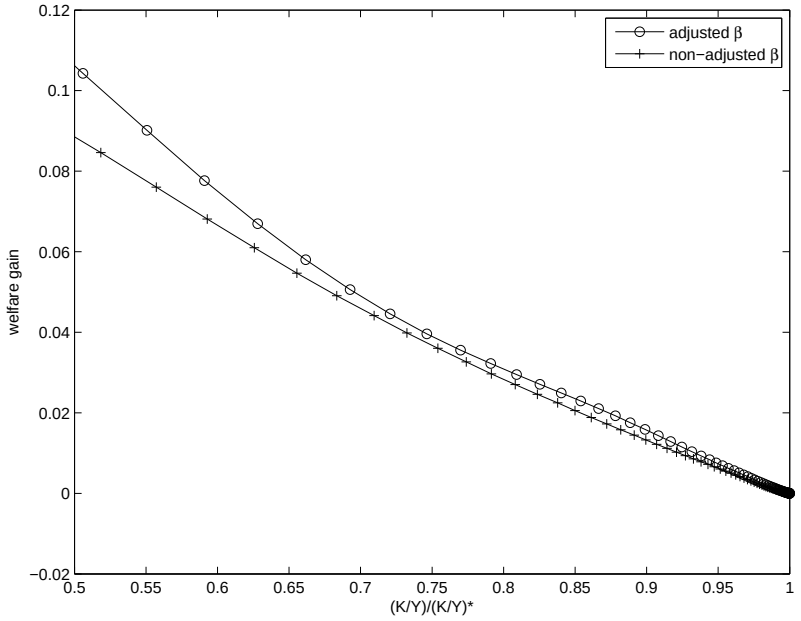

Figure 12: Average welfare gain versus capital abundance when $\sigma = 2$ and β is adjusted so that the model has a long run capital to output ratio of 2.63. Also depicted: original calibration with $\sigma = 2$. Model with endogenous borrowing limit.

by applying the same procedure as before but using a factor of 1.25. The average welfare gains of the three experiments and the benchmark are displayed in figure 13.

If the distribution starts out without borrowing, the average welfare gains are slightly smaller than in the benchmark. For instance, at the capital abundance of a non-OECD country, 0.56, the difference is about 0.9 percentage points, down from 5.4 in the benchmark.

When there is a mean preserving shrinkage of asset holdings, the behavior is similar: we have smaller welfare gains, although still large when compared with the deterministic case.

When we do a mean-preserving spread of the initial asset holdings, we get roughly the same gains as in the benchmark.

To the extent that in poor countries wealth inequality is typically large and the amount of lending is typically low, the gains documented in figure 13 should be viewed as upper and lower bounds for the case of the benchmark calibration. These results show that the choice of the initial distribution, arguably subjective, does not change the gains that can be attained from international financial integration by a large absolute amount, as long as there is a substantial decrease in the interest rate.

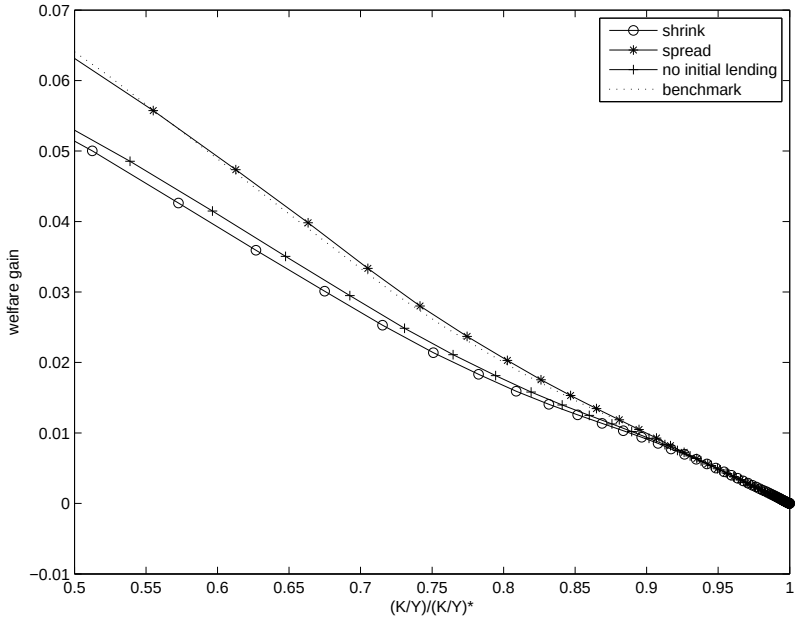

Figure 13: Average welfare gain versus capital abundance under different initial distributions: (i) no initial borrowing; (ii) mean-preserving shrinkage by 25 percent of λ_0; (iii) mean-preserving spread by 25 percent of λ_0. Model with endogenous borrowing limit.

C Computational procedure

We use value function iteration to solve both for the steady state and the transition between any given state and the new steady state. We set up a grid $\mathcal{A}$ on assets. This grid oversamples negative holdings. We use a sampling scheme where about one seventh of the grid points are negative. We set overall negative and positive asset holdings $\underline{a}$ and $\overline{a}$, and ensure that they are not binding in any of the calibrations. With the scale parameter of the production function normalized to 1, we set these bounds to -3 and 120. We use 500 points for $\mathcal{A}$ and 9 points for $\mathcal{Z}$. The stochastic process (13) is modeled after Tauchen (1986).[27]

We want to solve problem (6) subject to the borrowing limit $\hat{a}' \geq \underline{\hat{a}}^{\text{limit}}$, where $\hat{a}^{\text{limit}}$ depends on the type of borrowing limit.

The procedure for calculating the steady state in the case with endogenous borrowing limits is as follows.

1. Start with a first guess for for the interest rate, the value function, the autarky value, the joint distribution of assets and shocks, and the borrowing limit, $(r^0, v^0, \underline{v}^0, \lambda^0, (\underline{\hat{a}}^{\text{EB}})^0)$.

[27] Ábrahám and Cárceles-Poveda (2010) iterate on the first order conditions of the household's problem and use different approaches concerning the state space.

2. Using λ^i compute aggregate capital K^i, and from that and the interest rate r^i compute the current wage rate w^i.

3. Solve problem

$$v^{i+1}(\hat{a},z) = \max_{\hat{a}' \in \mathcal{A}} \quad u(\hat{a}(1+r^i)+\hat{w}^i z-(1+g)(1+n)\hat{a}')+\tilde{\beta}\,\mathrm{E}[v^i(\hat{a}',z')|z]\,, \quad (14)$$

subject to $\hat{a}' \geq (\underline{\hat{a}}^{\mathrm{EB}})^i$ in each point $(\hat{a},z)$ of the grid $\mathcal{A}\times\mathcal{Z}$. For simplicity we omit the dependence of the value functions on λ.[28] Denote the policy function associated with the previous problem by $h^{i+1}(\hat{a},z)$.

4. Compute for all z in $\mathcal{Z}$ the new autarky value,

$$\underline{v}^{i+1}(z) = u(\gamma\,\hat{w}^i\,z) + \tilde{\beta}\,\mathrm{E}[\underline{v}^i(z')|z]\,.$$

5. Compute the new borrowing limit $(\underline{\hat{a}}^{\mathrm{EB}})^{i+1}$ using

$$(\underline{\hat{a}}^{\mathrm{EB}})^{i+1} = \min\left\{\hat{a}\in\mathcal{A} : v^{i+1}(\hat{a},z) \geq \underline{v}^{i+1}(z)\,, \quad \forall z\in\mathcal{Z}\right\}\,. \quad (15)$$

6. Set $v^{i+1}(\hat{a},z) = \underline{v}^{i+1}(z)$ for all $\hat{a}\in\mathcal{A}$ smaller than $(\underline{\hat{a}}^{\mathrm{EB}})^{i+1}$.

7. Using the policy function h^{i+1}, update the joint distribution of assets and shocks, obtaining λ^{i+1}. Compute the aggregate capital K^{i+1}.

8. Compare K^i and K^{i+1} and update the interest rate accordingly, obtaining r^{i+1}. Iterate from step 2 until convergence.

The transition exercise consists of calculating the evolution of the economy starting with a distribution of assets and shocks λ^{Init} that is different from the steady-state distribution of the economy. Set the simulation horizon, T, to a large number, say 80 periods. Instead of guesses for the interest rate, the value function, the autarky value, the joint distribution of assets and shocks, and the borrowing limit, we need to have a first guess for the entire path of those quantities. In practical terms, a good first guess for the paths of these quantities is, for all T periods, their values at the final steady state.

We then have to proceed in the following way. Identify the iteration label i with the time period $t+1$ and the results of the current iteration, denoted by $i+1$, with

[28] Notice that, to calculate v^{i+1}, we only need to know v^i and prices, which are iterated upon. We end up having a value function and prices that are a fixed point of the iterative process. In the case of the transition the fixed points are *paths* of value functions and prices.

values in t. We start in moment t equal to $T-1$, so that i is 0. Run the procedure from step 2 to step 6. This is done using the same computational routines as for the steady state. Then, update t to $T-2$ and repeat this cycle until t is 1. The next part of the problem is to update the distributions of assets and shocks given the policy functions just calculated. Use the distribution λ^{Init} and the policy functions to update the entire path of the joint distribution. For each of the T periods compare the new aggregate capital with that of the previous iteration. Update the interest rate for each period accordingly. Repeat the entire procedure until the difference between the aggregate capital of the current and the previous iteration is sufficiently small in all periods.