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Growth and Capital Flows with Risky Entrepreneurship

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Growth and Capital Flows with Risky Entrepreneurship

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Abstract

This paper shows that the behavior of entrepreneurs facing incomplete financial markets and risky investment can explain why growth accelerations in developing countries tend to be associated with current account improvements. The uninsurable risk of losing invested capital forces entrepreneurs to rely on self-financing, so that when business opportunities open up entrepreneurs increase saving to finance the investment that produces growth. The key insight is that saving has to rise more than investment to allow also for the accumulation of precautionary assets. Plausibly calibrated simulations show that this net saving increase can sustain large and persistent net capital outflows.

JEL Classification Numbers: C6, E2, F4, O1

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Contents

I. INTRODUCTION

In a well-known paper, Lucas (1990) pointed out that capital flows from rich to developing countries were much smaller than suggested by the return differential implied by per worker output ratios. As discussed in Prasad, Rajan and Subramanian (2007), the pattern of international capital flows has become even more surprising in the last decade with low income countries actually financing more advanced economies. It is remarkable, for example, that over the last few years the largest borrower and lender on the international markets have been respectively the US and China. A particularly puzzling feature is that China is a very fast growing country and, according to benchmark models based on the Permanent Income Hypothesis, should be borrowing heavily in order to finance investment and smooth consumption over time. It is tempting to think about the Chinese experience as very peculiar and possibly driven entirely by policy intervention to maintain an undervalued exchange rate.

However, recent empirical evidence cautions against this interpretation by pointing out that growth and capital outflows tend to be positively correlated across all developing countries. Gourinchas and Jeanne (2007) show that the capital flows predicted by the standard neoclassical growth model calibrated with country specific productivity over the 1980-2000 period are in fact negatively correlated with actual flows across a large sample of 69 developing countries. Similarly, Prasad et al. (2007) also detect a positive correlation between growth and net capital outflows across non-industrial countries.[2] A simple way to get a quick grasp of the empirical evidence is to look at the time-series behavior of saving, investment, and the current account during growth acceleration periods.[3] Using the criteria proposed by Hausmann, Pritchett and Rodrik (2005) and data from the World Development Indicators on developing countries between 1960 and 2008, we detect 41 growth acceleration episodes. Figure 1 shows the time series evolution of the cross country means of relevant variables from six year prior to six years after the growth acceleration.[4] We observe that as the country enters a period of higher per capita income growth, the saving rate, instead of decreasing to allow for consumption smoothing over time, rapidly rises. Furthermore, the increase is stronger than for investment so that the country witnesses an improvement in the current account.[5]

In this paper we develop a small open economy model with insurable idiosyncratic investment risk which can account for these empirical findings. The crucial assumptions are that entrepreneurs are exposed to the idiosyncratic risk of business failure and that financial markets are incomplete

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[2]Eastern European emerging markets have instead experienced large current account deficits. As discussed in Section IV, this can be due to the higher level of financial development.

[3]Similar exercises are also performed by Prasad et al. (2007) and Buera and Shin (2009) with analogous results.

[4]See Appendix I for details on the construction of Figure 1.

[5]Similar results are obtained if considering the median. The improvement in the current account is even more pronounced if including growth accelerations only in the first half of the sample period (1960-1985), thus suggesting that the positive correlation between growth and capital flows is not only a recent phenomenon possibly driven by the wave of financial globalization over the last 20 years. Note that among the growth acceleration episodes there are also a few countries recovering from severe crises. Dropping countries with negative growth rates at any time over the considered time interval leads to an even stronger improvement in the current account.

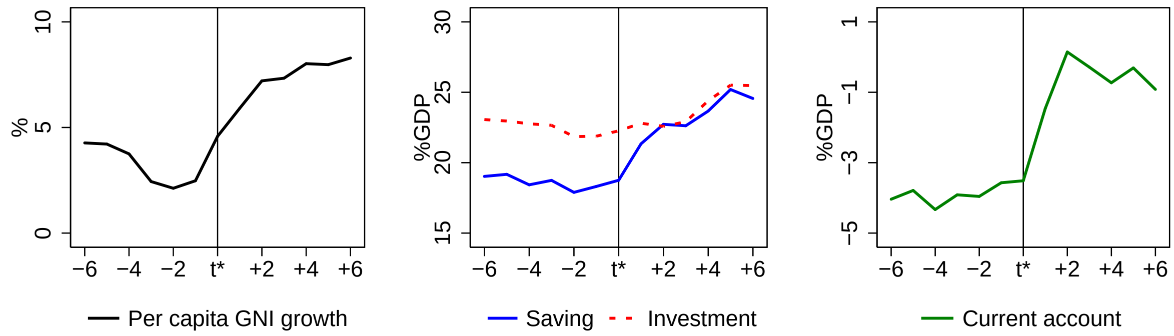

Figure 1. Mean over 41 growth acceleration episodes between 1960 and 2008

because they don't allow for risk sharing. Under these circumstances entrepreneurs have to rely on self-financing to scale up their firms so that when new entrepreneurial opportunities open up they increase saving to finance the investment which triggers growth. The key feature of the model is that since investment is risky, saving has to increase more than investment to allow for the accumulation of precautionary savings. Therefore, while expanding their businesses, entrepreneurs generate a net saving increase which can sustain persistent current account surpluses.

The model's calibration is based on standard values in the literature, with the exception of the production function curvature parameter and the risk of business failure which are structurally estimated using data from the Survey of Consumer Finances. We initialize the model to a setting in which all agents work as farmers in subsistence agriculture and study the dynamics generated by the opening up of entrepreneurial opportunities. The individuals with high entrepreneurial ability increase saving to finance investment in their new businesses, thus triggering a prolonged period of rapid growth. At the same time they also accumulate precautionary assets so that the economy generates large and persistent capital outflows consistent with the empirical evidence.

In the second part of the paper, we relax the degree of financial market incompleteness by introducing state-contingent claims and study the implications for aggregate dynamics and welfare. The availability of risk-sharing instruments speeds up growth (since entrepreneurs can use external financing to scale up their firms) and plays a pivotal role in shaping the relation between growth and capital outflows: the more idiosyncratic risk can be insured away, the less the need for precautionary savings and the smaller the size of capital outflows. Under full risk sharing, the model's dynamics collapse to those predicted by the benchmark neoclassical growth model under perfect foresight implying large international borrowing. We find that financial development can also lead to substantial welfare gains for both workers and entrepreneurs, but with different distributional effects according to the stage of entrepreneurial development.

The paper is structured as follows. After reviewing related literature in Section I.A, we develop the model in Section II, which is calibrated and simulated in Section III. Section IV considers the implications of financial development and Section V concludes by summarizing the key results.

A. Related Literature

The inability of standard neoclassical growth models to account for the empirical evidence is rooted in their prediction regarding the saving rate. The theory implies that the prospect of higher future income, by increasing permanent income relative to current income, should boost consumption and reduce the saving rate. This is, however, strongly counterfactual: as pointed out already by Houthakker (1961) and Modigliani (1970) and further documented by many others, saving and growth are in fact positively correlated. Initially this evidence was interpreted as supporting standard closed economy growth models *à la* Solow or Romer in which higher saving rates lead to more investment and growth. However, there are two main reasons for dissatisfaction with this interpretation. First, this mechanism fails in the case of a small open economy, since an exogenous increase in saving simply generates capital outflows without triggering faster growth.[6] Second, a large empirical literature suggests the opposite causal relation (Carroll and Weil (1994), Attanasio, Picci and Scorcu (2000), Rodrik (2000)).

An alternative explanation of the positive association between growth and saving was proposed by Modigliani (1970,1986) : by increasing the lifetime income of the younger generations relative to the older ones, growth boosts the amount of saving of young workers relative to the dissaving of retirees and thus leads to the increase of the aggregate saving rate. However, plausibly calibrated simulations show that the boost in consumption derived by higher income growth for each generation easily outweighs the aggregation effect described by Modigliani. Carroll, Overland and Weil (2000) have suggested that habits, by slowing down the rate of increase in consumption following a productivity growth shock, are potentially able to generate an increase in saving. The plausibility of this approach has, however, been disputed by a large body of empirical literature which, using household level data, has found very little support for the idea that habits constitute a structural element of individual utility (Naik and Moore (1996), Meghir and Weber (1996), Dynan (2000), and Flavin and Nakagawa (2008)). Therefore, as of today, we not only lack an explanation for the positive correlation between growth and net capital outflows, but are without even a conclusive understanding of the mechanisms responsible for the positive association between growth and saving. In this paper we consider a simple small open economy model based on entrepreneurial risk and incomplete financial markets which has the potential to account for both empirical findings.

The idea that financial market imperfections may be playing an important role in generating capital outflows from emerging economies is common to other recent papers. Mendoza, Quadrini and Ríos-Rull (2009) show that financial globalization leads to capital outflows from economies with lower domestic risk sharing due to the higher demand for precautionary assets. Similar results are obtained by Caballero, Farhi and Gourinchas (2008) with a model emphasizing heterogeneity across countries in the ability to supply financial assets. What differentiates our work is the focus

[6] Aghion, Comin, Howitt and Tecu (2009) propose a model for developing countries in which domestic saving preserves its growth enhancing potential even under international capital mobility: they suggest that the involvement of foreign investors is crucial to catch up with the technology frontier and that this is possible only if locals have the capital to co-finance investment projects to reduce moral hazard. Their model, however, still predicts that growth should be associated with larger capital inflows.

on the puzzling interplay between capital flows and growth, rather than on capital flows and financial globalization.

This is the core interest of two other recent papers, which also highlight the importance of the development of the entrepreneurial sector under incomplete financial markets to shed light on this phenomenon. Buera and Shin (2009) show that developing countries can experience growth and capital outflows if they contemporaneously remove entrepreneurial non-financial distortions and liberalize international capital flows. Song, Storesletten and Zilibotti (2009) argue instead that the high growth rates and capital outflows experienced by China can be the results of the shrinking demand for capital of the state-owned corporate sector facing the competition of private enterprises. While the contemporaneous opening to international capital flows or the downsizing of older firms have certainly the potential to magnify capital outflows, we show that the risky nature of entrepreneurial investment can by itself lead to a large improvement in the current account.

Complementing our results which focus on the time series dynamics of growth, saving and capital outflows, Benhima (2009) shows that idiosyncratic investment risk is crucial to explain also the cross country relation between growth and capital flows. Idiosyncratic risk is also a key driver of capital flows in Carroll and Jeanne (2009) who develop a tractable model of the net foreign asset position which can account for the positive correlation between growth and the current account as long as faster growth is associated with higher unemployment risk. Our model focuses instead on entrepreneurial risk and endogenizes both growth and its relation with risk.

The idea that entrepreneurs can strongly influence aggregate saving dynamics is inspired by studies on the entrepreneurial sector in the US. Gentry and Hubbard (2004) and Buera (2009) show that entrepreneurs have much higher saving rates than workers, especially at the time of entry when the differential is around 30 percentage points. These results strongly hint to the presence of financial market imperfections which force entrepreneurs to rely on internal financing to scale up their business activities.[7] While business owners account for a relative small share of the US population (around 11 percent), their potential to influence aggregate dynamics also comes from the fact that they account for almost 30% and 50% of the aggregate income and wealth (Quadrini (2000), Cagetti and Nardi (2006)).

The ability of entrepreneurs to influence macro dynamics is likely to be even stronger in emerging markets, where a much larger fraction of the population is self-employed (Gollin (2008)) and financial constraints are tighter (World Bank (2008)). China, for example, has witnessed after the economic reforms in 1992 an impressive growth of private firms which currently produce more than half of its GDP. As discussed in Gregory and Tenev (2001), investment has been almost entirely self-financed, with bank lending accounting for only around 4% of financing needs. This has led to a surge in enterprise saving that have become even larger than household saving exactly in conjunction with the increase in capital outflows (Kuijs (2005)).

[7] Hurst and Lusardi (2004) have shown that financial constraints are unlikely to be playing an important role in restraining business start up in the US. However, this does not rule out their relevance in shaping the saving and investment decisions of entrepreneurs while scaling up businesses. External financing seems to be limited even for the US corporate sector, as suggested by the sensitivity of investment to internal cash; see Hubbard (1998) for an excellent survey.

II. The Model

The main hypothesis of the paper is that countries can experience high growth and capital outflows as the equilibrium outcome of the development of entrepreneurial activities under uninsurable idiosyncratic investment risk. In order to focus on the key elements of this conjecture, but also assess its merit, we develop a very parsimonious model still amenable to quantitative investigation. We consider a small open economy model populated by infinitely-lived and risk-averse individuals gaining utility from consumption and endowed with heterogenous entrepreneurial ability. As in Lloyd-Ellis and Bernhardt (2000), initially all agents are constrained to work as self-employed farmers earning a subsistence income $\underline{\Omega}$.[8] This condition can result from explicit legal restrictions as in the case of China prior to the economic reforms or from a more general lack of investment opportunities. Then, unexpectedly, entrepreneurial constraints are lifted and agents are given the possibility to become entrepreneurs, which entails foregoing the farming income in favor of a risky income proportional to the invested capital. The individuals with high entrepreneurial ability start up their businesses, by investing capital and hiring workers at the market-clearing wage Ω_t, thus triggering growth.

Note that since entrepreneurial income is proportional to the invested capital and becoming entrepreneurs involves giving up the labor wage, under certain calibrations and limited external financing, some agents may prefer to postpone the time of entry to accumulate savings and start up their firms at a larger scale. This would generate pre-entry savings which are, however, not essential to sustain capital outflows. We thus prefer to dispense entirely from them by imposing that agents who want to become entrepreneurs have to do so at the time at which constraints are removed and that occupational choices are irreversible.[9]

A key feature of the model is the assumption of incomplete financial markets, captured by the absence of state-contingent claims (or equity financing) which requires entrepreneurs to bear the risk of their projects.[10] This can be caused by various combinations of asymmetric information, costly state verification and weak legal enforcement commonly plaguing developing countries which we don't model explicitly (see Appendix III for an example). We now formally describe the optimization problem faced by workers and entrepreneurs, as well as the competitive equilibrium of the model.

[8] Other related contributions studying the transition from subsistence agriculture to industrial development are Greenwood and Jovanovic (1990), Banerjee and Newman (1993), Aghion and Bolton (1997).

[9] If occupational choices were reversible, entrepreneurs who face capital losses after an unproductive investment may prefer to return to a wage occupation for a few years and accumulate savings prior to start a new enterprise, from which we want to dispense. Ruling out the possibility of returning to wage employment increases somewhat the risk of entrepreneurial failure and the need for precautionary savings. In our model, this effect is however extremely small, since entrepreneurs are always allowed to start up a new equally productive business.

[10] We will relax this assumption and investigate the implications for growth, capital flows, and welfare in Section IV.

A. Workers

In each period, workers decide whether to earn income as self-employed farmers, $\underline{\Omega}$, or offer their labor unit to entrepreneurs in exchange for the market-clearing wage, Ω_t. They also have to choose how to allocate cash-on-hand, x_t, between consumption and savings, which are invested in risk-free assets, a_t, earning the exogenous world interest rate R. Formally, they solve the following problem:

$$\begin{aligned} V_t^w(x_t) &= \max_{c_t \leq x_t} \left\{ u(c_t) + \beta V_{t+1}^w(x_{t+1}) \right\} \\ &s.t. \\ x_t &= c_t + a_t \\ x_{t+1} &= \mathsf{R} a_t + \overline{\Omega}_t \end{aligned} \tag{1}$$

where $\overline{\Omega}_t = \max\{\underline{\Omega}, \Omega_t\}$, $u(c_t) = c_t^{1-\rho}/(1-\rho)$, and the w subscript denotes workers' policy and value functions. Note that, as common in developing countries and to some extent in advanced economies as well, we assume that agents cannot borrow against future labor income, so that consumption cannot exceed cash-on-hand. The first order condition simply involves equating, in the unconstrained region, the marginal utility of consumption today to the discounted marginal utility of consumption tomorrow:

$$u'(c_t) = \max\left[\beta \mathsf{R} u'(c_{t+1}), u'(x_t)\right] \tag{2}$$

B. Entrepreneurs

As in Buera (2008), entrepreneurs operate their own firms according to a nested Cobb-Douglas production function in entrepreneurial ability η, invested capital k_t, and employed labor l_t:

$$\hat{f}(\eta, k_t, l_t) = \eta^\nu (k_t^\alpha l_t^{1-\alpha})^{1-\nu} \qquad 0 < \alpha < 1, \quad 0 < \nu < 1 \tag{3}$$

Solving the maximization problem:

$$\max_{l_t} \left\{ \eta^\nu (k_t^\alpha l_t^{1-\alpha})^{1-\nu} - \Omega_t l_t \right\} \tag{4}$$

we obtain the optimal labor demand:[11]

$$l_t^* = \left(\frac{(1-\nu)(1-\alpha)\eta^\nu k_t^{\alpha(1-\nu)}}{\Omega_t} \right)^{\frac{1}{\nu(1-\alpha)+\alpha}} \tag{5}$$

so that revenues net of labor payments can be more compactly expressed as:

$$f(\eta, k_t) = \Upsilon_t \eta^{1-\varphi} k_t^\varphi \tag{6}$$

[11] For simplicity we do not require l_t^* to be an integer, so that a worker can supply her labor endowment to various entrepreneurs in the same period.

where $\varphi = \frac{(1-\nu)\alpha}{1-(1-\nu)(1-\alpha)}$ and $\Upsilon_t = \left(\frac{(1-\nu)(1-\alpha)}{\Omega_t}\right)^{\frac{(1-\nu)(1-\alpha)}{1-(1-\nu)(1-\alpha)}} (1-(1-\nu)(1-\alpha))$.

Entrepreneurs choose at each time how much to consume and how to allocate savings between risk free assets, a_t, and invested capital, k_t. The return to investment is risky since with probability $\flat$ entrepreneurs can be hit by an exogenous idiosyncratic failure shock involving the loss of the invested capital, as also in Aghion and Bolton (1997).[12] Considering such a simple but fairly extreme shock helps to sharpen the key insights of the model, still without undermining realism. Indeed, Moskowitz and Vissing-Jørgensen (2002) point out that between 1990-1997 15.3 percent of the employer firm terminations were failures, likely involving the full loss of the equity investment and possibly also personal collateral used to raise financing. Similarly, Gentry and Hubbard (2004) find that the median reduction in wealth experienced by households that exit entrepreneurship is actually larger than the median net value of their business. We also want to emphasize that the failure shock does not involve any loss in entrepreneurial ability, so that entrepreneurs can immediately start up a new equally productive firm. Formally, entrepreneurs solve the following problem:

$$\begin{aligned} V_t^e(x_t,\eta) &= \max_{c_t,k_t} \left\{ u(c_t) + \beta \left[(1-\flat) V_{t+1}^e(x_{t+1}^{\not\flat},\eta) + \flat V_{t+1}^e(x_{t+1}^{\flat},\eta) \right] \right\} \\ & \quad s.t. \\ x_t &= c_t + a_t + k_t \\ x_{t+1}^{\not\flat} &= \mathsf{R} a_t + \Upsilon_t \eta^{1-\varphi} k_t^{\varphi} + (1-\delta) k_t \\ x_{t+1}^{\flat} &= \mathsf{R} a_t \end{aligned} \tag{7}$$

where $0 < \delta < 1$ is the capital depreciation rate, the e subscript denotes entrepreneurs' policy and value functions, and $x_{t+1}^{\not\flat}$ and $x_{t+1}^{\flat}$ are next period cash-on-hand values, respectively in case the business is successful or fails. The two optimality conditions are:

$$u'(c_t) = \beta \mathsf{R} \left((1-\flat) u'(c_{t+1}(x_{t+1}^{\not\flat})) + \flat u'(c_{t+1}(x_{t+1}^{\flat})) \right) \tag{8}$$

$$(1-\flat)\mathfrak{R}_t u'(c_{t+1}(x_{t+1}^{\not\flat})) = (1-\flat)\mathsf{R} u'(c_{t+1}(x_{t+1}^{\not\flat})) + \flat \mathsf{R} u'(c_{t+1}(x_{t+1}^{\flat})) \tag{9}$$

where $\mathfrak{R}_t = 1 - \delta + \Upsilon_t \eta^{1-\varphi} \varphi k_t^{\varphi-1}$. Equation (8) is the standard Euler condition, equating the marginal utility of consumption today with the discounted expected marginal utility of consumption tomorrow. Equation (9) is the optimal portfolio condition, requiring equality between the expected marginal utility of investing in the safe assets and in the firm's capital.

C. Competitive Equilibrium

Starting from an initial situation in which agents are prevented from being entrepreneurs, we are interested in studying the economy dynamics as this constraint is lifted, and agents select their

[12]The case in which the shock involves the loss of only a share of the invested capital is observationally equivalent to the case of partial risk sharing discussed in Section IV. The musical symbol $\flat$ (flat) is mnemonic since the entrepreneur is badly flattened by this shock.

occupation, $o \in [w, e]$. Given the distribution of agents over cash-on-hand and occupational status at the time of the removal of entrepreneurial constraints, $\mathbb{H}_0(x, o)$, the competitive equilibrium is given by the sequence of distributions $\{\mathbb{H}_t(x, o)\}_{t=0}^{\infty}$, policy functions $\{c_t^o(x, \eta), a_t^o(x, \eta),$ $k_t^o(x, \eta), l_t^o(x, \eta)\}_{t=0}^{\infty}$, value functions $\{V_t^o(x, \eta)\}_{t=0}^{\infty}$, and wage rates $\{\Omega_t\}_{t=0}^{\infty}$ such that:

- given $\{\Omega_t\}_{t=0}^{\infty}$, the policy functions solve the worker's and entrepreneur's problems
- the labor market clears for all $t \geq 0$
- $\{\mathbb{H}_t(x, o)\}_{t=0}^{\infty}$ is consistent with $\mathbb{H}_0(x, o)$, the policy rules, and the idiosyncratic shocks

Note that while the interest rate is exogenous, the wage is endogenous and will play an important role for the welfare implications of financial development as discussed in Section IV.B. The algorithm used to solve for the equilibrium dynamics is described in Appendix II.

D. Policy Functions

The main insights of the model are best understood by considering the policy functions, which are displayed in Figure 2. As standard in a setting with precautionary motives, these are solved under the impatience condition $\mathsf{R}\beta < 1$ needed to avoid infinite accumulation of savings as explained below. Workers face a very standard perfect foresight optimization problem under borrowing constraints. Given the impatience condition, they have no incentive to hold assets, so that cash-on-hand converges to $\overline{x}^w$ against the borrowing constraint where they behave as hand-to-mouth consumers. This is also the cash-on-hand level at which agents are offered the opportunity to become entrepreneurs when the transition begins.

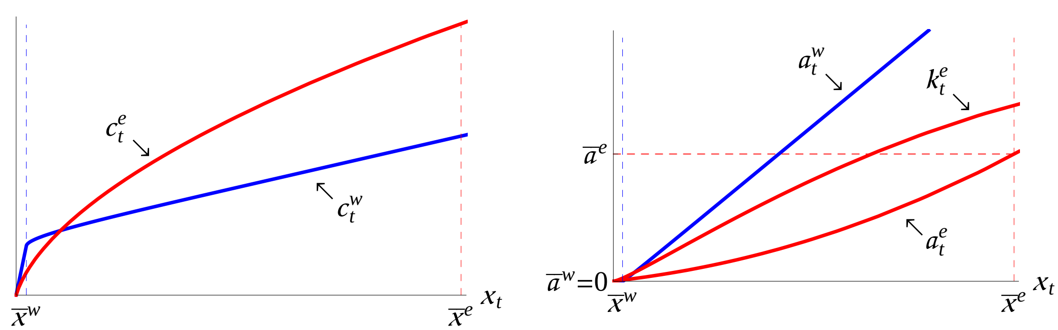

Figure 2. Policy functions under uninsurable entrepreneurial risk

Entrepreneurs would similarly have no incentive to save if entrepreneurial investment was riskless. In that case, they could use the invested capital as collateral for loans, and scale up their firms with external finance until the point at which the entrepreneurial return equals the world interest rate. The risky nature of entrepreneurial activities dramatically changes the entrepreneur's problem, by introducing two reasons to save. First, due to the risk of failure invested capital can no longer be used as collateral, so that entrepreneurs have to save in order to self-finance their firms. Second, entrepreneurs also have to accumulate precautionary savings to self-insure against entrepreneurial risk.

While the boundedness of the first incentive is guaranteed by the decreasing marginal productivity of capital, the impatience condition is needed to ensure that the precautionary motive does not lead to infinite accumulation of riskless assets. If the intertemporal discount factor were equal to the world interest rate, agents would be indifferent between consuming today or tomorrow. The presence of risk – together with the desire of smoothing consumption – would thus imply a permanent upward drift in safe asset holdings. Under the impatience condition, the model features instead a finite target of wealth, $\overline{x}^e$, to which entrepreneurs tend to converge. A formal proof of the existence of the target level of wealth is provided by Carroll (2009). The underlying intuition is that since the precautionary motive becomes infinitely strong as safe assets shrink to zero and vanishes as they go to infinity, there has to exist a finite level of wealth at which the precautionary desire to accumulate wealth is exactly counterbalanced by the impatience motive.

Consider now the transition dynamics from the removal of entrepreneurial constraints. From the left-side plot of Figure 2, we see that starting from $\overline{x}^w$ agents who become entrepreneurs restrain consumption to generate internal financing for their firms. The key insight of the paper is that, as shown on the right-side plot, the increase in invested capital is associated with the contemporaneous accumulation of precautionary safe assets, as required by the portfolio condition (9). The development of the entrepreneurial sector thus is characterized by the increase in safe assets holdings held by entrepreneurs up to $\overline{a}^w$ to hedge against the entrepreneurial risk they are getting exposed to. As shown in the next section, this net saving increase can sustain large and persistent net capital outflows.

The implications of the model are clearly in stark contrast with the simpler setup under complete financial markets. In the absence of idiosyncratic uninsurable risk, entrepreneurs would freely borrow internationally to immediately scale firms up to the optimal scale and adjust consumption upwards. We may still wonder if risk is a crucial element for our story, or if similar results could be obtained under perfect foresight by simply imposing borrowing constraints. A liquidity-constrained entrepreneur investing in a risk-free entrepreneurial activity would still want to increase saving to finance investment. The key difference, however, is that in the absence of uncertainty there is no reason for the entrepreneur to hold safe assets. The development of the entrepreneurial sector would still be characterized by higher saving rates, but all the available financial resources would be used for investment. The economy would growth without borrowing internationally, but won't be able to generate the observed increase in net capital outflows.

III. Aggregate Dynamics

A. Calibration and Structural Estimation

Some of the model's parameters are calibrated with values common in the literature. We use 2.5 for the relative risk aversion coefficient, 6% for the depreciation rate, 1.04 for the world interest rate, and 0.94 for the intertemporal discount factor. We also assume a capital share ratio $\alpha(1-\nu)$ equal to 0.3 so that the production function curvature is exclusively characterized by φ. Regarding the distribution of the entrepreneurial ability, we partition the simulated population into two groups with respectively zero and positive entrepreneurial ability normalized to 10.

Less obvious are the choices for the production curvature parameter, φ, and the risk of business failure, $\flat$. These are structurally estimated by matching the medians of the ratio of business income to invested capital (0.29) and the share of business wealth in total net worth (0.57) for business owners with positive income in the 2007 Survey of Consumer Finance (SCF) data.[13] The latter ratio mainly identifies the failure probability, with higher risk requiring a more conservative portfolio (i.e. a lower wealth share invested in business capital), while the income to capital ratio pins down the production curvature, since its value is inversely proportional to φ.[14] The choice of using US data is motivated by three considerations. First, the estimation is performed at the stochastic equilibrium of the model, requiring considering a country with a fully-developed entrepreneurial sector. Second, matching the portfolio of US entrepreneurs tilts the balance against the desired results, since the lack of social insurance and less developed financial markets in developing countries are likely to require even more precautionary savings for self-insurance. Finally, the accuracy of the estimation hinges upon high quality data on the portfolio of entrepreneurs. In this regard, the SCF is an ideal source of information since it oversamples rich people, among whom most of the entrepreneurs are concentrated.

Parameter description	Parameter label	Value	Standard errors
CRRA coefficient	ρ	2.5	-
Intertemporal discount	β	0.94	-
World interest rate	R	1.04	-
Depreciation rate	δ	0.06	-
Capital share	$\alpha(1-\nu)$	0.30	-
Entrepreneurial ability	η	[0,10]	-
Bankruptcy probability	$\flat$	0.0094	(0.0013)
Production function curvature	φ	0.49	(0.071)

Table 1. Model parameters

Table 1 reports the calibrated and structurally estimated parameters, together with their standard errors computed by bootstrap. The production function curvature parameter φ is estimated as 0.49, which is in the middle of the range commonly used in the literature, as surveyed by Buera (2008). The failure risk ($.94\%$) may seem quite low if compared with the observed exit rates, but while people can leave entrepreneurship for life-cycle reasons or when hit by milder shocks, we are here

[13]We exclude from net worth the net equity value of the primary house and quasi-liquid retirement accounts, since the model does not incorporate retirement savings nor housing decisions. To further leave out retirement savings, we use data only on agents younger than 50. These adjustments increase the share of business wealth in net worth, thus leading to a lower estimate of the failure risk. The structural estimation is performed following Cagetti (2003) by matching medians rather than means to be more robust to the high degree of skewness in the data that the model is not particularly suited to account for. Note that the estimation can be performed under an arbitrary wage rate for workers since it does not affect the targeted moments.

[14]This can be easily seen by considering that at the optimal investment scale under perfect foresight, the income to capital ratio is equal to $(\mathsf{R}-1+\delta)/\varphi$.

capturing the risk of fully losing the invested capital. To simulate the model dynamics triggered by the development of the entrepreneurial sector, we also have to choose the share of agents endowed with positive entrepreneurial ability, as well as the exogenous farming wage $\underline{\Omega}$. As shown in Gollin (2008), the share of self-employed in the workforce of developing countries tends to be much larger than in advanced economies, reaching in a few countries more than 50 percent compared to around 10 percent in the US. We choose an intermediate value of 20 percent, also considering that only some of the self-employed in developing countries are productive entrepreneurs. Regarding the choice of the farming wage rate, this is the income level from which the transition starts. As explained in detail in section III.C, it does not affect the ultimate equilibrium of the economy and thus the total amount of capital generated by the model, but a lower farming wage leads to a larger current account as a percentage of GDP during the transition. Therefore, in our benchmark calibration we conservatively set the farming wage to the market-clearing wage at which all workers are eventually absorbed by the entrepreneurial sector. This also leads to simple to understand transition dynamics since workers' income is constant. The robustness of the results to alternative calibration is explored in Section III.C.

B. Benchmark Simulation

Figure 3 shows the aggregate dynamics of the model once agents are given the opportunity to become entrepreneurs. The economy enters a period of high growth, triggered by capital accumulation and productivity gains from the reallocation of labor into entrepreneurial activities. In standard neoclassical growth models, agents should respond to the expected increase in income by borrowing in order to smooth consumption intertemporally. The top right hand side plot shows instead that, consistently with the empirical evidence, the saving rate strongly increases. As previously discussed, this is due to the reliance on internal saving to finance investment.

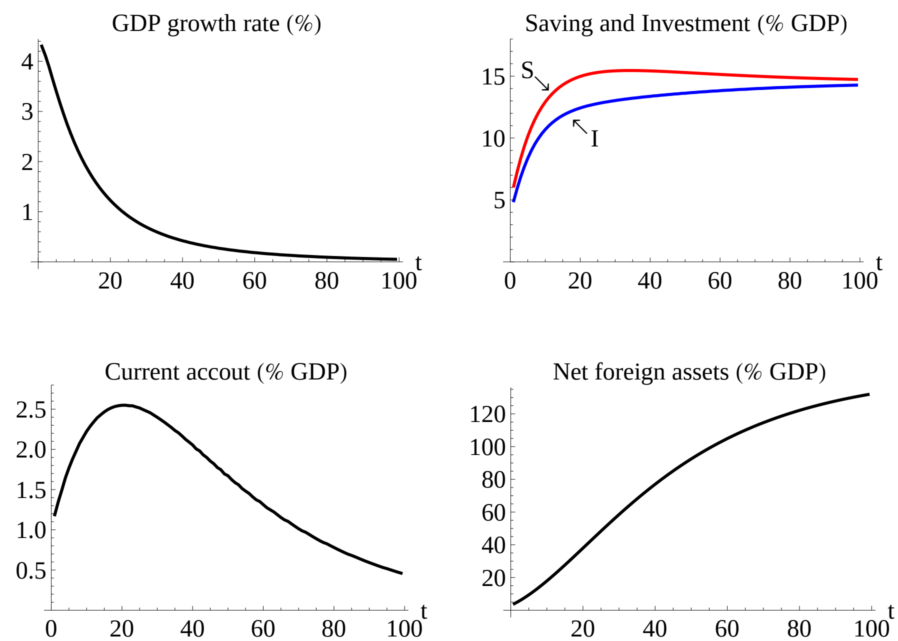

Figure 3. Economy dynamics following the opening to entrepreneurship

The key result of the model is that the increase in aggregate saving is even stronger than the increase in investment. This is where idiosyncratic investment risk plays the crucial role. Having to bear the risk of their investment projects, entrepreneurs need to increase saving not only to self-finance investment, but also to accumulate precautionary assets for self-insurance purposes. The simulation results show that this net saving increase can sustain persistent and large capital outflows, with the current account reaching 2.8 percent of GDP around 20 years after the beginning of the transition process.

C. Sensitivity Analysis

In this section we discuss the sensitivity of the simulation results to parameter values. Consider first the role of farming income, $\underline{\Omega}$. In the benchmark calibration this is set equal to the market-clearing wage, Ω_T, at which all the labor force is eventually employed by the entrepreneurial sector once reaching its stochastic steady-state equilibrium. This implies that during the simulated transition non-entrepreneurs will move from being farmers to wage earners while maintaining a constant income. Using a lower level for farming income does not change the ultimate equilibrium of the model, but strengthens the model results by increasing growth rates and current account surpluses during the transition. This is illustrated in Figure 4 which traces the economy transition with farming income set to half the ultimate market-clearing wage. The opening of entrepreneurial opportunities leads to a considerably higher growth rate, since entrepreneurs benefit from lower labor costs. As in Lewis (1954), the wage rate is fixed at $\underline{\Omega}$ until all the rural labor force is absorbed, and then gradually increases. Lower initial wage also speeds up the development of the entrepreneurial sector, thus generating larger current account surpluses peaking at more than 4 percent of GDP.[15]

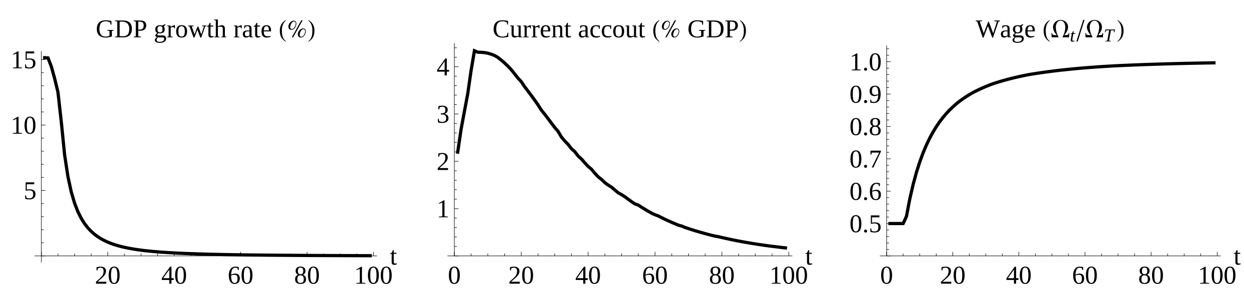

Figure 4. Economy dynamics under a lower farming income

Regarding the sensitivity to the structurally estimated parameters, Table 2 reports the values of key summary statistics computed under alternative calibrations: the market-clearing wage at which all the labor force is absorbed by the entrepreneurial sector, the final net foreign asset position as a percentage of GDP, the number of years required for GDP to rise half way between the initial and final level, the highest growth rate experienced by the country, and the maximum values achieved

[15]The level of farming income has interesting implications for inequality dynamics: while in the benchmark calibration inequality monotonically increases, using a lower farming income leads to non-monotonic dynamics. As in Kuznets (1955), inequality increases early in the transition as entrepreneurs benefits from stable low wages, and then shrinks as the absorbtion of the all the rural labor force leads to inflationary pressure on wages.

by the current account, saving and investment as a percentage of GDP. The second column reports the statistics under the benchmark parameter values used to generate the dynamics in Figure 3. Increasing the failure risk mostly affects the optimal level of precautionary savings, leading to considerably larger current accounts and net foreign asset position. The parametrization of the production function instead mainly controls the growth dynamics. A lower value for φ implies stronger decreasing marginal returns, leading to a smaller optimal firm scale and equilibrium wage. However, it also increases the marginal returns at low levels of capital, considerably speeding up convergence to the ultimate equilibrium and generating much higher growth rates. We also consider the sensitivity to the intertemporal discount factor, β, whose calibration somewhat varies in the literature. Higher β, by weakening the impatience condition $\mathsf{R}\beta < 1$, can lead to a much larger ultimate net foreign asset position, while only moderately increasing the peak in the current account. In conclusion, the sensitivity exercise shows that the key implications of the model are robust to different calibrations.

Statistics	$\flat = .94\%$ $\varphi = .49$ $\beta = .94$	Failure probability $\flat$		Prod. function curvature φ		Discount factor β	
		0.5%	2%	0.4	0.6	.92	.96
Final wage	0.79	0.82	0.75	0.62	0.88	0.74	0.87
Final NFA (%GDP)	148	107	207	141	162	93	501
Half GDP (years)	18	18	18	10	38	16	22
Max GDP growth	4.3	4.2	4.5	12.8	1.4	4.7	3.8
Max CA (%GDP)	2.8	2.2	3.9	3.3	3.3	2.8	3.5
Max S (%GDP)	15.5	15.2	16.1	18.3	14.4	13.7	18.8
Max I (%GDP)	14.5	14.4	14.8	15.1	14.4	12.3	17.5

Table 2. Sensitivity analysis

IV. Financial Development

The analysis has been developed so far in the absence of risk sharing, so that entrepreneurs have to fully bear the investment risk. We believe this is a good characterization of the level of financial development in many developing countries and helps to distill the essence of our contribution. In this section, we relax this assumption and investigate the implications of the introduction of state-contingent claims for the model's dynamics and welfare.

A. Dynamics under Risk Sharing

The inability of sharing risk with outside investors in the previous part of the paper was captured by the lack of state-contingent claims. We now relax this assumption by introducing financial claims with payoff contingent on the failure shock. This can be thought as representing equity markets or a well developed banking system which is able to extend uncollateralized credit by properly pooling idiosyncratic risk. Assume that entrepreneurs can pledge to fully diversified investors a share χ of tomorrow firm's value, which is zero if the business fails and

$$\chi \overbrace{\left(\Upsilon_t \eta^{1-\varphi} k_t^{\varphi} + (1-\delta)k_t\right)}^{F_t^{\not\flat}} \tag{10}$$

otherwise, thus being able to raise external financing up to

$$d_t \leq (1-\flat)\chi F_t^{\not\flat}/\mathsf{R} \tag{11}$$

Given the absence of risk premium, entrepreneurs use all the available financing, so that the transition equations for cash-on-hand become:

$$x_{t+1}^{\not\flat} = \mathsf{R}a_t + \mathsf{R}d_t + F_t^{\not\flat} - \chi F_t^{\not\flat} = \mathsf{R}a_t + (1-\flat\chi)F_t^{\not\flat} \tag{12}$$

$$x_{t+1}^{\flat} = \mathsf{R}a_t + \mathsf{R}d_t = \mathsf{R}a_t + (1-\flat)\chi F_t^{\not\flat} \tag{13}$$

from which it is easy to observe that the parameter χ controls the amount of risk sharing. If $\chi = 1$ the investment return is independent of the realization of the failure shock, since entrepreneurs entirely exchange the uncertain return of the investment with its expected value. Conversely, if $\chi = 0$ the problem collapses to the case previously considered, in which entrepreneurs have to fully bear the investment risk.[16]

Figure 5 compares the portfolio policy functions for the entrepreneur in the absence of risk sharing with those under state-contingent financing (identified with the χ subscript). As previously discussed, without contingent claims an increase in invested capital has to be matched by an increase in safe assets for precautionary reasons. Financial development substantially alters this prediction. First, for a given unit of investment, entrepreneurs have to hold less precautionary savings since part of the risk is shared with external investors. Second, entrepreneurs can rely on external financing to scale-up their firms.[17] In other words, financial development weakens the need for both self-financing and self-insurance. As a consequence, the development of the entrepreneurial sector can actually be associated with an increase in the demand for capital and a negative target for safe asset holdings, $\overline{a}_{\chi}^{e}$.

We now consider the aggregate implications of state-contingent financing by simulating the transition dynamics under different values of χ. Focusing first on the GDP pattern, Figure 6 shows that more financial development leads to a higher ultimate level of income, since risk sharing allows for a larger optimal production scale by reducing the demanded risk premium, and speeds up the transition dynamics as firms can be financed also with external capital.[18] The country thus

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[16]Limits on the pledgeable share of the return from risky investment can arise for various reasons that we are not here interested in identifying (see Appendix III for an example).

[17]Entrepreneurs may also have the incentive to borrow against future income in order to finance current consumption. As for workers, we prevent this possibility by imposing $c_t \leq x_t$.

[18]For a more extensive analysis of how idiosyncratic investment risk influences the economy steady state in a closed economy see Angeletos (2007).

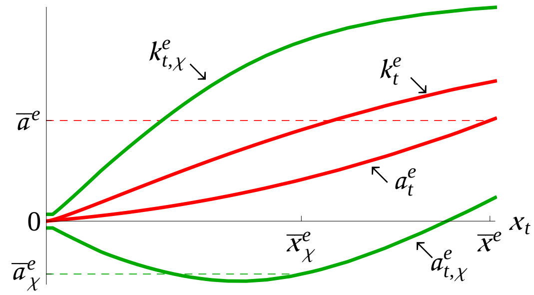

Figure 5. Entrepreneur's investment function with and without state-contingent claims

experiences initial capital inflows, leading to the deterioration of its net foreign asset position, which can be reversed later in time if the degree of risk sharing is relatively low. In order to understand the welfare implications studied in the next section it is crucial to notice that higher risk sharing (by allowing entrepreneurs to build up larger firms) also bids up the ultimate market-clearing wage and leads to an earlier absorbtion of the rural labor force and wage increase. The model thus predicts that the level of domestic financial development plays a pivotal role in shaping the relation between growth and capital flows. Growth is associated with capital outflows for countries with low domestic financial development, and capital inflows for countries with more advanced financial intermediation.

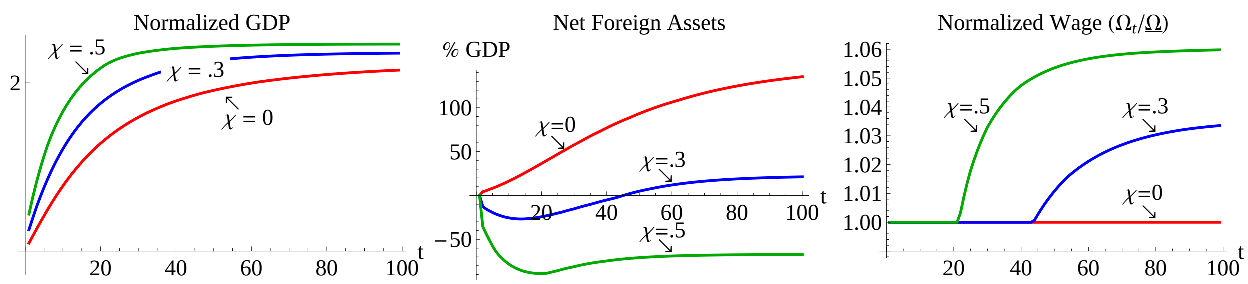

Figure 6. Economy dynamics with different degree of risk sharing

This result may importantly sheds light, for example, on the recent opposing experiences of Asian and Eastern European emerging economies. As emphasized in Lane and Milesi-Ferretti (2007) and Abiad, Leigh and Mody (2007), contrary to emerging Asia, growth in Eastern Europe has been associated with large capital inflows. Interestingly, recent data reported in Claessens, Horen, Gurcanlar and Sapiain (2008) show that the share of banks owned by foreigners has increased to almost 70% in emerging Europe, while it remains below 25% in emerging Asia. Insofar as foreign banks are more effective in managing idiosyncratic risk and extending credit to entrepreneurial projects, the model would indeed predict a larger reliance on international borrowing for Eastern European countries.[19]

[19]The emphasis of the paper on entrepreneurial risk suggests also an additional factor which can be relevant to explain the Eastern European dynamics. Even though not explicitly modeled here, if investment risk is borne by foreigners, the country would not need to accumulate precautionary savings. Consistent with this implication, the net inflows of FDI as a percentage of GDP over the last decade have been twice as large in emerging Europe than in emerging Asia.

B. Welfare Gains from Risk Sharing

The model is also suitable to evaluate the welfare gains from financial development. These are commonly expressed in the literature as the permanent percentage increase in annual consumption for the agent in the economy without risk sharing which makes her indifferent to move to the economy with state-contingent claims. Formally welfare gains are measured by the λ_t at which:

$$\mathbb{E}_t \sum_{j=0}^{\infty} \beta^j u\left(c_{t+j}(1+\lambda_t)\right) \quad = \quad \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j u\left(c_{t+j,\chi}\right) \tag{14}$$

which by exploiting the homotheticity of the CRRA utility function can be rewritten as:

$$(1+\lambda_t)^{1-\rho} V_t(x_t) = V_{t,\chi}(x_t) \tag{15}$$

Aggregate welfare gains are obtained as in Mendoza, Quadrini and Ríos-Rull (2007) by weighting individuals equally, and are computed for the whole population (Λ_t) as well as for only workers (Λ_t^w) and entrepreneurs (Λ_t^e).

We start by considering the welfare gains from financial development at the time at which agents are allowed to start up entrepreneurial activities, denoted as $t = 0$. Figure 7 shows that the introduction of state-contingent claims leads to substantial aggregate welfare gains, with full risk sharing being equivalent to a permanent increase in aggregate consumption of almost 25%. The figure also reveals that the gains are very unevenly distributed between workers and entrepreneurs. The gains for entrepreneurs are one order of magnitude larger, since risk sharing allows them to scale up businesses faster by using external financing and reduces the need to accumulate precautionary assets. The gains for workers are instead exclusively a function of the increase in the wage rate. A low level of risk sharing has negligible effects since it leads to an increase in the wage far away in the future. Under full risk sharing instead the wage rate jumps immediately up to the equilibrium level, since entrepreneurs can fully finance their firms by borrowing, and workers experience a welfare gain equivalent to almost a 13% permanent increase in consumption.

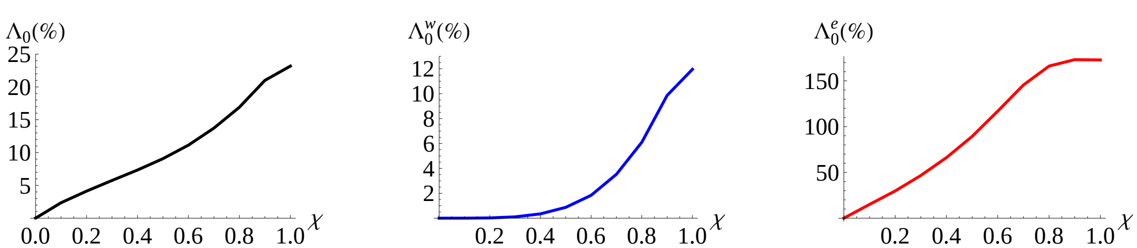

Figure 7. Welfare gains from risk sharing at the beginning of the transition period

Quite different are the distributive welfare implications of the introduction of state-contingent claims at the end of the transition period $t = T$, i.e. at the ultimate stochastic equilibrium with a fully developed entrepreneurial sector. Figure 8 shows that in this case workers are those who benefit the most from financial development. Better risk-sharing opportunities lead to larger firms and higher wages so that gains for workers grow monotonically with χ. Welfare gains for entrepreneurs are instead much smaller and interestingly are inversely U-shaped in χ, initially increasing but then shrinking in the degree of financial development.

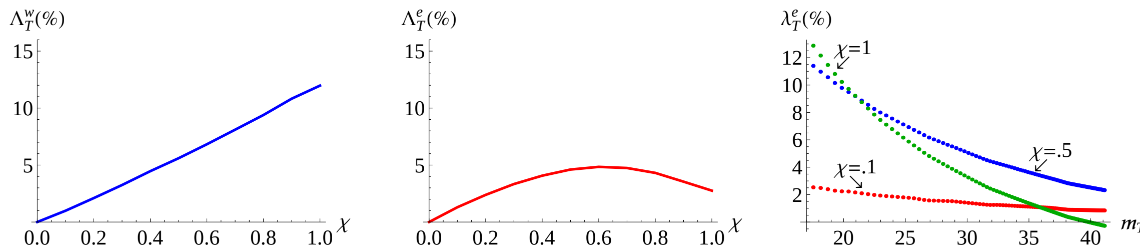

Figure 8. Welfare gains from risk sharing at the final equilibrium with entrepreneurship

To understand the reason for this non-linearity, the right-side plot in Figure 8 shows the individual welfare gains for entrepreneurs as a function of wealth. The heterogeneity in wealth is generated by the failure shocks, so that poorer entrepreneurs are those who have been losing their investment more recently and are gradually re-scaling up their firms. Note that the density of the dots represents the distribution of entrepreneurs over wealth. We observe that while benefits for small businesses grow monotonically with financial development, larger businesses can be hurt by the increase in risk sharing as pointed out also in Giné and Townsend (2004). This is because financial development allows smaller entrepreneurs to scale up their firms faster but at the cost of rising the competitive market wage.

In conclusion, we find that financial development can lead to large welfare gains, especially at the beginning of the transition period, since it substantially speeds up the process of development and limits the need to accumulate precautionary assets. Sizeable gains, mainly in terms of higher wages, can also be seized by economies at a more advanced level of entrepreneurial development. Financial development can, however, be harder to achieve later in the transition for political economy considerations, given the possible opposition from the wealthiest entrepreneurs who want to avoid the inflationary wage pressure from faster growing small businesses.

A final remark is on the benefits of financial globalization. It has been so far rather difficult to clearly identify the advantages of financial openness for developing countries mostly because scholars have been looking essentially for an elusive positive association between capital inflows and growth. The model shows that a potential benefit of financial globalization is instead to allow for the reverse effect, such as to let emerging markets balance risky domestic investment by holding safe assets abroad.

V. Conclusion

For a long time economists have known that saving rates and growth are positively correlated, but as of today no convincing explanation for this correlation has yet emerged. More recently it has been noted that the increase in saving rates in fast growing developing countries tends to be even stronger than the increase in investment rates, thus leading to an improvement in the current account. In this paper we have developed a small open economy model with uninsurable idiosyncratic investment risk which has the potential to account for both empirical findings.

Facing the risk of losing the invested capital and in the absence of state-contingent financing, entrepreneurs have to rely on self-financing to scale up their firms. Therefore once entrepreneurial opportunities become available, they increase saving to finance the investment which triggers higher growth. The increase in saving must, however, be larger than the increase in investment since entrepreneurs also need to accumulate safe assets to self-insure against the risk of their businesses going bust. Simulation results have shown that this net saving increase driven by precautionary reasons can sustain large and persistent capital outflows. Consistent with this interpretation is the fact that capital outflows from developing countries have taken mostly the form of debt asset claims rather than more risky equity or FDI investments.

We have also studied how financial development can alter the dynamics of economic development and improve welfare. The availability of risk-sharing instruments can considerably speed up the process of growth, limit the need for precautionary savings, and drastically change the implications for the current account by allowing for capital inflows. The welfare gains from financial development can be substantial and with very different distributive implications for workers and entrepreneurs depending on the stage of development of the entrepreneurial sector.

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Appendix I. Growth Acceleration Episodes

These are the criteria used to identify the year of occurrence of growth acceleration episodes: growth has to be rapid (at least 3% over the following seven years), growth has to accelerate (the growth rate over the subsequent seven years has to be at least 2% higher than over the previous seven years), and growth should not be simply driven by a recovery phase out of a recession (per capita gross national income seven years after the growth acceleration year has to be at least as large as the pre-growth peak).[20] We consider only non-OECD countries (as well as Czech Republic, Hungary, Mexico, Poland, Slovakia, South Korea, and Turkey) with complete data on saving and investment around the acceleration year so that the dynamics are not influenced by missing observations. We use the difference between saving and investment to approximate the current account which has more limited data coverage. These are the identified episodes: Argentina 2000*, Bolivia 2001, Botswana 1984, Botswana 1996, Chile 1988*, Chile 2000, China 1991, Cameroon 1977, Dominican Republic 1985*, Ecuador 2001*, Ethiopia 2000, Hungary 1993*, Hungary 1998*, India 2000, Jordan 2001, South Korea 1983, Sri Lanka 1975, Sri Lanka 1992, Lesotho 2001, Morocco 2001, Mozambique 1995, Malaysia 1988*, Pakistan 1976, Pakistan 2001, Panama 1991*, Peru 2001, Philippines 1993, Paraguay 2001*, Romania 2000*, Russian Federation 1998*, Sudan 1992, El Salvador 1971, Swaziland 2000, Thailand 1986, Trinidad and Tobago 1973, Trinidad and Tobago 1997*, Turkey 2001*, Uganda 1992*, Uruguay 2001*, Venezuela 2001*, South Africa 2001. The * symbol identifies countries with at least one year of negative income growth over the 13 years considered. The improvement in the current account is even larger if excluding them.

Appendix II. Numerical Solution

Here we describe the numerical procedure to solve for the model transition dynamics. The first step is to solve for stochastic equilibrium with a fully developed entrepreneurial sector and the market-clearing wage. This can be accomplished as follows:

1. Guess the steady-state equilibrium wage Ω_T and distribution $\mathbb{H}_T(x, o)$
2. Solve for the converged policy functions
3. Simulate the model until convergence to the new stochastic steady state and compute the market-clearing wage
4. Update the wage guess and repeat steps 2 and 3 until the wage converges

[20] We identify these growth acceleration episodes using GNI rather than GDP since the former also includes net income from abroad and is therefore the relevant variable to which consumption and saving should respond. In the case of multiple years for a given country satisfying the above criteria (and less than 5 years apart), the relevant episode is selected by considering the year with the highest explanatory power as the breaking point of a spline regression of growth over time.

To solve for the transition dynamics following the opening to private entrepreneurship (at time 0):

1. Choose the (sufficiently large) number of transition periods T
2. Guess the transition sequence for wage $\{\Omega_t\}_{t=0}^{T}$
3. Iterate backward the policy functions from time T to 0
4. Given the initial distribution $\mathbb{H}_0(x, o)$, simulate the model until time T and compute the market-clearing wage for each period
5. Update the wage transition sequence and repeat steps 3 and 4 until the wage sequence converges

APPENDIX III. LIMITED LEGAL ENFORCEMENT

The level of financial development and in particular the provision of state-contingent financing can be hampered by various problems in developing countries. We consider as an example the case of limited ability to enforce contracts. Assume that entrepreneurs with a successful business can deny repayment to outside investors and retain a share τ of the business value, where the higher is τ the lower is the degree of enforcement. Under this circumstance, external investors would have to limit financing in order to provide the entrepreneur with the incentive to repay. This requires ensuring that entrepreneur's cash-on-hand without defaulting is higher than if reneging on the contract:

$$\mathsf{R}a_{t+1} + \mathsf{R}d_t + F_t^{\not\flat} - d_t\mathsf{R}/(1-\flat) \geq \mathsf{R}a_{t+1} + \mathsf{R}d_t + \tau F_t^{\not\flat} \tag{A1}$$

This limits external financing to:

$$d_t \leq (1-\flat)(1-\tau)F_t^{\not\flat}/\mathsf{R} \tag{A2}$$

which by interpreting χ as $(1-\tau)$ is equivalent to equation (11).