Growth and Capital Flows with Risky Entrepreneurship

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Abstract

Contrary to the prediction of benchmark neoclassical models, growth accelerations in developing countries tend to be associated with current account improvements, resulting from larger increases in saving than in investment. I argue that this can be driven by the behavior of entrepreneurs facing incomplete financial markets and risky investment. The uninsurable risk of losing invested capital forces entrepreneurs to rely on self-financing to build up their firms. As new business opportunities open up, entrepreneurs increase their saving to finance the investment that produces growth. The key insight is that saving has to rise more than investment in order to allow also for the accumulation of precautionary assets. As a consequence, entrepreneurs generate a net saving increase that sustains persistent net capital outflows. Plausibly calibrated simulations produce sizeable quantitative effects. I then show that the introduction of state contingent claims reduces capital outflows, speeds up growth and leads to substantial welfare gains.

Keywords: Capital flows, growth, entrepreneurship, idiosyncratic risk, heterogeneity, financial underdevelopment, saving.

JEL Classification Codes: C6, E2, F4, O1

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1 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 the per worker output ratios. As discussed in Prasad, Rajan, and Subramanian (2007), the pattern of international capital flows has become even more puzzling in the last decade with low income countries actually financing more advanced economies. It is remarkable, for example, that in 2007 the largest borrower and lender on the international markets have been respectively the US with a current account deficit of $238 billion and China with a $238 billion surplus.

An even more surprising feature of the current patterns of capital flows is that China is a very fast growing country and, according to benchmark models based on the Permanent Income Hypothesis (PIH), 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 by policy interventions, but recent empirical studies suggest it is actually typical. Gourinchas and Jeanne (2007) show that the capital flows predicted by the standard neoclassical growth model calibrated with country specific productivity dynamics 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.[1]

The inability of standard PIH 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 Modigliani (1970) and further documented by many others — among them Carroll and Weil (1994), Attanasio, Picci, and Scorcu (2000) and Rodrik (2000) — saving and growth are in fact positively correlated. Thus, the novel empirical

[1] Eastern European emerging markets have instead experienced large current account deficits. In Section 5 I will argue that this can be explained by the higher level of financial development and larger FDI inflows.

finding pointed out by Gourinchas and Jeanne (2007) is that saving and growth are not only positively correlated, but that their correlation is even stronger than the one between investment and growth.[2]

A possible explanation of the positive correlation between growth and saving was proposed by Modigliani (1970, 1986) considering an overlapping generation model based on the Life Cycle Hypothesis: 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. This conjecture, however, relies on an assumption found counterfactual by Carroll and Summers (1991): namely, that growth leads to a higher lifetime income of the newly born generations, but does not change the expected growth rate of income. Plausibly calibrated simulations show that the boost in consumption derived by higher income growth for a given generation easily outweighs the aggregation effect suggested by Modigliani.

Another attempt to account for the positive correlation between growth and saving has been to consider models with habits in consumption. Carroll, Overland, and Weil (2000) demonstrate 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 no 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 (2004)).

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 I develop a small open economy model with insurable idiosyncratic investment risk which has the potential to account for both empirical findings. The crucial assumptions are that entrepreneurs are exposed to the exogenous idiosyncratic risk of business failure

[2] This is because net capital outflows are the difference between saving and investment.

(entailing the loss of the invested capital) and that financial markets are incomplete insofar as they are unable to provide insurance against it. 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. Thus, 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. I initialize the model to a setting in which all agents are constrained to earn their living as self-employed farmers and study the dynamics which occur as they are unexpectedly given the opportunity to become entrepreneurs. 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. I also discuss the sensitivity of the simulation results to the estimated parameters and the intertemporal discount factor.

I then relax the degree of financial market incompleteness by introducing state contingent claims in order to study their implications for the 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 the agents are able to diversify away investment risk, the less the need for precautionary savings and the smaller the size of capital outflows. Under full risk-sharing, the model's dynamics actually collapse to those predicted by the benchmark neoclassical growth model with large international borrowing. I 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 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 Rios-Rull (2007a) show that financial globalization leads to capital outflows from economies with lower 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 my work is its focus on the implications for capital flows of the growth acceleration experienced by emerging markets, rather than on financial globalization. This is motivated by the fact that the positive association between growth and capital outflows is the most surprising finding since it is strongly opposed to the prediction of benchmark growth models.

Explaining the positive association between growth and the current account for developing countries is also the purpose of a recent paper by Buera and Shin (2008) who also emphasize the role of entrepreneurs, but through a different mechanism. Instead of considering the implications of investment risk for the accumulation of precautionary assets, they attribute capital outflows following economic liberalization to the rapid disinvestment of less productive entrepreneurs and the slow capital absorption by new entrepreneurs due to borrowing constraints.

Finally, Carroll and Jeanne (2008) develop a tractable model of the net foreign asset position which also has the potential to account for the positive correlation between growth and the current account under the assumption that faster growth is associated with higher unemployment risk. The model I present focuses instead on entrepreneurial risk and endogenizes both growth and its relation with risk.

I start by reviewing the empirical evidence on growth, saving and the current account in Section 2. Section 3 describes the model that is calibrated and simulated in Section 4. Section 5 considers the implications of financial development and Section 6 concludes by summarizing key results and open research questions.

2 Empirical Motivation

It is a well established fact that the national saving rate is positively correlated with growth. Some preliminary cross sectional evidence was already provided long ago by Houthakker (1961) and Modigliani (1970) and has been confirmed by numerous subsequent studies. Strong positive correlations have also been detected within countries over time and is not a recent phenomenon as shown by Maddison (1992) using data back to 1870.

These results were first 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 of all, this mechanism fails in the case of a frictionless small open economy, since an exogenous increase in saving simply generates capital outflows without triggering faster growth.[3] A second reason to reject the idea that the correlation between saving and growth is driven by exogenous increases in saving is that a large empirical literature suggests the opposite causal relation. For example, Bosworth (1993), considering OECD countries during the period 1960-1980, concludes that growth is the most important determinant for saving. Edwards (1996) also finds similar results for developing countries over the period 1970-92, and Loayza, Schmidt-Hebbel, and Serven (2000), in a comprehensive World Bank study using panel instrumental-variable techniques, confirm that higher growth leads to higher saving.

Tackling more directly the issue of causality, Carroll and Weil (1994) perform Granger causality tests and find that growth positively Granger causes saving not only on aggregate data, but for individual households as well. Similar results are found by Attanasio et al. (2000) on a larger country dataset and using alternative econometric techniques. Finally, particularly convincing is the evidence provided by Rodrik (2000) who shows that while

[3] Aghion, Comin, and Howitt (2006) 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.

periods of sustained increases in saving rates do not systematically lead to higher growth, transitions into higher growth are followed by persistent higher saving rates.

Recent empirical work has documented another interesting related regularity, namely that the correlation between saving and growth tends to be even higher than the correlation between investment and growth. Gourinchas and Jeanne (2007) calibrate the standard neoclassical small open economy model with the productivity dynamics of 69 developing countries and use it to predict net capital inflows over the period 1980-2000. Surprisingly, they find that actual capital flows have been in fact negatively correlated with the predicted flows, i.e. capital appears to flow more to countries growing less. These results are robust to the exclusion of aid flows, which only helps to explain the dynamics of a few African countries.

Similarly, Prasad et al. (2007) also strongly reject the negative correlation among developing countries between growth and net capital outflows predicted by the standard neoclassical growth model, considering both the cross sectional and time series variation. Interestingly, they also point out that European emerging markets have instead run large current account deficits as also emphasized by Abiad, Leigh, and Mody (2007). I discuss how the model presented here can reconcile this finding in Section 5.1.

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.[4] Specifically, I identify the year in which a country experiences a growth acceleration episode using the criteria proposed by Hausmann, Pritchett, and Rodrik (2005): 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 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).[5]

[4]Similar exercises are also performed by Prasad et al. (2007) and Buera and Shin (2008) with analogous results.

[5]I use GNI rather than GDP since the former also includes net income from abroad and is therefore the

Using data from the World Development Indicators on developing countries between 1960 and 2004, I detect 33 growth acceleration episodes and consider the time series evolution of the cross country mean of per capita income growth, saving, investment, and the current account from six years before to six years after the growth acceleration.[6] Figure 1 shows that as the country enters a period of higher growth, the saving rate, instead of decreasing to allow for consumption smoothing over time, rapidly rises. Furthermore, the increase is stronger than for the investment so that the country witnesses an improvement in the current account.

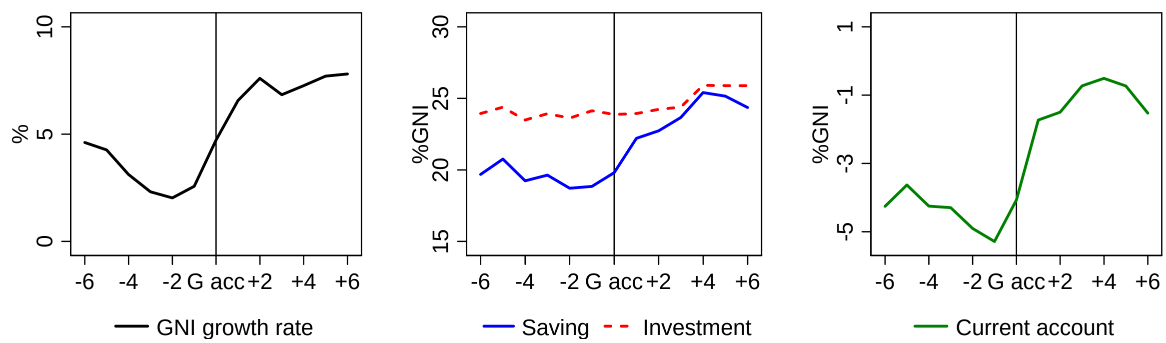

Figure 1: Mean over 33 growth acceleration episodes between 1960 and 2006

Some authors have suggested that capital outflows from emerging countries may be driven by financial globalization. Due to their limited ability to supply financial assets (Caballero et al. (2008)) or their higher demand for precautionary savings (Mendoza et al. (2007a)), emerging markets would be witnessing large capital outflows as the equilibrium outcome of the recent process of international financial integration. Buera and Shin (2008) also present a model in which capital outflows from emerging markets during rapid growth are magnified by the contemporaneous process of financial opening. While it is plausible

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.

[6] I consider only those countries with complete data on saving and investment around the acceleration year so that the dynamics are not influenced by missing observations. Extending the period of analysis to more than 6 years would reduce the number of countries I could consider. I use the difference between saving and investment to approximate the dynamics of the current account which has worse data coverage. See Appendix A for a detailed description of the data and the list of the growth acceleration episodes.

that the recent wave of financial globalization may have contributed to the flow of capital towards developed economies, Figure 2 suggests that this is unlikely to be the key factor behind the positive correlation between growth and capital outflows. If we limit the sample to the growth acceleration episodes up to 1985 (which is commonly used as the starting date for financial globalization), the transition into a faster growth period is still associated with an improvement in the current account, which actually appears even more pronounced.[7]

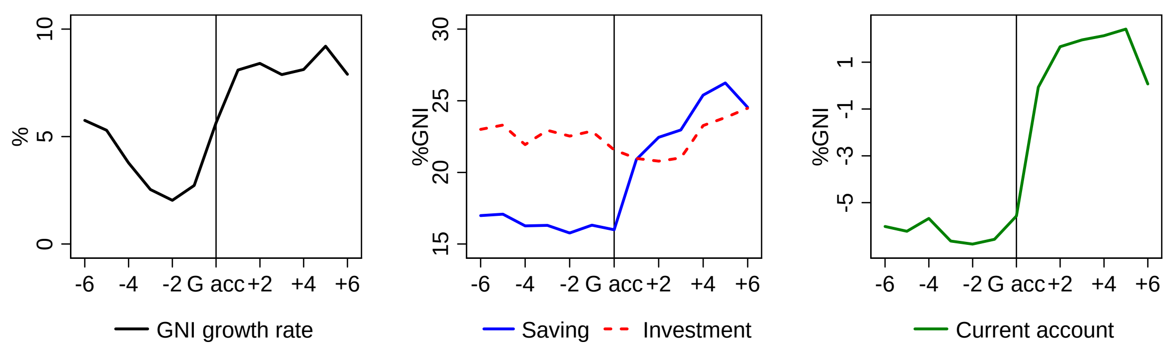

Figure 2: Mean over 11 growth acceleration episodes between 1960 and 1985

Summing up, the recent Chinese experience characterized by fast growth and an improving current account is far from unique. The empirical evidence on developing countries rejects the negative correlation between growth and net capital outflows predicted by the neoclassical growth model, and the key challenge is to account for the strong increase in saving. I suggest that an important role in driving the positive correlation between saving, net capital outflows, and growth is played by entrepreneurs.

Suggestive evidence supporting this idea comes from US data which show that entrepreneurs have higher saving rates relative to workers, especially at the time of entry, and account for a very large share of total income. Using the Survey of Consumer Finances (SCF) panel data for the years 1983 and 1989, Gentry and Hubbard (2004) document that households owning a business in both years have saving rates 16% higher than workers after controlling for standard life cycle determinants, income, and housing ownership. Even more striking is the fact that new entrepreneurs (identified as the households owning a business

[7] Similar results hold if we use medians instead of means, for both the full sample and the one limited to 1985.

only in 1989) experience a positive saving rate differential of 35%. Analogous results are reported by Buera (2008a), who finds using PSID data that entrepreneurs up to 31 years old save 26% more than workers. These results strongly hint at the presence of financial market imperfections, which force entrepreneurs to rely on internal financing to scale up their business activities.[8]

The potential for entrepreneurs to have a sizeable impact on aggregate saving also comes from the fact that in the US wealth is extremely concentrated and a large proportion of the wealthiest households are business owners. According to the 2004 SCF, the wealthiest top 5% of households own more than 50% of total wealth, and more than 70% of them are business owners.[9] More specifically, the 11.5% of the US population with positive business assets accounts for more than 46% of aggregate wealth and more than 27% of total income.

The availability of accurate and nationally representative data from developing countries is much more limited. However, strong evidence about the relevance of financial imperfections has been provided by recent surveys of firms across the world (including the World Business Survey and the Investment Climate Survey) which have documented that financial constraints feature among the major impediments for business growth for small and medium size firms.[10] Regarding more directly the relation between saving and growth, most of the empirical literature has focused on testing the implications of the life-cycle consumption model, finding very little support from both aggregate and household level data. Interestingly, Chamon and Prasad (2007) have recently documented that the increase in saving rates in China between 1995 and 2005 has been much more pronounced among rich households, which under financial constraints are more likely to start up a business. Preliminary results in Sandri (2008) confirm that a similar trend has also been experienced in Taiwan.

[8] 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. This, of course, does not rule out their relevance in shaping the saving and investment decisions of entrepreneurs while scaling up businesses. The relevance of internal finance for investment has also been pointed out in the corporate finance literature; see Hubbard (1998) for an excellent survey.

[9] Similar results are reported by Quadrini (2000) for different years with data from the Survey of Consumer Finances and the Panel Study of Income Dynamics.

[10] See "Finance for All? Policies and Pitfalls in Expanding Access", The World Bank, 2008.

3 The Model

Consider a small open economy model populated by infinitely lived individuals endowed with heterogenous entrepreneurial ability and maximizing the expected present discounted value of consumption:

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

where β is the intertemporal discount factor and $u(.)$ is parameterized as the standard constant relative risk aversion utility function with coefficient ρ. All agents are initially constrained to work as self-employed farmers earning the risk free income $\underline{\Omega}$. Then, unexpectedly, they are offered the one time chance of forever becoming entrepreneurs, which entails foregoing the farming income in favor of a risky income proportional to invested capital and entrepreneurial ability. The individuals with sufficiently high entrepreneurial ability seize this opportunity and invest in their firms, thus triggering growth. Entrepreneurial activities also require the employment of workers which are absorbed from the rural sector and paid the market clearing wage Ω_t.

The assumption that the opportunity of transitioning to entrepreneurship is unexpected, irreversible, and requires immediate departure from the farming sector is imposed in order to rule out pre-entry saving, from which I dispense since it is not essential for the results of the model.[11] This also considerably simplifies and speeds up the numerical solution procedure since the maximization problems of workers and entrepreneurs (described in detail in the following two sections) can be solved independently from each other.

A key element of the model is the assumption of incomplete financial markets. In particular, I rule out the presence of state contingent claims and the possibility of default

[11] If farmers could foresee the possibility of becoming entrepreneurs or were allowed to delay entry, they may find it optimal under particular calibrations to increase saving and accumulate wealth prior to entry. This would allow them to have more financial resources to scale up their business activities to a sufficiently large size upon entry, thus compensating for the foregone farming income. The same mechanism could be at work for the entrepreneur who, in the case of a shock involving the loss of the invested capital, may find it optimal to go back to farming and save over a few years before re-entering.

so that the entrepreneur has to fully bear the investment risk. This can be due to various forms of asymmetric information, costly state verification, and/or weak legal enforcement which are likely to plague many developing countries.

Finally, the model is solved under the impatience condition $\mathsf{R}\beta < 1$ which is standard under precautionary motives and is required to guarantee a finite accumulation of safe assets by entrepreneurs.

3.1 Workers

In each time period, workers decide whether to earn income as self-employed farmers or offer their labor unit to entrepreneurs. They also choose in each period how to allocate their total market resources, m, between consumption and savings, which are invested in risk free assets, a, earning the return R, the exogenous world interest rate. Formally, they solve the following problem:

$$\begin{aligned} V_t^w(m_t) &= \max_{a_{t+1}\geq 0} \left\{u(c_t) + \beta V_{t+1}^w(m_{t+1})\right\} \\ &s.t. \\ m_t &= c_t + a_{t+1} \\ m_{t+1} &= \mathsf{R}a_{t+1} + \overline{\Omega}_{t+1} \end{aligned} \tag{2}$$

where $\overline{\Omega}_{t+1} = \max\{\underline{\Omega}, \Omega_{t+1}\}$, $\underline{\Omega}$ being the farming income and Ω_{t+1} the wage offered by the entrepreneurial sector. Asset holdings are constrained to be non-negative since I rule out the possibility for workers to finance consumption by borrowing against future labor income.[12] 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:

$$u'(c_t) = \max\left[\beta \mathsf{R} u'(c_{t+1}), u'(m_t)\right] \tag{3}$$

[12] Given the impatience condition and the absence of labor income risk, workers would otherwise implausibly borrow against all the present discounted value of future labor income.

3.2 Entrepreneurs

Entrepreneurs run their own business activities which, as in Buera (2008b), are based on a nested Cobb-Douglas production function in entrepreneurial ability η, invested capital k, and employed labor l:

$$\hat{f}(\eta, k_t, l_t) = \eta^{\nu}(k_t^{\alpha} l_t^{1-\alpha})^{1-\nu} \qquad 0 < \alpha < 1, \quad 0 < \nu < 1 \tag{4}$$

In order to limit the number of state variables in the dynamic maximization problem, I dispense with adjustment costs to capital or labor so that the optimal input composition is freely chosen at each time.[13] Solving the maximization problem:

$$\max_{l_t} \left\{ \eta^{\nu}(k_t^{\alpha} l_t^{1-\alpha})^{1-\nu} - \Omega_t l_t \right\} \tag{5}$$

we obtain the optimal labor demand:[14]

$$l_t^* = \left(\frac{(1-\nu)(1-\alpha)\eta^{\nu} k_t^{\alpha(1-\nu)}}{\Omega_t} \right)^{\frac{1}{\nu(1-\alpha)+\alpha}} \tag{6}$$

so that the production function can be more compactly written as:

$$f(\eta, k_t) = \Upsilon_t \eta^{1-\phi} k_t^{\phi} \tag{7}$$

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

The entrepreneur chooses at each time how much to consume and how to allocate savings between the risk free asset, a, and the invested capital, k. The return to investment is risky since with probability $\flat$ entrepreneurs will be hit by an exogenous idiosyncratic shock involving the loss of the invested capital.[15] Formally, the entrepreneur solves the

[13] One reason for the introduction of adjustment costs is to avoid sudden large variations in the stock of capital. As shown in Section 3.5, the presence of business failure shocks automatically leads to smooth investment dynamics.

[14] For simplicity I do not require l_t^* to be an integer, so that a worker may be supplying his labor endowment to various entrepreneurs in the same period.

[15] This assumption is actually not so extreme: Gentry and Hubbard (2004) find that the median reduction in

following problem:

$$
\begin{aligned}
V_t^e(m_t, \eta) &= \max_{a_{t+1}, k_{t+1}} \left\{ u(c_t) + \beta \left[(1 - \flat) V_{t+1}^e(m_{t+1}^{\not\flat}, \eta) + \flat V_{t+1}^e(m_{t+1}^{\flat}, \eta) \right] \right\} \\
& s.t. \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (8) \\
m_t &= c_t + a_{t+1} + k_{t+1} \\
m_{t+1}^{\not\flat} &= \mathsf{R} a_{t+1} + \Upsilon_{t+1} \eta^{1-\phi} k_{t+1}^{\phi} + (1 - \delta) k_{t+1} \\
m_{t+1}^{\flat} &= \mathsf{R} a_{t+1}
\end{aligned}
$$

where $0 < \delta < 1$ is the capital depreciation rate, and $m_{t+1}^{\not\flat}$ and $m_{t+1}^{\flat}$ are the beginning of next period market resources for the entrepreneur with a successful and failed business, respectively. Note that the assumption that the entrepreneur has to bear entirely the business risk (captured by the lack of state contingent claims and the impossibility of default) implies that investment has to be self-financed. The entrepreneur actually wants to always hold a positive amount of safe assets in order to afford consumption even if the firm suddenly goes bust. There are two optimality conditions:

$$
\mathbb{E}_t \left[\mathfrak{R}_{t+1} u'(c_{t+1}) \right] = \mathsf{R} \mathbb{E}_t u'(c_{t+1}) \tag{9}
$$

$$
u'(c_t) = \beta \mathsf{R} \mathbb{E}_t u'(c_{t+1}) \tag{10}
$$

where $\mathfrak{R}_{t+1} = \Upsilon_{t+1} \eta^{1-\phi} \phi k_{t+1}^{\phi-1}$ if the business does not fail and 0 otherwise. Equation (9) states that the expected marginal value of investing in the safe asset has to equal the expected marginal utility of investing in the firm's capital. This is the key condition which implies that invested capital and safe asset holdings increase together as the entrepreneur becomes wealthier. Equation (10) is the standard Euler condition, equating the marginal utility of consumption today with the discounted expected marginal utility of consumption tomorrow.

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wealth experienced by households that exit entrepreneurship is actually larger than the median net value of their business. 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 5.1. The musical symbol $\flat$ (flat) is mnemonic since the entrepreneur is badly flattened by this shock.

3.3 The Net Foreign Asset Position

The net foreign asset position of the country, A, is given by the aggregate risk free asset holdings of workers and entrepreneurs:

$$A_t = \int_{m,\epsilon} a_t^{\epsilon}(m)\mathbb{H}_t(m,\epsilon) \tag{11}$$

where $a_t^{\epsilon}(.)$ is the safe asset policy function at time t given the employment status ϵ (either worker, w, or entrepreneur, e) and $\mathbb{H}_t(m,\epsilon)$ is the distribution of agents across wealth and occupation. Note that while the net foreign asset position of a standard small open economy model under perfect foresight has to be arbitrarily pinned down, it is here well defined as an implication of the existence of a target level of wealth under precautionary behavior as discussed in Section 3.5.[16] Given that the current account is, in the absence of valuation effects, equal to the change in the net foreign asset position, the scope of the present analysis can be re-interpreted as understanding the relation between growth and the dynamics of A.

3.4 Competitive Equilibrium

Given the world interest rate R and the initial distribution of agents over wealth and employment choices $\mathbb{H}_0(m,\epsilon)$, a competitive equilibrium is given by the sequence of distributions $\{\mathbb{H}_t(m,\epsilon)\}_{t=0}^{\infty}$, policy functions $\{c_t^{\epsilon}(m,\eta), a_{t+1}^{\epsilon}(m,\eta), k_{t+1}^{\epsilon}(m,\eta), l_{t+1}^{\epsilon}(m,\eta)\}_{t=0}^{\infty}$, value functions $\{V_t^{\epsilon}(m,\eta)\}_{t=0}^{\infty}$, 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 $t \geq 0$
- $\{\mathbb{H}_t(m,\epsilon)\}_{t=0}^{\infty}$ is consistent with $\mathbb{H}_0(m,\epsilon)$, 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 5.2. The algorithm used to solve for the equilibrium dynamics is described in Appendix C.

[16] The net foreign asset position of a small open economy model under perfect foresight is also not stationary. Schmitt-Grohé and Uribe (2003) discuss various *ad hoc* mechanisms to induce stationarity.

3.5 Policy Functions

The main insights of the model are best understood by looking at the policy functions, which are solved numerically with value function iteration as described in appendix B. The left plot of Figure 3 shows the consumption function for the worker c^w and the entrepreneur c^e. Due to the impatience condition and the absence of uncertainty, the worker has no incentive to hold any assets so that wealth converges to $\overline{m}^w$, at which consumption equals the wage.

As typical of a setting with income uncertainty, the consumption function of the entrepreneur is concave in the level of market resources. Differently from the worker, the entrepreneur accumulates wealth for two reasons. The incentive to save comes both from the high return which can be earned on the invested capital and from the desire to create a buffer stock of safe assets to smooth consumption in the case of business failure. While the boundedness of the first stimulus 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, but to a finite target of wealth $\overline{m}^e$. A formal proof of the existence of the target level of wealth is provided by Carroll (2004). 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.

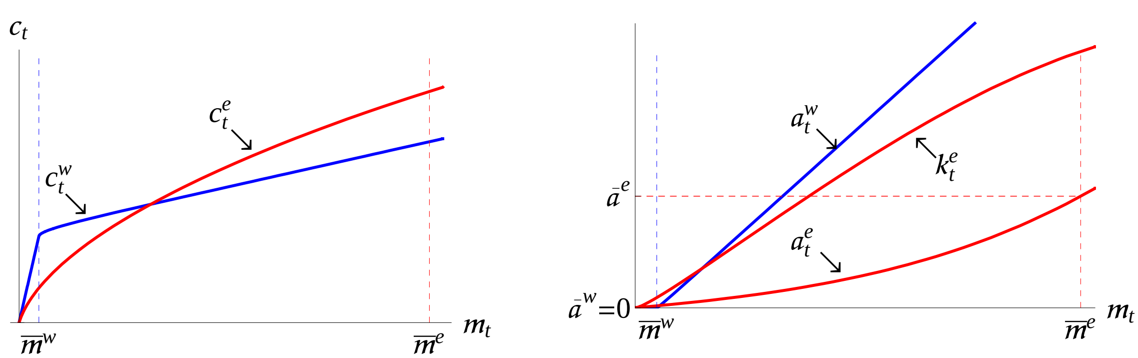

Figure 3: Policy functions under uninsurable entrepreneurial risk

Consider now the transition dynamics of a worker who is suddenly given the opportunity of becoming an entrepreneur. The left-side plot shows that, starting from the initial wealth $\overline{m}^w$, the new entrepreneur initially restrains consumption in order to have more resources to scale up the firm. From the investment functions displayed on the right plot of Figure 3, we see that the increase in invested capital is associated with the contemporaneous accumulation of precautionary safe assets as required by the portfolio condition (9). Consequently, the final equilibrium involves higher safe asset holdings, from $\overline{a}^w$ to $\overline{a}^e$, and the improvement of the country's net foreign asset position brought about by persistent current account surpluses.

The implications of the model are in stark contrast with the benchmark setup under complete financial markets, whose policy functions are plotted in Figure 4 and distinguished with a hat.[17] In this case the entrepreneur immediately borrows as much as needed to bring the firm to the optimal scale by equating the expected marginal return to capital to the interest rate on debt:

$$\hat{k} = \eta \left(\frac{\Upsilon \phi}{\mathsf{R}/(1-\flat) - 1 + \delta} \right)^{\frac{1}{1-\phi}}, \quad \hat{\Omega}^e = \Upsilon (1-\phi) \left(\frac{\hat{k}}{\eta} \right)^{\phi} \tag{12}$$

and the consumption functions are analytically defined as:

$$\hat{c}_t^w = \frac{\mathsf{R} - (\mathsf{R}\beta)^{1/\rho}}{\mathsf{R}} \left(m_t + \frac{\hat{\Omega}^w}{\mathsf{R}-1} \right), \quad \hat{c}_t^e = \frac{\mathsf{R} - (\mathsf{R}\beta)^{1/\rho}}{\mathsf{R}} \left(m_t + \frac{\eta \hat{\Omega}^e}{\mathsf{R}-1} \right) \tag{13}$$

The higher present discounted value of labor income earned as an entrepreneur leads to a sudden increase in consumption, and there is no incentive to accumulate wealth since the return to invested capital is immediately equalized to the interest rate. The final equilibrium involves a deterioration of the country's net foreign asset position.

We have thus seen that the presence of uninsurable investment risk leads to very differ-

[17] Since complete financial markets allow for perfect insurance against idiosyncratic risk, the impatience condition would lead wealth to asymptote towards the negative of the present discounted value of future income. To prevent this extreme implication, in the present discussion of the complete market version of the model I assume $\mathsf{R}\beta = 1$, as is common in the literature, so that each wealth level is stable.

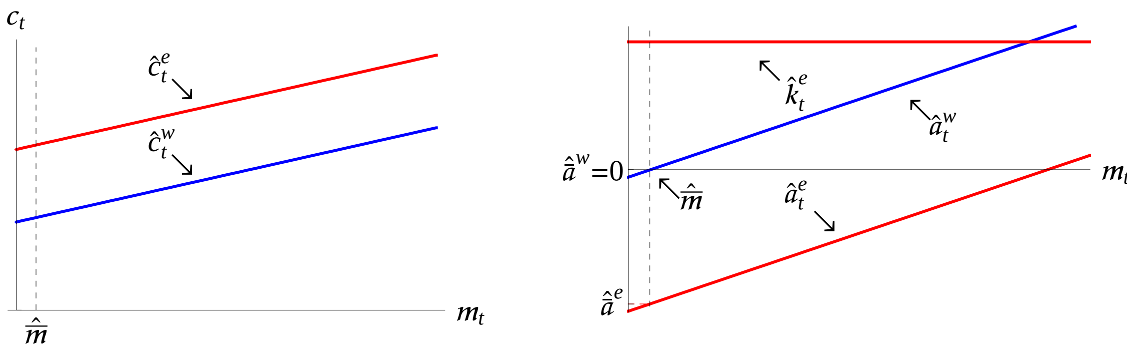

Figure 4: Policy functions under perfect foresight

ent predictions than under full risk-sharing. We may now wonder if similar results would not be obtained by exclusively imposing borrowing constraints. A liquidity constrained entrepreneur investing in a risk-free entrepreneurial activity may still want to restrain consumption 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 transition into entrepreneurship could thus be characterized by higher saving rates, but all the available financial resources will be invested in the firm until the point at which the marginal return to capital is equal to the interest rate. The current account, being the difference between investment and saving, would thus possibly not go into deficit, but also not turn positive.

4 Model Implications

Having discussed the micro foundations of the model, I now solve for the aggregate dynamics of the economy as the entrepreneurial sector develops. In particular, I consider an initial setting in which all agents are prevented from owning private businesses and thus have to work as self-employed farmers. This constraint can be thought as either a government ban, as in the case of centrally planned economies, or more broadly as a result of the lack of entrepreneurial opportunities. I then trace out the economy's dynamics as this constraint is suddenly and unexpectedly removed.

4.1 Calibration and Structural Estimation

Some of the model's parameters are easily calibrated using values common in the literature. I 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. I 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, I partition the simulated population into two groups with respectively zero or positive entrepreneurial skills.

In order to avoid movements in the wage rate which would distract from the key mechanism of the model, I assume that farmers earn the market clearing wage at which all the workers are eventually absorbed by the entrepreneurial sector. As a consequence, the development of entrepreneurial activities involves the gradual absorbtion of all farmers, but does not alter the wage.[18] This specification also allows for the normalization, without loss of generality, of the positive entrepreneurial ability parameter, η, which leads to a different wage level, but has no impact on the relevant model dynamics.

I still have to choose appropriate values for the production curvature parameter, ϕ, and the risk of business failure, $\flat$. I structurally estimate these two parameters by matching the median of the income-to-wealth ratio and invested-capital-to-wealth ratio for entrepreneurs from the Survey of Consumer Finance (2004) data. The choice of using US data is motivated by three considerations. First, I am going to match the medians of the model at the stochastic equilibrium with entrepreneurship and this requires considering a country which has already presumably achieved such an equilibrium. Secondly, matching the model to US data should lead to a lower bound of the actual business risk faced by entrepreneurs in developing countries. The estimate of the $\flat$ coefficient is inversely related to the portfolio share invested in business capital, which is likely to be higher in the US, since developed financial markets and a more stable economic environment limit the need for precautionary

[18] The increase in wage would reduce the growth rate of income for entrepreneurs, thus boosting their savings, but I dispense from this general equilibrium channel since it is not at the core of the present analysis. Wage dynamics are instead crucial for the welfare analysis conducted in Section 5.2.

savings, by allowing respectively for insurance instruments and lower risk. Finally, correctly identifying the parameters of the model requires good information about the wealth holdings of entrepreneurs and their portfolio allocations. The SCF is particulary appropriate for this since it oversamples rich people, among who most of the entrepreneurs are concentrated.

I identify entrepreneurs in the SCF as individuals reporting positive business assets which account for 11.5% of the population.[19] This is also going to be the share of agents that I endow with positive entrepreneurial ability in the simulated economy. Note that I compute the portfolio share invested in business activities by excluding from total wealth the net equity value of the primary house and quasi-liquid retirement accounts, since the model does not incorporate retirement savings nor housing decisions. This, of course, boosts the invested capital portfolio share, further reducing the estimate of the business failure shock. Furthermore, I only use data on agents between 25 and 60 years old.

The parameters are structurally estimated by matching medians rather than means. The reason for this choice is that even among entrepreneurs the wealth distribution is substantially skewed, and the model is not particularly suitable to account for it. Following Cagetti (2003), I solve for the parameters $\flat$ and ϕ which minimize:

$$\min_{\flat,\phi} \sum_{i=1}^{N^e} \omega_i \left(|\kappa_i - \kappa^s(\flat,\phi)| + |\iota_i - \iota^s(\flat,\phi)| \right) \tag{14}$$

where N^e is the number of entrepreneurs in the SCF data, ω_i is the sampling weight of agent i with business capital share κ_i and income to wealth ratio ι_i, and κ^s and ι^s are the simulated medians. Standard errors are computed by bootstrap, performing multiple estimations over random samples of the SCF data. Appendix D describes the estimation algorithm.

The calibrated and structurally estimated parameters are reported in Table 1. The production function curvature parameter ϕ is found to equal $= 0.48$, which is in the middle of the range commonly used in the literature, as surveyed by Buera (2008b). The risk for

[19] The alternative is to consider individuals reporting to be self-employed. The problem with this category is that it includes a substantial share of people who do not actually have any capital investment.

the businesses to go bust (.99%) may seem too low if compared with commonly observed exit rates, but we have to keep in mind that this is a rather catastrophic outcome involving the full loss of the invested capital. Section 4.3 discusses the sensitivity of the simulation results to the estimated parameters.

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	-
Entrepreneurial ability	η	10	-
Bankruptcy probability	$\flat$	0.0099	(0.0009)
Production function curvature	ϕ	0.481	(0.017)

Table 1: Model parameters

4.2 Simulation

The aggregate dynamics of the model following the opening to private entrepreneurship are shown in Figure 5. The economy experiences a sharp increase in the GDP growth rate triggered by investment and the productivity gains from the reallocation of labor into entrepreneurial activities. The growth rate remains high for a prolonged period of time as entrepreneurs gradually scale up their firms. The investment and saving rates substantially increase and do so smoothly over time. This is mainly an aggregation result due to the increasing relevance of entrepreneurs in national income, since under the current parametrization the personal saving and investment rates of entrepreneurs actually gradually shrink over time.[20]

The key result is that the aggregate saving rate increases more than the investment rate so that the economy runs persistent current account surpluses all throughout the higher growth period. As previously discussed, this is driven by the fact that entrepreneurs want

[20] The latter is, however, not an intrinsic feature of the model, since sufficiently poor entrepreneurs may actually experience increasing personal investment and saving rates, depending on the particular balance between the reduction in the marginal utility of consumption and in the capital marginal return.

to accumulate precautionary assets to self-insure against the risk of having their business go bust. As a consequence, the net foreign asset position of the country gradually improves. Capital outflows as a percentage of GDP are relatively small at the beginning of the transition since the very high return to capital makes entrepreneurs willing to hold a more risky portfolio. As the marginal product declines, entrepreneurs increase the share of their wealth invested in safe assets, generating a peak in net capital outflows around 20 years after the beginning of the transition process.

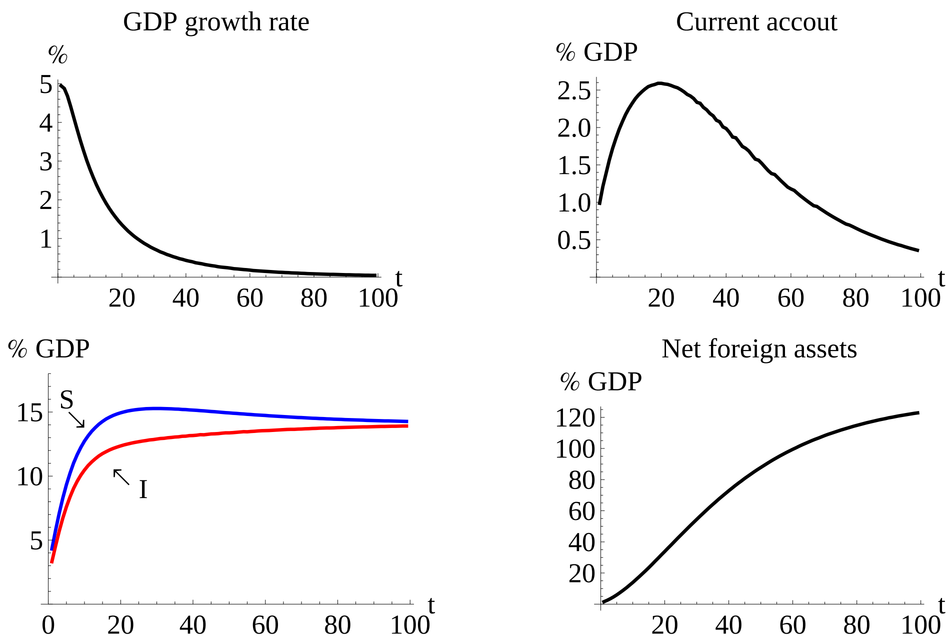

Figure 5: Model dynamics following the opening to entrepreneurship

The simulation exercise thus confirms that the model is able to account for the positive correlation between growth, saving, and the current account and reveals substantial quantitative implications: the aggregate saving rate increases by 15 percentage points and net capital outflows reach 2.6% of GDP. It also highlights that the dynamics triggered by the opening up of entrepreneurial activities are very persistent, especially for the net foreign asset position.

4.3 Sensitivity Analysis

I now discuss the sensitivity of the simulation results to alternative values of the structurally estimated parameters. Table 2 reports key summary statistics of the model dynamics capturing the main impacts of the parameters. I consider 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, the maximum values achieved by the current account, saving and investment as a percentage of GDP, and the time of the current account peak.

The first column reports the statistics under the parameter values used to produce the dynamics in Figure 5. Regarding the sensitivity to the risk of business failure, it is worth pointing out two main aspects. First, we observe that higher risk reduces the equilibrium wage; this is due to the fact that higher investment risk commands a higher return which requires a smaller business scale.[21] Second, higher risk boosts the size of precautionary savings, considerably increasing the current account peak and the final equilibrium net foreign asset position.

Variables	$\flat = 1\%$ $\phi = .48$ $\beta = .94$	Failure probability $\flat$		Prod. function curvature ϕ		Discount factor β	
		0.5%	2%	0.4	0.6	.92	.96
Final wage	0.57	0.58	0.54	0.40	0.72	0.54	0.63
Final NFA (%GDP)	134	94	183	129	146	95	464
Half GDP (t)	16	17	16	10	34	15	19
Max GDP growth	4.9	4.8	5.2	13.8	1.5	5.3	4.3
Max CA (%GDP)	2.6	1.8	3.6	3.3	1.9	2.3	3.6
Max CA (%GDP) (t)	21	22	18	15	33	17	37
Max S (%GDP)	15.3	14.9	15.8	18.0	14.0	13.9	19.0
Max I (%GDP)	14.0	13.9	14.3	14.8	14.0	12.4	17.5

Table 2: Sensitivity analysis

[21] The negative impact of uninsurable investment risk on the equilibrium capital level in a small open economy is also discussed in Angeletos (2007).

The dynamics of the model are also importantly influenced by the parametrization of the production function. A lower value for ϕ leads to stronger decreasing returns. Consequently, the optimal firm scale is smaller and so is the equilibrium wage and the optimal net foreign asset position. A lower ϕ, however, boosts the marginal return at low levels of capital and this significantly alters the transition dynamics; we observe that the period of growth is shorter, requiring considerably less years for GDP to reach half way through the transition. Furthermore, the model generates higher peak values for the growth rate and the current account as a percentage of GDP.

Finally, I also explore the impact of the intertemporal discount factor. A higher value reduces the degree of impatience, so that entrepreneurs are willing to further postpone consumption to finance larger scale firms, thereby boosting the equilibrium wage. Similarly, lower impatience substantially boosts the accumulation of precautionary assets and leads to larger current account surpluses.

In conclusion, the sensitivity exercise shows that the key implications of the model are robust to different calibrations. It also confirms the intuitive results that the investment risk and the intertemporal discount factor strongly influence the total amount of precautionary assets that the economy accumulates, and that the shape of the production function plays an important role for the speed of the transition dynamics and the peak value of the current account.

5 Financial Development

The setting I have explored until now rules out any form of risk-sharing, so that entrepreneurs have to fully bear the investment risk. I now study how financial development changes the model's dynamics and affects welfare for both workers and entrepreneurs.

5.1 Economy's Dynamics under Risk-Sharing

Assume that entrepreneurs can exchange state contingent claims in each other's firms. This provides the opportunity to diversify away business uncertainty that a risk-adverse entrepreneurs will clearly seize. I limit the share of investment return which can be traded to χ so that I can study the implications of different degrees of risk-sharing. The wealth transition equations for the entrepreneur become:

$$m^{\not\flat}_{t+1} = \mathsf{R}a_{t+1} + (1-\flat\chi)(\Upsilon_{t+1}\eta^{1-\phi}k^{\phi}_{t+1} + (1-\delta)k_{t+1}) \tag{15}$$

$$m^{\flat}_{t+1} = \mathsf{R}a_{t+1} + (1-\flat)\chi\left(\Upsilon_{t+1}\eta^{1-\phi}k^{\phi}_{t+1} + (1-\delta)k_{t+1}\right) \tag{16}$$

from which it is easy to observe that the χ parameter controls the amount of risk-sharing: if $\chi = 1$ the investment return is independent of the realization of the failure shock, while if $\chi = 0$ the problem collapses to the case previously considered in which entrepreneurs have to fully bear the business risk.

Figure 6 displays the investment functions for the entrepreneur with and without state contingent claims. While in the absence of risk-sharing the entrepreneur cannot afford to borrow since she will be unable to repay the loan if the business goes bust, the possibility of holding diversified shares ensures that even in the case of business failure not all the investment is lost. This allows the entrepreneur to use external financing to scale up the firm faster, as can be seen by the fact that the policy function for safe assets, a_{χ}, leads to negative values.[22] Whether the final equilibrium asset holding position is positive or negative depends on the extent of risk-sharing, i.e. on χ. The firm is not only scaled up faster, but also to a larger scale since the reduction in risk commands a lower rate of return.

To better evaluate the impact of risk-sharing on the growth rate of the economy and the evolution of the net foreign asset position, I solve for the simulation exercise presented

[22] The entrepreneur may also have the incentive to borrow against future income in order to finance current consumption. As for workers, I prevent this possibility by imposing $a_{t+1} + k_{t+1} \geq 0$.

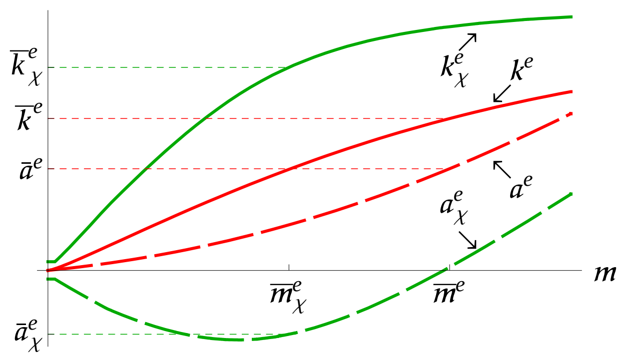

Figure 6: Entrepreneur's investment function with and without state contingent claims

in Section 4 under different values of χ. Figure 7 shows that a larger level of diversification boosts the final equilibrium production level and shortens the transition period, leading to higher growth rates in the first years following the opening to entrepreneurship. The reason is that entrepreneurs can scale their companies up faster by relying on external financing. The country thus experiences initial capital inflows (leading to the deterioration of its net foreign asset position) which may be reversed if the degree of diversification is relatively low. Otherwise, under higher levels of χ the process of growth is characterized by a persistent deterioration of the net foreign asset position, collapsing to the values predicted by the neoclassical growth model for $\chi = 1$. Crucial to understand the welfare implications of financial development, is to note that higher risk-sharing (by allowing entrepreneurs to build up larger firms) bids up the ultimate market clearing wage. Furthermore, by leading to faster business growth, it also anticipates the time at which all the self-employed farmers are absorbed by the entrepreneurial sector and the wage rate starts to growth.

This exercise also suggests that a possible factor accounting for the different experience of European emerging economies, characterized by large capital inflows, is the level of domestic financial development. Interestingly, recent data reported in Claessens, Van 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. As long as foreign banks are more effective in pooling together entrepreneurial risk and taking equity stakes in investment projects, the model would predict a larger reliance on

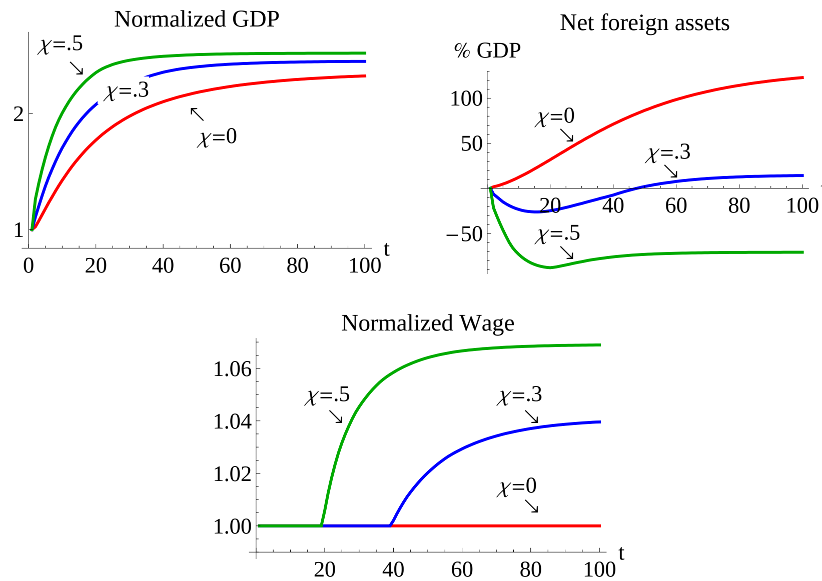

Figure 7: Simulated time series dynamics under varying degree of risk-sharing

international borrowing.[23]

5.2 Welfare Gains from Risk-Sharing

In this section, I 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:

$$\mathbb{E}_t \sum_{j=0}^{\infty} \beta^j u\left(c_{t+j}(1+\lambda_t)\right) \quad = \quad \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j u\left(c_{t+j,\chi}\right) \tag{17}$$

where the additional subscript χ denotes variables in the economy with state contingent claims. The homotheticity of the CRRA utility function allows us to rewrite the above

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

expression as:[24]

$$(1+\lambda_t)^{1-\rho} V_t(m_t) = V_{t,\chi}(m_t) \tag{18}$$

Regarding the measure of aggregate welfare, similarly to Mendoza, Quadrini, and Rios-Rull (2007b), I use an aggregate welfare function $\mathfrak{V}$ which weights individuals equally so that:

$$\mathfrak{V}_t^w = \int_m V_t^w(m)\mathbb{H}_t(m,w) \tag{19}$$

$$\mathfrak{V}_t^e = \int_m V_t^e(m)\mathbb{H}_t(m,e) \tag{20}$$

$$\mathfrak{V}_t = \int_{m,\epsilon} V_t^\epsilon(m)\mathbb{H}_t(m,\epsilon) \tag{21}$$

denote respectively the aggregate welfare for workers, entrepreneurs, and the entire population. The aggregate welfare gain is thus given by the value Λ_t solving:

$$(1+\Lambda_t)^{1-\rho}\mathfrak{V}_t = \mathfrak{V}_{t,\chi} \tag{22}$$

I start by considering the welfare gains from financial development in the time period at which agents are allowed to start up entrepreneurial activities, denoted as $t=0$. Figure 8 shows that the introduction of state contingent claims leads to substantial welfare gains, with full risk-sharing being equivalent to a permanent increase in aggregate consumption of more than 18%.

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, driven by the fact that 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

[24] Since η is constant across entrepreneurs and over time, for simplicity I drop it as an argument of the value function for entrepreneurs.

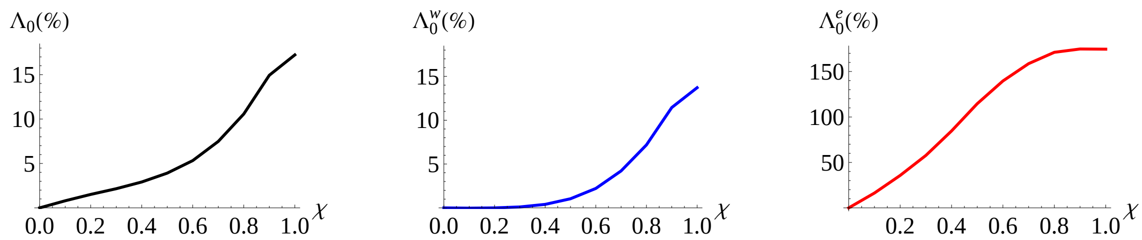

Figure 8: Welfare gains from risk-sharing at the beginning of the transition period

has negligible effects since it leads to an increase in the wage far away in the future; i.e., given that agents are prevented from borrowing against future labor income, the impact on the present discounted value of consumption is very modest. Higher values of χ anticipate the wage take-off year and consequently increase workers' welfare more substantially. Under full risk-sharing the wage rate jumps immediately to the final equilibrium level, since entrepreneurs fully borrow to bring firms to the optimal scale, and workers experience a welfare gain equivalent to more than 15% of annual consumption.

I now examine the 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 entrepreneurship. Figure 9 shows that in this case workers are the ones to benefit the most from financial development. Better hedging opportunities lead to larger firms and higher wages so that workers' gains monotonically grow with χ. Welfare gains for entrepreneurs are instead much lower and interestingly are inversely U-shaped in χ, initially increasing but then shrinking in the degree of financial development.

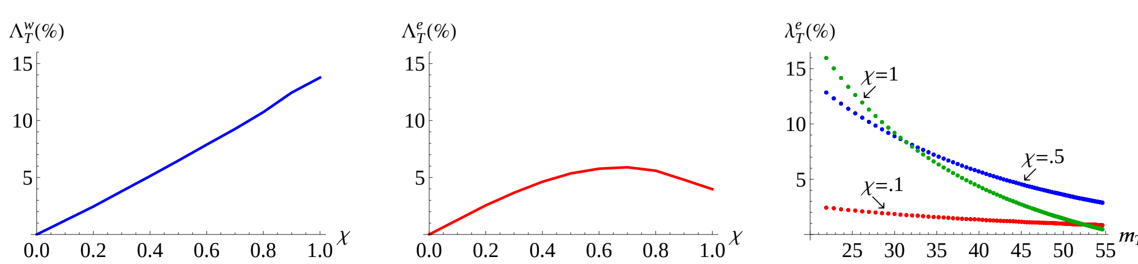

Figure 9: Welfare gains from risk-sharing at the equilibrium with entrepreneurship

In order to understand the reason for the non-linear welfare relation, the right-side plot in figure 9 shows the welfare gains for entrepreneurs in the stochastic equilibrium as a function of their 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 the benefits for small businesses grow monotonically with financial development, while larger businesses can be hurt by the increase in risk-sharing. This is because financial development allows smaller entrepreneurs to scale up their firms more quickly, thus bidding up the market clearing wage.

In conclusion, I find that financial development can lead to very large welfare gains, especially at the beginning of the transition period, since it substantially speeds up the process of development and limits the need for entrepreneurs to accumulate precautionary assets. Sizeable gains, mainly driven by the increase in the equilibrium wage, can also be seized by economies at a more advanced level of development. Financial development can, however, be harder to achieve at the equilibrium stage 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.

6 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 I 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, which cannot be diversified away due to the lack of financial development, entrepreneurs have to rely on self-financing to scale up their firms. Therefore once new 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 want to accumulate safe assets to self-insure against the risk of their businesses going bust. I argue that this net saving increase by entrepreneurs, driven by precautionary reasons, can be responsible for the improvement in the current account. 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. Simulation results show that the model has the potential to generate quantitatively relevant dynamics, with persistent current account surpluses peaking at more than 2.5% of GDP.

I also studied how financial development alters the economy dynamics and improves welfare. The availability of risk-sharing instruments considerably speeds up the process of growth by reducing dependency on internal financing, and limits the need for precautionary savings. A sufficiently high level of financial development brings the model implications back in line with benchmark neoclassical growth models, predicting current account deficits for fast growing countries. This insight is potentially able to explain the different experiences of emerging European countries, which have witnessed growing net capital inflows together with the increasing penetration of foreign banks that are likely to be more effective in providing risk-sharing. Regarding the welfare gains from financial development, I have shown that they can be substantial, with different distributive implications for workers and entrepreneurs depending on the stage of development of the entrepreneurial sector.

Regarding future research directions, the next natural step is to empirically test the implications of the model on household level data. Lacking alternative models, a large empirical literature has tried with very limited success to explain the rising saving rates in fast growing developing countries by focusing mainly on demographic variables as predicted by the life-cycle consumption theory. The present model suggests instead that investment opportunities may be providing the key stimulus to higher saving rates. Preliminary evidence in Sandri (2008) shows that the increase in the national saving rate of Taiwan has been mostly driven by higher income households, who, under incomplete financial markets, are the ones more likely to undertake investments. Similar results are found by Chamon and Prasad (2007) on Chinese urban data.

I also plan to incorporate in the model a richer variety of international financial instruments. Intuitively, an interesting implication of the model appears to be that the larger the proportion of entrepreneurial opportunities financed by foreigners through FDI or portfolio investment, the lower the need for the country to generate precautionary savings, since investment risk is borne by foreigners. More generally, the model can be used to learn about international portfolio dynamics during periods of rapid growth.

Appendix

A Data

The data to produce figures 1 and 2 are from the World Development Indicators and the method to identify the growth acceleration episodes is the one suggested by Hausmann et al. (2005). I consider non-OECD countries as well as Hungary, Mexico and South Korea. Table 3 lists the growth acceleration episodes for countries with full coverage of investment and saving data from six years prior to six years after the acceleration year.

Belize	1983	Myanmar	1990
Botswana	1984	Namibia	1995
Botswana	1996	Pakistan	1976
China	1991	Panama	1991
Comoros	1977	Philippines	1993
Dominican Republic	1994	Romania	1999
Ecuador	1999	Sri Lanka	1992
El Salvador	1971	Swaziland	1985
Hungary	1993	Thailand	1986
Hungary	1998	Trinidad and Tobago	1973
Indonesia	1989	Trinidad and Tobago	1997
Jordan	1999	Tunisia	1994
Korea	1983	Uganda	1992
Lesotho	1999	Uruguay	1974
Mexico	1995	Uruguay	1985
Mozambique	1995	Venezuela	1999
Myanmar	1975		

Table 3: Growth acceleration episodes

B Solving Numerically for the Policy Functions

This section describes the numerical solution procedure to solve for the policy functions at the stochastic steady state with entrepreneurship and during the transition period. Consider first the problem of the liquidity constrained worker whose first order condition by using the Envelope theorem and the CRRA definition of the utility function can be written as:

$$(c_t(m_t))^{-\rho} = \max\left[\beta \mathsf{R}(c_{t+1}(\mathsf{R}a_{t+1} + \Omega_{t+1}))^{-\rho}, m_t^{-\rho}\right] \tag{23}$$

The consumption function is solved by backward iteration until convergence using the Method of Endogenous Gridpoints developed by Carroll (2006). I initialize the consumption function to the one of the worker at a hypothetical last period of life in which all the available resources are consumed. I then define a grid of end of period savings $a_{t+1} \geq 0$ (being negative savings ruled out by the borrowing constraint) and by using the optimality intertemporal condition (23) I recover the value of c_t consistent with each of them:

$$c_t = \left(\beta \mathsf{R}(c_{t+1}(\mathsf{R}a_{t+1} + \Omega_{t+1}))^{-\rho}\right)^{-1/\rho} \tag{24}$$

Using the budget constraint, it is then straightforward to compute the endogenous gridpoints of $m_t = c_t + a_{t+1}$, consistent with each considered combinations of consumption and end of period savings. By linearly interpolating the pairs (c_t, m_t), we are able to approximate the consumption function of the second to last period of life in the unconstrained region. The solution for the constrained region simply involves consuming all the available resources and can be integrated in the solution procedure by adding to the (c_t, m_t) list the pair $(0, 0)$. In order to improve the approximation of the consumption function at values of m above the highest endogenous gridpoint, we can add to the (c_t, m_t) list a bigger m value and evaluate the corresponding consumption level at the one predicted by the analytically solved consumption function under perfect risk-sharing. We indeed know that as m goes to infinity, the precautionary motive vanishes and optimal behavior converges to the one under full insurance.

In order to compute the welfare gains from risk-sharing and assess the convenience for a worker to become an entrepreneur, we have to recover also the value function. This can be done during the process of iteration for the consumption function by considering that:

$$V_t(m_t) = u(c_t(m_t)) + \beta V_{t+1}(m_{t+1})$$

and initializing the value function to the utility function, given that in the last period of life all resources are consumed. Since the value function is highly concave for low levels of wealth and goes to negative infinity as wealth shrinks to zero, it is convenient to make a linear interpolation of a transformation of it: given that under perfect foresight the value function is a particular CRRA function, much of its non linearity can be taken away by multiplying by $(1-\rho)$ and raising everything to the $1/(1-\rho)$ power. This also prevents the transformed value function going to negative infinity.

The backward iteration is continued until convergence, defined as a maximum gap between the contiguous consumption and value function iterations of less than 0.01%.

Regarding the entrepreneur's problem, the policy functions are constructed by iterating over the two first order conditions (9) and (10) which by using the Envelop theorem and making explicit the expectation operator reduce to:

$$\begin{aligned}
(1-\flat)(1-\flat\chi)\mathfrak{R}_{t+1}(c_{t+1}(m^{\not\flat}_{t+1}))^{-\rho} &+ \flat(\chi-\flat\chi)\mathfrak{R}_{t+1}(c_{t+1}(m^{\flat}_{t+1}))^{-\rho} = \\
&= (1-\flat)\mathsf{R}(c_{t+1}(m^{\not\flat}_{t+1}))^{-\rho} + \flat\mathsf{R}(c_{t+1}(m^{\flat}_{t+1}))^{-\rho} \\
(c_t(m_t))^{-\rho} &= \beta\mathsf{R}\left((1-\flat)(c_{t+1}(m^{\not\flat}_{t+1}))^{-\rho} + \flat(c_{t+1}(m^{\flat}_{t+1}))^{-\rho}\right)
\end{aligned}$$

with intertemporal budget constraints:

$$\begin{aligned}
m^{\not\flat}_{t+1} &= \mathsf{R}a_{t+1} + (1-\flat\chi)(\Upsilon_{t+1}\eta^{1-\phi}k^{\phi}_{t+1} + (1-\delta)k_{t+1}) \\
m^{\flat}_{t+1} &= \mathsf{R}a_{t+1} + (\chi-\flat\chi)(\Upsilon_{t+1}\eta^{1-\phi}k^{\phi}_{t+1} + (1-\delta)k_{t+1})
\end{aligned}$$

Note that the equations include already the insurance parameter χ, which if assumed zero leads the solution for the problem without state contingent claims.

I initialize the policy functions to the ones of a risk neutral borrowing constrained entrepreneur. The solution procedure involves choosing a grid vector for the end of period total amount of savings, $s_{t+1} = k_{t+1} + a_{t+1}$, and for each of them use a numerical rootfinder to solve for the pairs of capital and risk free assets satisfying the portfolio arbitrage condition. I can then recover the optimal level of consumption and the initial market resources consistent with each end of period investment choice using:

$$
\begin{aligned}
c_t(m_t) &= \left(\beta \mathsf{R} \left((1-\flat)(c_{t+1}(m^{\flat}_{t+1}))^{-\rho} + \flat(c_{t+1}(m^{\not\flat}_{t+1}))^{-\rho}\right)\right)^{-1/\rho} \\
m_t &= c_t + a_{t+1} + k_{t+1}
\end{aligned}
$$

I follow the same steps as for the worker's problem to interpolate the policy and value functions and continue the backward iteration until convergence.

The difference between solving for the policy functions at the stationary equilibrium with entrepreneurship and during the process of growth is in the treatment of the wage: in the former case, the wage is held constant, while during the transition it adjusts over time to clear the labor market. More details on this are contained in Appendix C.

C Simulation Algorithm

Here I describe the numerical procedure to solve for the model transition dynamics. The first step is to solve for the model at the ultimate stationary equilibrium under entrepreneurship and in particular to identify the market clearing wage. This can be accomplished with this routine:

1. Guess the steady state equilibrium wage Ω_T and distribution $\mathbb{H}_T(m, \epsilon)$

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

I then proceed by solving for the dynamics following the opening to private entrepreneurship (at time 0) through the following steps:

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 $\mathbb{H}_0(m, \epsilon)$, 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

D Structural Estimation

The algorithm for structural estimation involves for any set of parameters ϕ and $\flat$ solving for the model at the stochastic equilibrium as described in Appendix C and evaluating the object function (14). The search for the parameters which minimize the object function is performed with Nelder-Mead after a preliminary grid search on a large parameter region to verify the absence of local minima. Standard errors are computed by bootstrap, repeating the estimation procedure over random samples with replacement from the SCF data.

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