Credit Constraints and Growth in a Global Economy

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Abstract

In a period of rapid integration and accelerated growth in emerging markets, three striking trends have been (1) a divergence in the private saving rates of emerging markets and advanced economies, (2) large net capital outflows from emerging markets, and (3) a sustained decline in the world interest rate. This paper shows that a multi-country general-equilibrium model with household liquidity constraints—more severe in emerging markets— is able to account for all of the above facts. It focuses on explaining both the levels and the time series behavior of savings rate across countries, providing a theory on why saving rate responses to the common world interest rate can be markedly different across economies.

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1 Introduction

Two of the most important developments in the global economy over the recent decades have been the integration of developing economies and their rapid growth, particularly in certain parts of Asia. Accompanying these changes have been three striking and unprecedented trends: (1) a large and persistent increase in the private savings rate in emerging Asia and a fall in the private savings rate in advanced economies; (2) the emergence of global imbalances with developing countries running a large current account surplus and advanced economies a current account deficit; (3) a sustained decline in the world long-term interest rate. Various theories have been proposed to address (2) and (3), while little emphasis has been being placed on (1).

The striking divergence in the savings rate appears in Figure 1, which shows both private saving rates and household saving rates for advanced economies and Emerging Asia (or wherever available). Prior to 1990, the time around when Emerging Asia entered the world economy, rather small differences in savings rate characterized the two economies. Over the last two decades, against a period of rapid decline of the world interest rate, the savings rates have persistently diverged—a sustained and persistent increase in the private/household savings rate in Asia against advanced economies' prolonged decline. This curious pattern of the opposite response of the saving rate to the common world interest rate has inspired the popular caricature of 'debt ridden' U.S. put into sharp contrast against 'thrifty' Asia.

Standard open-economy growth models have difficulty in accounting for these facts, predicting the opposite patterns of what is observed. In a fast growing economy, such as Asia, the savings rate should fall rather than rise, as agents borrow against their higher future income to increase consumption and investment. With a rise in the world interest rate, a result of higher productivity of capital in Asia, savings rate is likely to fall in other parts of the world.[1] Also, Asia should be net importers of capital rather than being net exporters. In the long run, there is nothing that stands in the way of a convergence in savings rate and

[1]Standard parameters make the income effect associated with changes in the interest rate dominate the substitution effect.

investment rates across countries.

Together, these facts pose a challenge to existing open-economy macroeconomic models, which must explain not only why savings can outpace investment in a fast-growing economy, but also why the global equilibrium features asymmetric responses of saving rate, leading to an ever greater dispersion in the cross-section of saving rates over time. Explaining both the levels and time-series behavior of saving rates thus becomes important, and is largely overlooked in the existing literature on global imbalances.

We show that in a global general-equilibrium growth model with asymmetric household credit constraints across countries, a small number of shocks — capital market integration, fast growth in emerging markets and heterogeneous demographic developments—can generate all of the above patterns featured in the data. Our benchmark framework consists of multiple open-economies, characterized by a three-period overlapping generations structure. This structure provides scope for both international and intergenerational borrowing. In all economies, young agents are subject to a liquidity constraint, but the tightness of the constraint is more severe in developing countries than in advanced economies. We show that a country's aggregate saving places a greater weight on the (dis)savings of the young for less liquidity-constraint economies and greater weight on the middle-aged's saving for more constraint economies. A fall in world interest rates induces greater borrowing (lower savings) of the young—through a loosening of constraints—while leading to greater savings of the middle-aged, through a dominant income effect. With these different weights on the young borrowers versus the middle aged savers, sharp differences in the response of an economy's aggregate savings rate can emerge. These slope differences in saving rates combined with initial levels-differences induce a permanent divergence in the long run across countries.

The decline in the world interest rate can be caused by accelerated growth and the integration of Asian economies, in this framework. A net capital outflow from Asian economies to the rest of world also emerges as saving rise by more than investment. These effects are absent in the standard model without liquidity constraint, but also absent in a model where liquidity constraints are symmetric across countries. An additional implication of our

model is that whereas savings rates tend to diverge when the more constrained economies experience growth accelerations, they tend to converge when the less constrained economy grows faster.

The multi-period overlapping generations structure provides scope for analyzing the impact of demographics, at the same time allowing for both borrowers and savers to coexist in a given economy. In a representative-agent, infinite horizon economy, even in the presence of liquidity constraints, savings rate will tend to fall in the fast growing economy. Thus, a mass of savers is necessary to generate the rise in savings in fast-growing economies. In the three-period OLG model, the mass of savers are the middle-aged, and their relative importance on the aggregate economy depends on the severity of liquidity constraints in that economy. The asymmetry in the severity of credit constraints is needed to bring about a long-run decline in the world interest rate, as the weight of Asia increases in the global economy, and is also important for generating the divergence in the cross-sectional saving rates.

The root cause of global imbalances in our framework, in view of the mechanism highlighted above, is inevitably savings. What does the data reveal about the relative importance of the savings versus investment in driving the current account? Figure 2 first examines the experience of the U.S. over 1970-2009. As is clear, the household savings rate is strongly correlated with the current account, whereas there is almost no relationship between investment and the current account, over the same period. A similar finding also holds for China (Figure 3). Across all countries, between 1998-2007, the same relationship between the average current account and the average savings rate of a country also holds—suggesting that the cross-sectional dispersion in the savings rate accounts for the majority of the cross-sectional dispersion in the current account (Figure 4).

A number of theories of global imbalances have emerged in recent years, although with very little focus on the savings rate divergence across countries. Many papers have emphasized the importance of investment in accounting for the recent global imbalances across countries. Buera and Shin (2009), Benhima (2009), and Song, Storesletten and Zilibotti (2009) emphasize a suppression of investment demand due to financial frictions. While in-

vestment declined during the East Asian Crisis (Figure 5), it quickly reverted back and beyond the pre-crisis level in Emerging Asia, making investment a less plausible candidate for explaining the recent divergence in global imbalances.

On the other hand, models of global imbalances revolving around a savings story have emphasized a strong precautionary savings motive emanating from uninsurable risk in developing countries. Mendoza, Quadrini and Rios-Rull (2009) show that lower risk sharing opportunities in developing countries increase precautionary savings so that when opening up to capital markets, these countries see a net capital outflows. However, risk is likely to be of second-order relevance compared to the rapid productivity growth in emerging markets that raises their marginal productivity of capital. Incorporating growth into these frameworks will likely produce a surge in investment that can dominate the rise in savings, leading to a current account deficit in fast-growing emerging markets. This result can be countered if growth is accompanied by a strong increase in idiosyncratic uncertainty, as in Carroll and and Jeanne (2009), although the empirical evidence for this is unclear. Caballero, Gourinchas, and Farhi (2009) focus on the lack of ability to generate assets in developing countries, whose savings need to be largely channeled abroad. Their model does not allow for investment, in contrast to our model which permits the interplay of both savings and investment on determining capital flows. Also, saving rates fall globally in their framework, with integration and fast growth in emerging markets.

Other papers have put the emphasis on corporate savings in explaining global imbalances. Sandri (2010) shows that in the face of uninsurable investment risks, firms rely on precautionary savings to finance future investment opportunities. Benhima and Bacchetta (2011) shows that credit-constrained firms demand liquidity to finance investment in periods of high productivity growth, and thus accumulate foreign liquid assets. In both papers, corporate savings rise above investment, and the outcome is a net capital outflow. However, it is unclear that corporate saving, which has been increasing both in developing and advanced economies, has been the point of divergence across economies. [2]

[2]A closer look at firm level data in Bayoumi, Tong, and Wei (2010) casts doubt on corporate savings being the main driver of global imbalances, especially for China. First, corporate savings have increased

All in all, the key departure point of this paper from others in the existing literature is the ability of this framework to explain the divergence in saving rate—that is, the asymmetric slope of savings rate to interest rate changes that leads to its greater dispersion in the long run. The above models with a savings-account of global imbalances tend to focus on the differences in the *levels* of the savings rate, and the outflow of capital from the high-savings rate country to the low-savings rate country upon integration of these economies. In the long run, however, differences in these levels do not become more disparate. In view of the data, the initial differences in the savings rate in 1990 is dwarfed by their vast differences in 2010.

The paper proceeds as follows. Section 2 develops the theoretical framework, in which key intuition is provided from certain analytical results. Section 3 investigates numerical experiments, capital market integration and faster growth in emerging markets, and contrasts the results with the standard model and a model in which credit constraints are symmetric across countries. We then develop a multi-country model to be able account for the other countries' experience over the same period. Section 4 concludes.

2 Model

In this section, we develop a multi-country general equilibrium framework that can account for the above facts. At center stage is the role of credit constraints on household borrowing, the extent of which differs across countries. In all other aspects our framework is standard: each country uses identical technology to produce one homogeneous good, which is used for consumption and investment, and is traded freely and costlessly. Preferences and production technologies are assumed to have the same structure and parameter values across countries. Technologies only differ to the extent that in each country, the labor input consists only of

in many countries—in developing and in advanced–so that its rise is not unique to the emerging markets running a current account surplus. Second, the corporate savings *rate*, has not increased, and has actually fallen in China. Bayoumi et al (2010) shows that Chinese firms do not have a significantly higher savings rate than the global average, as corporations in most countries have a high savings rate. Household savings rate in China, however, compared to the group of Japan, Korea, Germany, Australia, United Kingdom, and the United states, is higher than the average of by 10% of GDP.

domestic labor, and firms are subject to country-specific productivity shocks. Countries are indexed by $i = 1, ..., n$.

2.1 Production

The production technology, identical in each country, uses capital and labor to produce a homogeneous good. Let Y_t^i denote the gross output in country i, K_t^i the aggregate capital stock at the beginning of period t, and $L_{m,t}^i$ the labor input employed in period t:

$$Y_t^i = \left(K_t^i\right)^{\alpha} \left(Z_t^i L_{m,t}^i\right)^{1-\alpha}, \tag{1}$$

where $0 < \alpha < 1$ and Z_t^i denotes the country-specific labor productivity.

The capital stock in country i is augmented by investment goods, I_t^i, and the current capital stock K_t^i. The law of motion for capital stock is given by

$$K_{t+1}^i = (1-\delta)K_t^i + I_t^i, \tag{2}$$

where δ is the rate of depreciation.

Factor markets are competitive so that each factor, capital and labor, earns its marginal product. The wage rate per unit of labor in country i is

$$w_t^i = (1-\alpha)Z_t^i \left(k_t^i\right)^{\alpha}, \tag{3}$$

where $k_t^i \equiv K_t^i/(Z_t^i L_{m,t}^i)$ denotes the capital-to-effective-labor ratio. The rental rate earned by capital in production equals the marginal product of capital, $r_{K,t}^i = \alpha \left(k_t^i\right)^{\alpha-1}$. The gross rate of return earned between period $t-1$ and t in country i is

$$R_t^i = 1 - \delta + r_{K,t}^i.$$

2.2 Households

We consider simple overlapping-generation economies where individuals live for three periods. In every period, three generations of agents coexist in each country: the young (y), the middle-aged (m), and the old (o). Agents earn labor income only in the second period of their life, when they each supply one unit of labor inelastically, and consume in all periods of their life. Let $c^i_{\gamma,t}$ denotes the consumption of a consumer in country i belonging to generation $\gamma \in \{y, m, o\}$. The lifetime utility of a consumer born in period t in country i is

$$U^i_t = u(c^i_{y,t}) + \beta u(c^i_{m,t+1}) + \beta^2 u(c^i_{o,t+2}),$$

with standard CRRA preferences

$$u(c) = \frac{c^{1-\frac{1}{\sigma}} - 1}{1 - \frac{1}{\sigma}}.$$

The discount factor β satisfies $0 < \beta < 1$ and the intertemporal elasticity of substitution coefficient σ is such that $\sigma \leq 1$.

Let $a^i_{\gamma,t+1}$ denote the net asset position at the end of period t of an agent belonging to generation $\gamma \in \{y, m, o\}$. When young, individuals earn no wage income and hence need to borrow in order to consume. When middle-aged, they earn the competitive wage, repay their loans, consume and save for retirement. When old, they consume all their accumulated resources. Thus, an agent born in period t faces the following sequence of budget constraints:

$$c^i_{y,t} + a^i_{y,t+1} = 0, \tag{4}$$

$$c^i_{m,t+1} + a^i_{m,t+2} = w^i_{t+1} + R^i_{t+1} a^i_{y,t+1}, \tag{5}$$

$$c^i_{o,t+2} = R^i_{t+2} a^i_{m,t+2}, \tag{6}$$

We assume that young agents are subject to credit constraints: they can only borrow up

to a fraction θ^i of the present value of their future labor income:

$$a^i_{y,t+1} \geq -\theta^i \frac{w^i_{t+1}}{R^i_{t+1}}. \tag{7}$$

The tightness of credit conditions, captured by θ^i, can differ across countries. We are interested in the case in which θ^i is low enough so that (7) is binding for all countries.

Assumption 1 *Credit constraints for the young are binding in all countries.*

This assumption is satisfied when[3]

$$\theta^i < \frac{\beta^{-2\sigma}(R^i_{t+1})^{1-\sigma}(R^i_{t+2})^{1-\sigma}}{1+\beta^{-\sigma}(R^i_{t+2})^{1-\sigma}[1+\beta^{-\sigma}(R^i_{t+1})^{1-\sigma}]}, \quad \text{for all } t.$$

The right hand side of the inequality is the fraction that the young cohort in period t would consume out of their intertemporal wealth in the absence of credit constraints. When $\sigma = 1$ (log-utility), the condition becomes

$$\theta^i < \frac{1}{1+\beta+\beta^2}.$$

The assumption that credit constraints are binding for the young implies that

$$a^i_{y,t+1} = -\theta^i \frac{w^i_{t+1}}{R^i_{t+1}}. \tag{8}$$

From the Euler condition that links $c^i_{m,t}$ and $c^i_{o,t+1}$, we obtain the net asset position of a middle-aged agent at the end of period t:

$$a^i_{m,t+1} \quad = \quad \frac{1}{1+\beta^{-\sigma}(R^i_{t+1})^{1-\sigma}}(1-\theta^i)w^i_t. \tag{9}$$

We let $L^i_{\gamma,t}$ denote the size of generation $\gamma \in \{y,m,o\}$ in country i in period t, while $A^i_{\gamma,t+1} \equiv L^i_{\gamma,t}a^i_{\gamma,t+1}$ denotes the aggregate net asset position of generation $\gamma \in \{y,m\}$ at

[3]We later verify that this condition is satisfied on the equilibrium path.

the end of period period t. The aggregate wealth of country i in period t, $A^i_{y,t+1} + A^i_{m,t+1}$, corresponds to the sum of the debt of the young and the wealth of the middle-aged, and is greater when liquidity constraints are more severe, i.e., when θ^i is lower (holding everything else constant).

2.3 Closed-Economy Equilibrium

We first turn to the autarkic equilibrium, with a particular emphasis on the determination of the autarkic rates of return R^i. Since the bonds issued by the young and purchased by the middle-aged are in zero net supply, the capital market equilibrium condition in autarky amounts to

$$K^i_{t+1} = A^i_{y,t+1} + A^i_{m,t+1}. \tag{10}$$

Equation 10, combined with (8) and (9), gives the law of motion for k^i, the capital per efficient unit of labor in country i:

$$k^i_{t+1} = -\theta^i \frac{(1-\alpha)\left(k^i_{t+1}\right)^\alpha}{R^i_{t+1}} + \frac{1}{1+g^i_{t+1}} \frac{(1-\theta^i)(1-\alpha)\left(k^i_t\right)^\alpha}{1+\beta^{-\sigma}(R^i_{t+1})^{1-\sigma}}, \tag{11}$$

where g^i_{t+1} captures the growth of effective labor

$$g^i_{t+1} \equiv \frac{Z^i_{t+1} L^i_{m,t+1}}{Z^i_t L^i_{m,t}} - 1.$$

In the special case where $\sigma = 1$ and $\delta = 1$, the law of motion simplifies to

$$k^i_{t+1} = \frac{1}{1+g^i_{t+1}} \frac{\beta}{1+\beta} \frac{\alpha(1-\alpha)(1-\theta^i)}{\alpha+\theta^i(1-\alpha)} \left(k^i_t\right)^\alpha. \tag{12}$$

The dynamics in the absence of credit constraints can be obtained by replacing θ^i by $1/(1+\beta+\beta^2)$. Given an initial capital stock, tighter borrowing constraints (lower θ^i) lead to a higher path of capital stock at every point along the transition path. In the long run, with effective labor force $Z^i_t L^i_{m,t}$ growing at a constant rate g^i, the steady-state capital stock

per unit of efficiency is determined by

$$k^i = \left[\frac{1}{1+g^i}\frac{\beta}{1+\beta}\frac{\alpha(1-\alpha)\left(1-\theta^i\right)}{\alpha+\theta^i(1-\alpha)}\right]^{\frac{1}{1-\alpha}}, \qquad \frac{dk^i}{d\theta^i} < 0. \tag{13}$$

The steady state level of capital stock in an economy with liquidity constraints, i.e., $\theta^i < 1/(1+\beta+\beta^2)$, is higher than in an economy with perfect markets; and in the former case, the steady state level of capital stock is higher when borrowing constraints are tighter (i.e., lower θ^i). The autarkic steady-state rate of return in country i

$$R^i = (1+g^i)\frac{1+\beta}{\beta}\frac{\alpha+\theta^i(1-\alpha)}{(1-\alpha)\left(1-\theta^i\right)}, \tag{14}$$

depends on g^i and θ^i. All else equal, the rate of return is lower in an economy with binding liquidity constraints than in the absence of such constraints, and $dR^i/d\theta^i > 0$, i.e., tighter constraints imply a lower interest rate.

2.4 Open-Economy Equilibrium

Under financial integration, capital can flow across borders until rates of return are equalized across countries. Financial integration in period t implies $R^i_{t+1} = R_{t+1}$ and $k^i_{t+1} = k_{t+1}$, for all i. Also, since world debt markets only need to clear globally, the capital markets equilibrium condition becomes

$$\sum_i K^i_{t+1} = \sum_i \left(A^i_{y,t+1} + A^i_{m,t+1}\right). \tag{15}$$

Let $\lambda^i_t \equiv A^i_t L^i_{m,t} / \sum_j A^j_t L^j_{m,t}$ denote the relative size of country i in terms of effective labor. With borrowing constraints that are binding in all countries, the law of motion for k is

$$k_{t+1} = -\bar{\theta}_{t+1}\frac{(1-\alpha)k^\alpha_{t+1}}{R_{t+1}} + \frac{1}{1+\bar{g}_{t+1}}\frac{\left(1-\bar{\theta}_t\right)(1-\alpha)k^\alpha_t}{1+\beta^{-\sigma}R^{1-\sigma}_{t+1}}. \tag{16}$$

where $\bar{\theta}_t \equiv \sum_i \lambda^i_t \theta^i$ and $\bar{g}_{t+1} \equiv \sum_i \lambda^i_t g^i_{t+1}$. This is the open-economy analogous of Eq. 11, where country-specific growth rates and liquidity constraint parameters are replaced by their global weighted-average counterparts.

In steady state, the growth rate of the effective labor force is constant and equal across countries, $g_t^i = g$ and $\lambda_t^i = \lambda^i$. In the analytically convenient case where $\sigma = 1$ and $\delta = 1$, the steady-state level of k is

$$k = \left[\frac{1}{1+g} \frac{\beta}{1+\beta} \frac{\alpha(1-\alpha)\left(1-\bar{\theta}\right)}{\alpha + \bar{\theta}(1-\alpha)} \right]^{\frac{1}{1-\alpha}}, \tag{17}$$

where $\bar{\theta} \equiv \sum_i \lambda^i \theta^i$ plays the same role as θ^i in Equation 13. The larger the size of the more constrained-economy in the long run, the greater the steady-state capital effective labor ratio in every country. Also, a loosening of borrowing constraints in constrained economies tends to reduce the global capital stock per effective labor. The world steady-state (gross) interest rate is

$$R = (1+g)\frac{1+\beta}{\beta} \frac{\alpha + \bar{\theta}(1-\alpha)}{(1-\alpha)\left(1-\bar{\theta}\right)}, \tag{18}$$

which is the counterpart of Eq. 14. The rate of return tends to be lower when the size-weighted average of credit conditions across countries worsens (i.e., lower $\bar{\theta}$). The world interest rate R can also be written as a weighted-average of the country-specific autarky interest rates:

$$R = \sum_i \mu^i R^i, \tag{19}$$

where R^i is given by (14) for $g^i = g$, and with weights $\mu_i \equiv \frac{\lambda^i\left(1-\theta^i\right)}{\sum_j \lambda^j (1-\theta^j)}$, so that $\sum_i \mu^i = 1$. A given country i thus exerts a greater impact on the world interest rate when its relative size is large (high λ^i) and/or when it tends to be more liquidity constrained (high θ^i). An expansion of more constrained economies (higher λ^i in a country with low θ^i) will tend to push down world interest rates, while an expansion of less-constrained economies has the opposite effect.[4]

[4]More generally, for any level of the elasticity of substitution σ, the steady state world interest rate with full depreciation satisfies $F(R) = \sum_i \mu^i F(R^i)$ where $F(R) = \frac{R}{1+\beta^{-\sigma} R^{1-\sigma}}$.

2.5 Savings, Investment and the Current Account

Aggregate savings is by definition GNP less consumption

$$S_t^i \equiv Y_t^i + (R_t - 1)NFA_t^i - C_t^i,$$

with the net foreign assets of country i at the end of period $t-1$ being

$$NFA_t^i = A_{y,t}^i + A_{m,t}^i - K_t^i.$$

In steady state, the saving rate in country i is

$$\frac{S^i}{Y^i} = -g(1-\alpha)\frac{\theta^i}{R} + \frac{g}{1+g}(1-\alpha)\frac{1-\theta^i}{1+\beta^{-\sigma}R^{1-\sigma}} + \delta k^{1-\alpha}, \tag{20}$$

where R and k are at their steady-state values. The above equation illustrates three important points. First, it shows that the divergence in the savings rate across country occurs only through the *interaction* between growth and credit constraints— in the absence of growth ($g = 0$), net savings rate is zero, and there are no cross-country differences in the levels of saving rates. Second, under integration, the *levels* of savings rate differ—the saving rate is higher in the more constrained economy (lower θ^i), as more weight is put on the middle-aged savers than on young borrowers, compared to a less-constrained economy. Third, changes in saving rates, in response to a fall in R, differ across countries. The fact that

$$\frac{\partial^2(S/Y)}{\partial\theta\partial R} > 0 \tag{21}$$

reveals that the impact of the interest rate on the savings rate is stronger for the lower θ countries. Suppose for instance that the world starts from some initial steady state, and after an episode of high growth in the more constrained economies, reaches a new steady state with a lower $\bar{\theta}$, and therefore a lower interest rate R. The initial differences in levels combined with the differences in the slope of the savings rate imply that the fall in R leads

to a greater dispersion in saving rates.

The aggregate investment rate in country i, on the other hand, is given by:

$$\frac{I_t^i}{Y_t^i} = \frac{(1+g_{t+1}^i)k_{t+1}^i - (1-\delta)k_t^i}{(k_t^i)^\alpha}, \tag{22}$$

and in the case of full depreciation ($\delta = 1$),

$$\frac{I_t^i/Y_t^i}{I_t^j/Y_t^j} = \frac{1+g_{t+1}^i}{1+g_{t+1}^j}. \tag{23}$$

Differences in investment-output ratios across countries are determined by their relative growth prospects. In the long run as $g^i = g$ for all i, investment rates are equalized across countries.

The current account of country i in period t, defined as the change in net foreign asset position in period t, can be equivalently written as the difference between aggregate savings and investment:

$$\begin{aligned} CA_t^i &\equiv NFA_{t+1}^i - NFA_t^i \\ &= S_t^i - I_t^i. \end{aligned}$$

3 Quantitative Analysis

The following section investigates whether the two most striking global changes of the past two decades—capital markets integration and the rapid growth of Emerging Asia—can generate the savings divergence and current account imbalances observed in the data. In order to provide intuition on the mechanism at hand, we first explore the implications of growth differentials separately, before analyzing the joint impact of capital market integration and growth differentials. We show that the implications on the aggregate economy are in stark contrast to those of a standard two-country OLG model in the absence of credit constraints and those in the absence of an *asymmetry* in the degree of credit constraints.

3.1 Calibration

Each period is 20 years. Preference parameters and technologies are standard. The intertemporal elasticity of substitution is assumed to be $\sigma = 0.5$, and the discount factor $\beta = 0.82$ which reflects an annual discount factor of 0.99. Depreciation rate is set at 10 percent per year which gives $\delta = 0.88$ over a 20 year period. The capital share α is set at 0.7. In the first two-country experiments, we denote advanced economies as H and Asia as F.

In choosing θ^i, we make the assumption that advanced economies can borrow up to 35 percent of the present value of their future income, whereas emerging Asia can only borrow up to 5 percent of the present value of their future income, so that $\theta^H = 0.35$ and $\theta^F = 0.05$.

3.2 Faster Growth in Emerging Markets

We first examine the impact of faster growth in a country with tighter credit constraints. In order to understand the main impact of growth in the presence of asymmetric credit constraints across countries, we first assume that capital markets are already integrated and both countries start from their integrated steady state. This shuts down the potential confounding effect of capital market integration on macro aggregates and also the effect of transitional dynamics on emerging markets. We later relax this assumption and allow for emerging markets to commence at a point on their transition path towards own their steady state.

In an integrated economy, the initial effective labor of emerging markets relative to advanced economies, $(ZL)_F/(ZL)_H$, is chosen to match the share of Asia in the world GDP of 18%. This gives an effective labor ratio of 0.22. Developed countries are assumed to grow at $g_H = 2.5\%$ throughout the entire period, whereas the growth rates of Asia, g_F, between $t = 2$ and $t = 4$ is set to 6%, in order to match the rise in the share of Asia's GDP from 18% to 45% of world GDP over a forty-year period. It is assumed to be growing at the steady-state growth rate of advanced economies thereafter.

Figure 6 displays the behavior of key variables. The rate of return initially increases as a result of rapid growth in Asia, before falling to a permanently lower level. This long-run

decline in the world interest rate is a consequence of the large increase in the relative weight of Emerging Asia, which features a tighter credit constraint and a lower autarkic interest rate.

Turning to the savings behavior, Emerging Asia sees a large increase in the aggregate savings rate between $t = 2$ and $t = 4$, while the advanced economies see a sizeable decline. This decline, notably in period 4, is due to the sharp drop in the interest rate in period 5 (the rate of return between period 4 and 5)—allowing the young cohort to increase their borrowing. In contrast, the savings rate rises in period 4 in Asia, due to the dominance of the middle-aged cohort, who increase their savings in response to a lower interest rate. The different weights put on the young versus the old in the two regions is what causes this large divergence in the savings rate.[5]

The current account in Asia is initially in deficit (between periods 1 and 2), which is caused by the fall in the savings rate and a sharp rise in the investment rate, over that period. Starting from period 2, the current account diverges across the two economies, whereby Asia sees a sharp improvement reaching to a maximum surplus of 7% of GDP, against the advanced economies' deficit of about 6% of GDP, at $t = 4$. Over this period, the steep rise in the savings rate exceeds that of investment rates, leading to a net capital outflow in Asia. Although the current account gap closes a bit after period 4, it remains to be much greater than the initial imbalances.

3.3 Integration and Growth Experiment

The previous experiment makes the unrealistic assumptions that emerging markets start from a steady state and that capital markets have always been integrated. In the following

[5]In period 2, the savings rate behavior converges slightly compared to the previous period. In advanced economies, the young consumers are compelled to borrow less as a result of the higher interest rate in the following period ($t = 3$). Their impact causes the aggregate savings rate to rise slightly. In Asia, however, the savings rate of the young and the middle-aged both fall at $t = 2$. The reason is that the young cohort is able to borrow more because of the higher wage income in the following period ($t = 3$), and the middle-aged's savings fall because of the income effect due to the higher future interest rates. The small decline in the savings rate of Asia and the small rise in advanced economies, in period 5, is driven by the behavior of the old cohort, whose differing behavior reverses the divergence in the savings rate of the previous period. In Asia, the old's savings fall because of the greater discounted wealth decumulation in the presence of a lower interest rate.

exercise, both regions are in autarky in period -1 and financial opening occurs in period 0. Periods -1 and 0 are meant to correspond to the 1970's and 1990's eras, respectively. Emerging markets are capital-scarce in period -1, while advanced economies are at their own steady state. Advanced economies always grow at the constant steady-state growth rate of 2.5% per year, while emerging markets grow faster over the 1970-2010 period (i.e., between $t = -1$ and $t = 1$). In the long-run, all regions grow at the same rate. We calibrate the initial values of k_F and $(ZL)_F/(ZL)_F$, along with the growth path of Asia, to match Asia's share of world GDP in 1970 and 2010, as well as the relative capital-effective labor ratios, k_F/k_H measured by Hall and Jones (1999) for 1990.

Figure 7 displays key results. An important difference from the previous example is that Asia is still on a transition path towards its steady state, which features a lower autarkic rate of return than the rest of the world. Because Asia is capital scarce, its aggregate saving rate is high in the inital period. The rate of return continues to fall for both countries, and reaches a lower long-run steady state rate of return than in the advanced economies' initial steady state. The immediate fall in the rate of return causes the saving rates to diverge from the outset. As investment rate decreases in Asia and increases in advanced economies—the latter due to the lower cost of capital–the current account also diverges immediately. Asia runs a current account surplus of 6% in 2010 and the advanced economies run a deficit of a bit less than 6% in the same period. Neither savings rate nor the current account converges across countries in the long run.

3.4 Comparisons

The asymmetry between θ across countries is vital for our results. Figure 8 displays the results for the same experiment as previous ones except that θ^i is taken to be 0.35 for both countries. As is clear from the graph, the existence of credit constraints alone is insufficient to generate the key patterns of the data. In this case, the rate of return increases in developed economies for a few periods, before reverting to the same level as before. Saving rate falls initially in Asia, rather than rises, and converge to the same level as the advanced economies'

saving rate in the long run. The high investment rate in Asia and the fall in saving rate leads an immediate current account deficit in Asia, and the current account converges in the long run. These results are qualitatively similar to those of a standard model.

What happens if the less constraint economy grows faster? This is a relevant scenario when considering Europe and the US over the period 1980-2007. In 1980, Europe was roughly the same size as the US, but reached to only 75 percent of the latter in 2007. For illustration sake, we assume that $\theta^{eur} = 0.175$ and $\theta^{us} = 0.35$. The US grows at a rate of 2.5 percent per year throughout, whereas Europe grows at a slower rate of 1.5 percent during one period. The experiment assumes that capital markets are already integrated. As seen from Figure 9, the rate of return permanently *rises* as the weight of the less constraint economy (with the higher autarky interest rate) increases due to the growth deceleration episode in Europe. The permanent increase in the interest rate now generates a *convergence* in the savings rate—uniformly falling in both countries–as both middle aged and young agents' savings decline. Finally, the high investment demand generates a deficit in the US, and the current account converges over time although never reverting to balance in the long run.

3.5 Three-Country Experiment

The heterogeneous behavior of countries belonging to the advanced economies group, with large debtors such as US, UK, New Zealand, and Australia against large creditors such as Germany and Japan, makes the two-region view of the world incomplete. Excluding the Anglo-Saxon countries and Asia, the current account of the rest of the world in the last ten years has been a modest surplus (Figure 10). Moreover, savings rate have been relatively flat in the rest of the world (Figure 11). The fact that these three regions all have displayed asymmetric savings rate behavior in response to the common world interest rate bids us to ask whether an experiment with three countries, characterized by different degrees of credit constraints, is able to replicate these patterns.

Figure 12 displays the household debt as a % of GDP in all three regions. Although we do not want to extrapolate too much from this figure, it does provide indirect evidence

on the various degree of credit constraints among these economies. The vast differences in household debt, ranging from more than 90% of GDP in anglo-saxon economies, to 50% in Europe and to about 20% in Asia lead us to think that there must be some institutional forces in terms of the ability to borrow that markedly differs among these economies. Serving only as a broad guidance, this figure suggests that Europe's degree of borrowing constraints is somewhere in between the other two regions. As such, in our subsequent experiment, we assign the degree of credit constraints in the US and Anglo Saxon economies, the rest of the world, and Asia, to be $\theta_H = 0.35$, $\theta_M = 0.2$, and $\theta_L = 0.05$, respectively.

The following experiment assumes that in the initial period ($t = -1$), the 'H' and 'M' economies are integrated and at their steady state, whereas Asia ('L') is in autarky and capital-scarce. Integration occurs after one period ($t = 0$). In the initial period, the GDP of each region as a share of world GDP is 0.41 (H), 0.41 (M) and 0.18 (L), respectively. In terms of growth, the 'M' region grew at a slower rate compared to the 'H' and 'L' regions in the past two decades, and therefore we take $g_M = 2\%$ between period 0 and 1, and otherwise at 2.5% as in g_H throughout the entire period. Asia, on the other hand, grows faster than the other economies between $t = -1$ and $t = 1$.

Figure 13 displays the results. As is clear, the response of the savings rate in M is relatively modest, in comparison to the opposite responses of the H and L regions. In the long run, the savings rate dispersion widens even between H and M regions. Slower growth in M depresses the investment rate compared to the other two regions, leading to an initial small current account surplus. The decline in the world interest rate reduces the cost of capital and therefore increases the investment rate in the H and M countries, which combined with a decline (in various degrees) of a savings rate, leads to a mild current account deficit in the M region and large current account deficit in the L region. What is important is that differing levels of θ can lead to a cross-section of responses of the savings rate and current account/GDP ratio, ultimately leading to a greater dispersion in cross-sectional differences in the long run.

4 Conclusion

This paper develops a global general equilibrium model with asymmetric household liquidity constraints. Financial integration, along with rapid growth in Emerging Asia, can lead to a persistent decline in the world interest rate, which causes a divergence in the savings rate across countries with different levels of credit constraints. Less constrained economies place greater weight on the (dis)savings of the young, who respond to a lower interest rate by borrowing more; more constrained economies place a greater weight on the savings of the middle-aged, who respond to a lower interest rate by saving more. Asymmetric weights on the savers of the economy can lead to markedly different responses of the savings rate in face of a decline in the world interest rate. Even though Emerging markets experience greater investment demand due to high growth rates, higher savings can outpace investment and lead to a net capital outflow.

An important implication of this framework is that in a cross section of countries with different degrees of credit constraints, asymmetric responses to a fall in the interest rate in each country will generate a greater dispersion in the cross-section of savings rate over time. This has been a feature of the data largely ignored until now. Since investment rates are determined by the world interest rate, our model predicts a convergence in the investment rate in the long run. Thus, savings become the main driver of the current account across countries. Our predictions are consistent with all of the broad stylized facts, which should be jointly accounted for in a single, consistent, general-equilibrium model applicable to the spectacular experience of the last three decades.

A Data

[TO BE COMPLETED]

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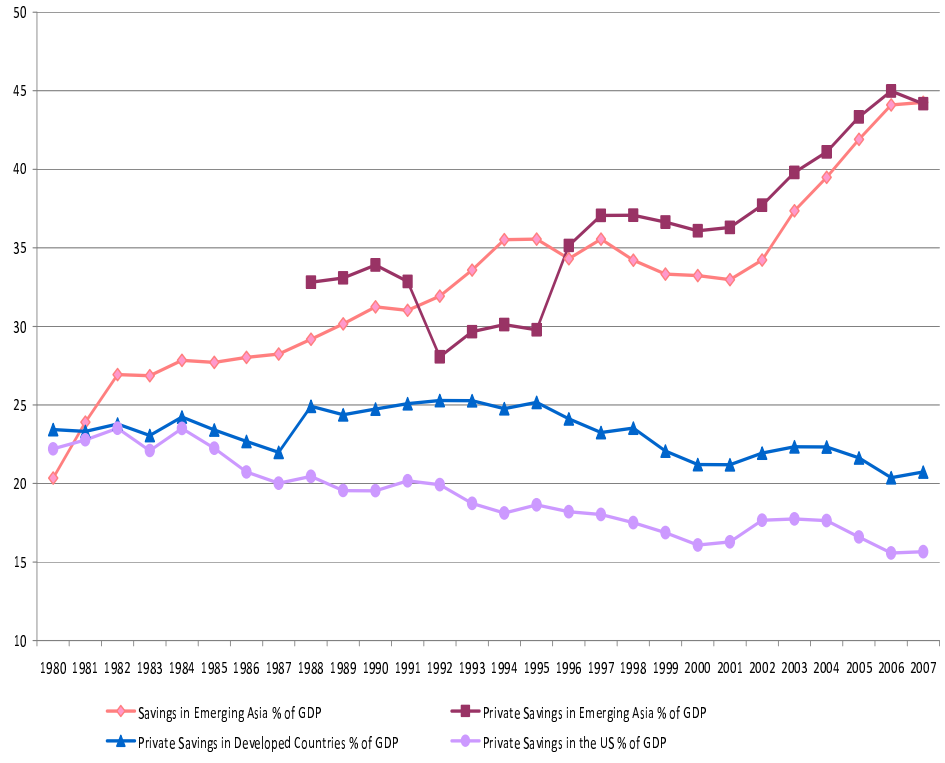


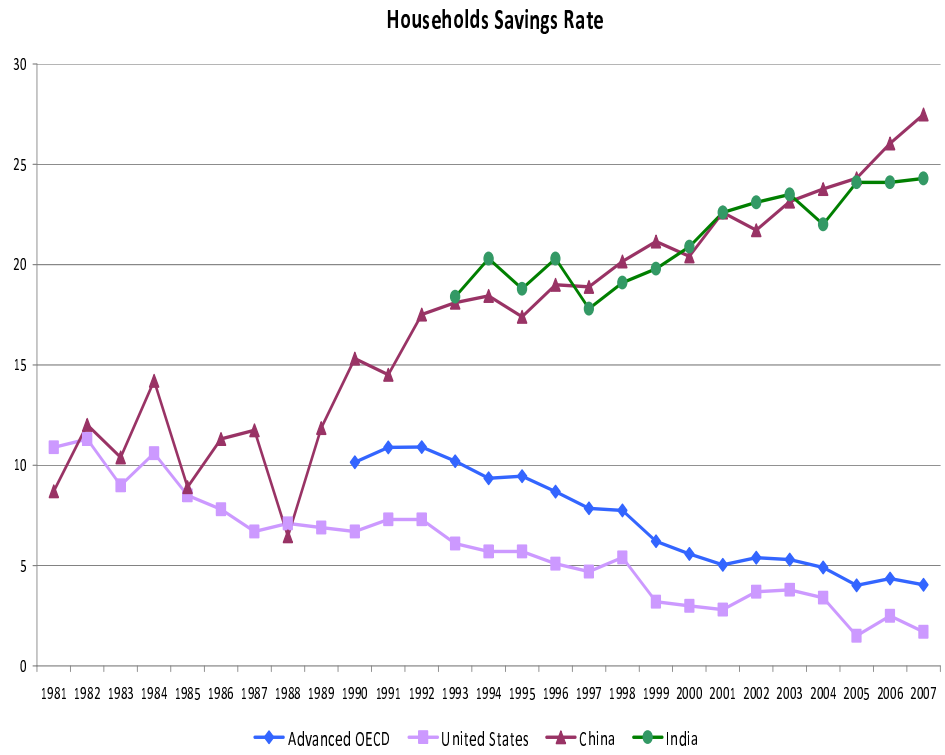
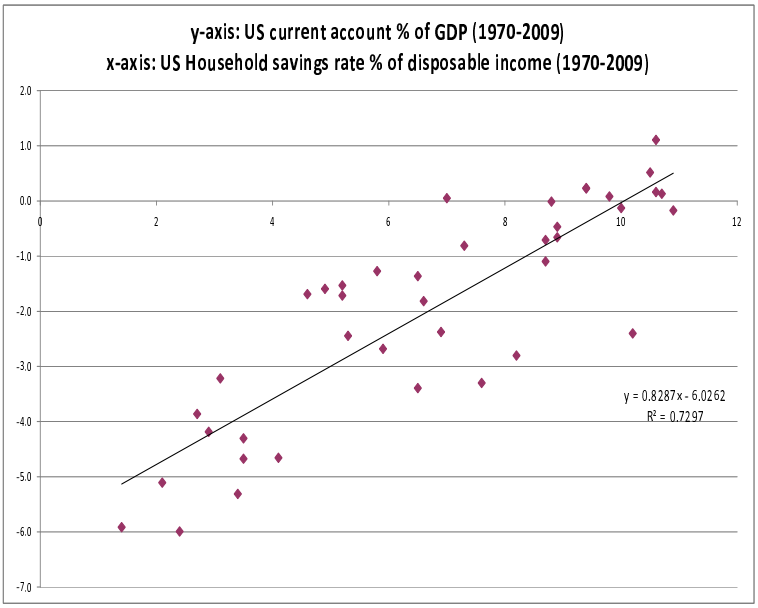


Figure 1: Private savings and household savings



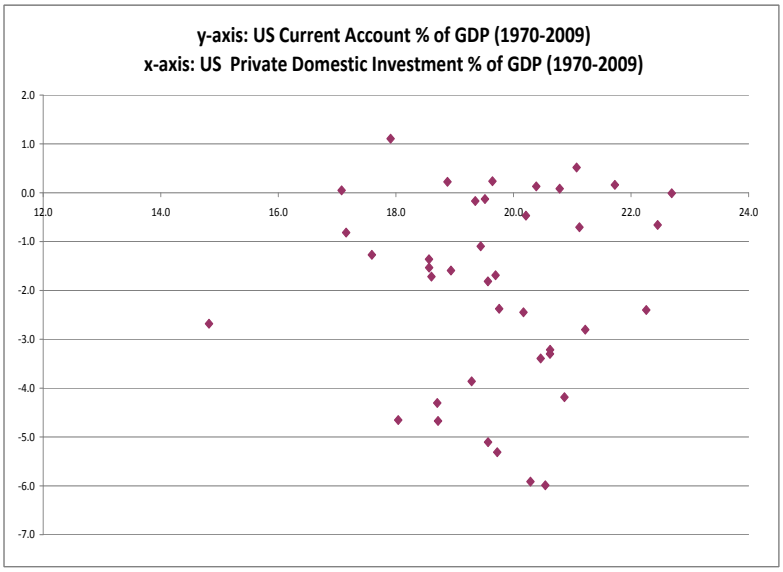


Figure 2: US current account, savings and investment

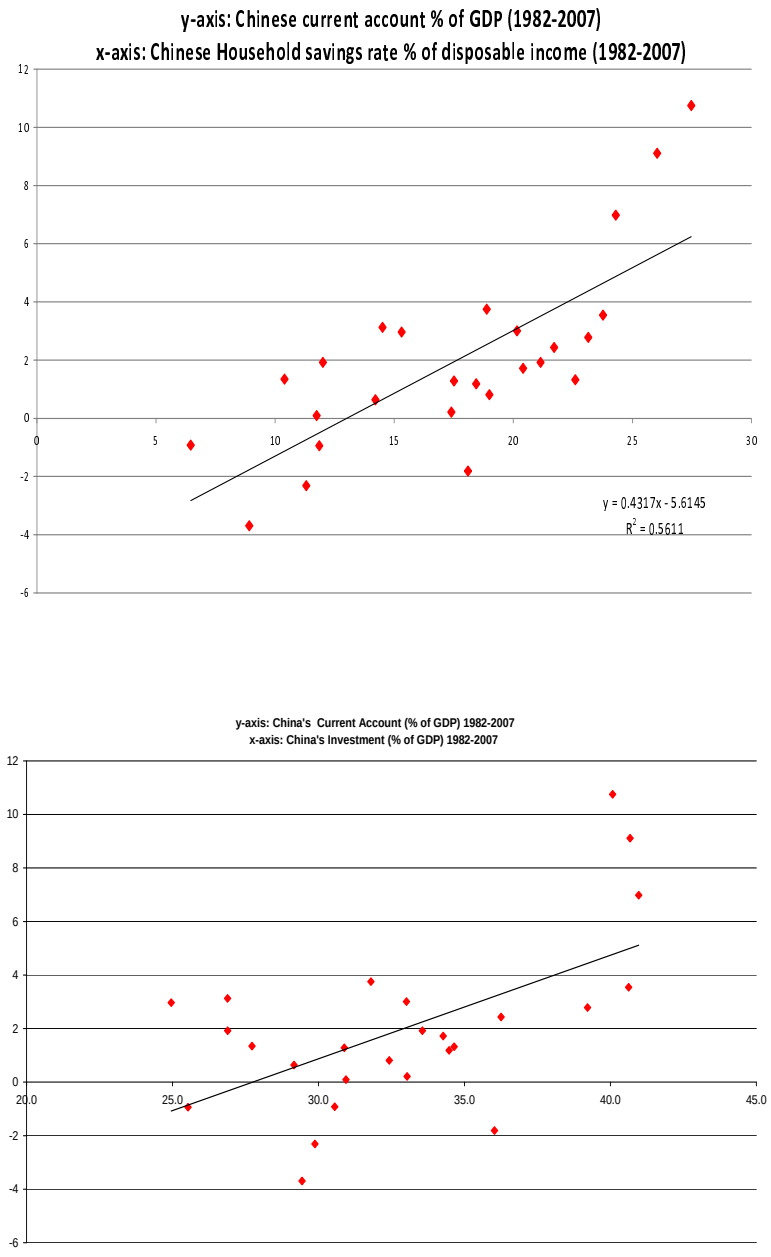


Figure 3: China current account, savings and investment

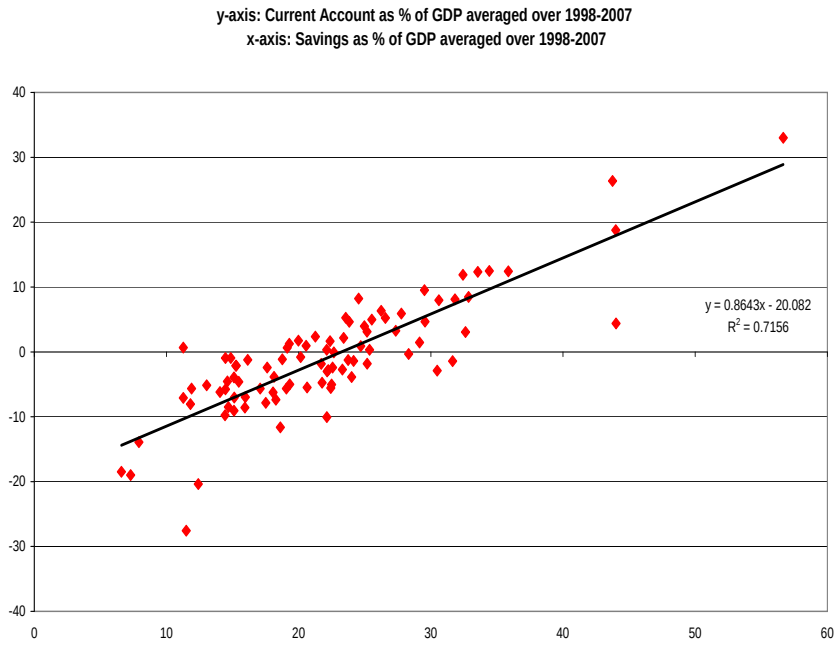


Figure 4: Current account and savings in the cross-section

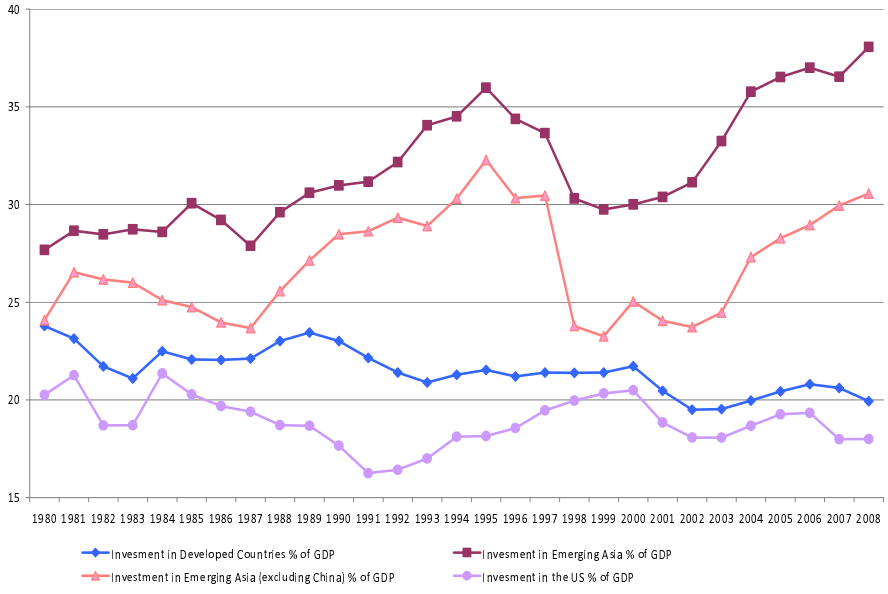


Figure 5: Investment

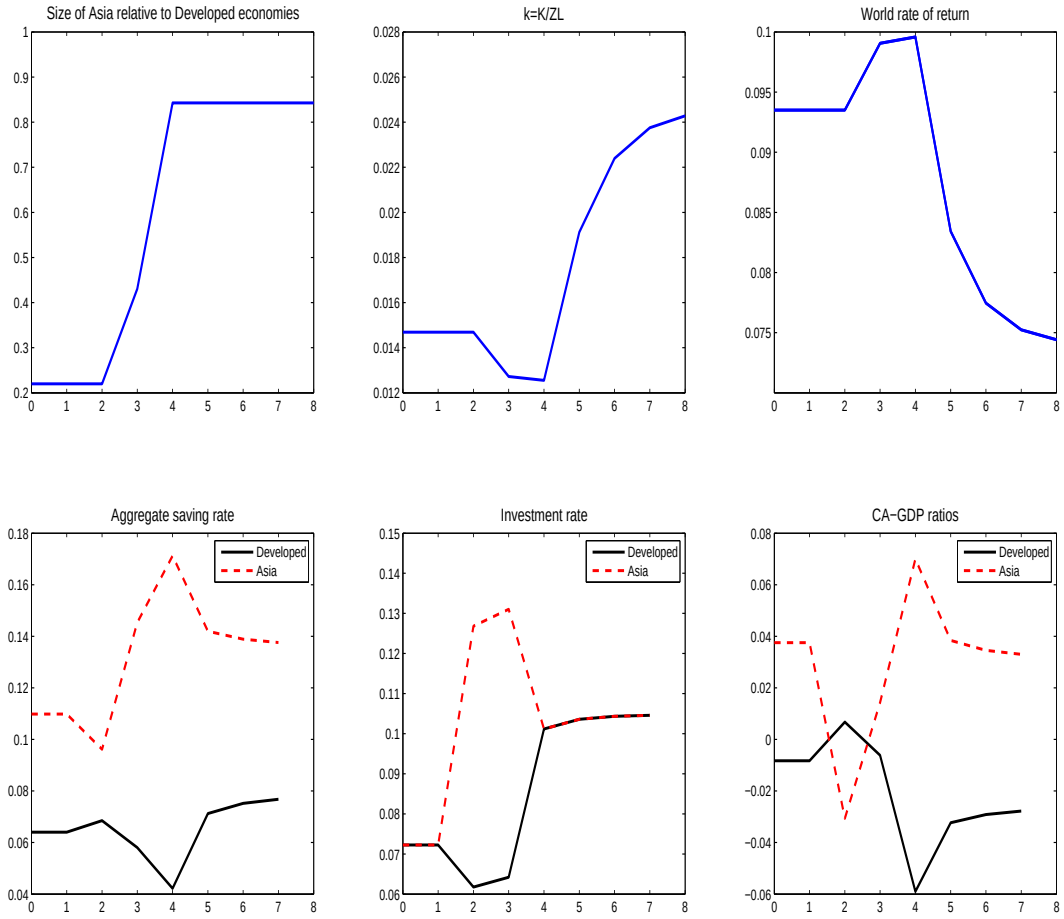


Figure 6: Growth experiment

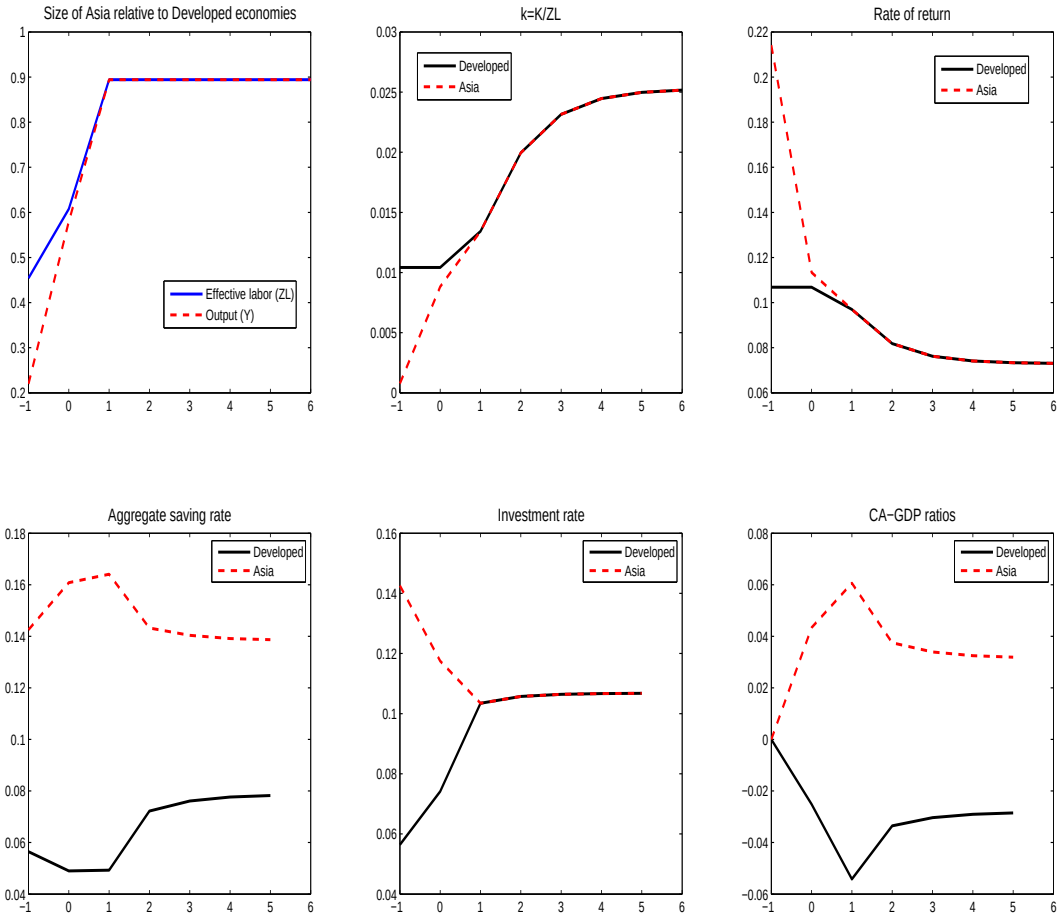


Figure 7: Full experiment: integration and fast growth in Asia

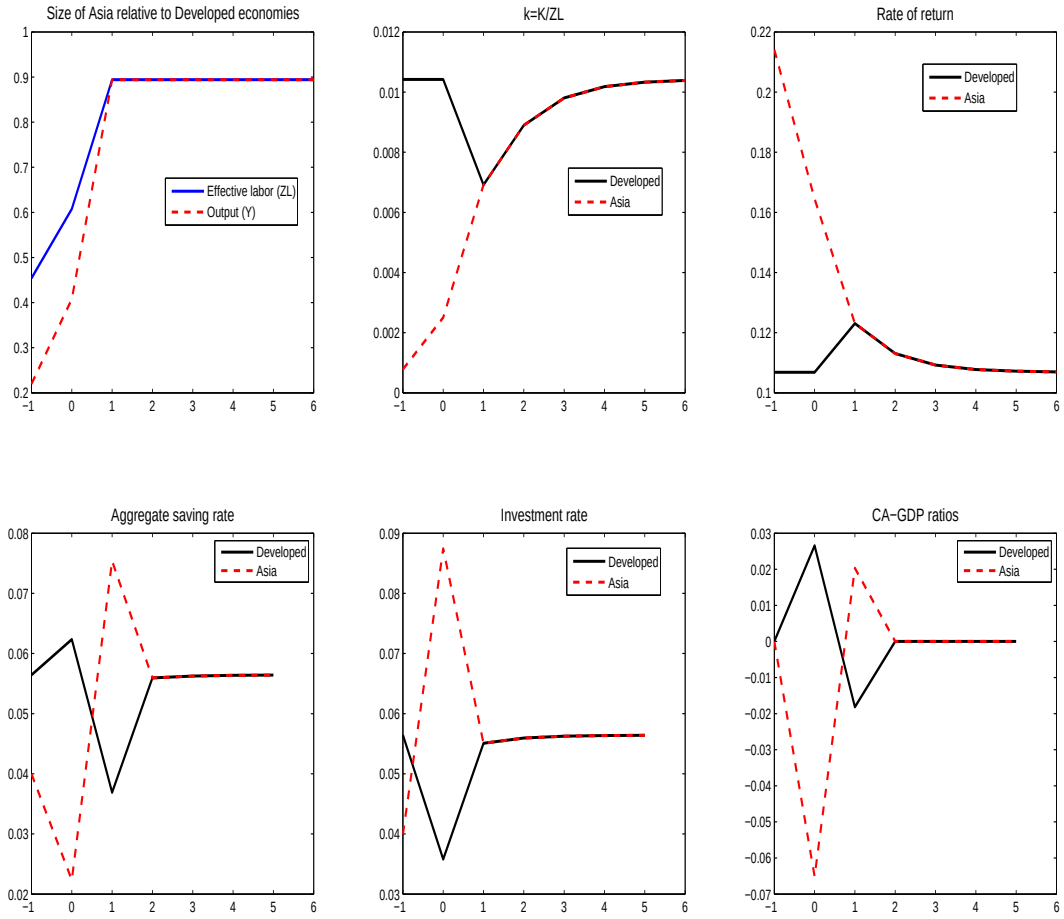


Figure 8: Experiment with symmetric credit constraints

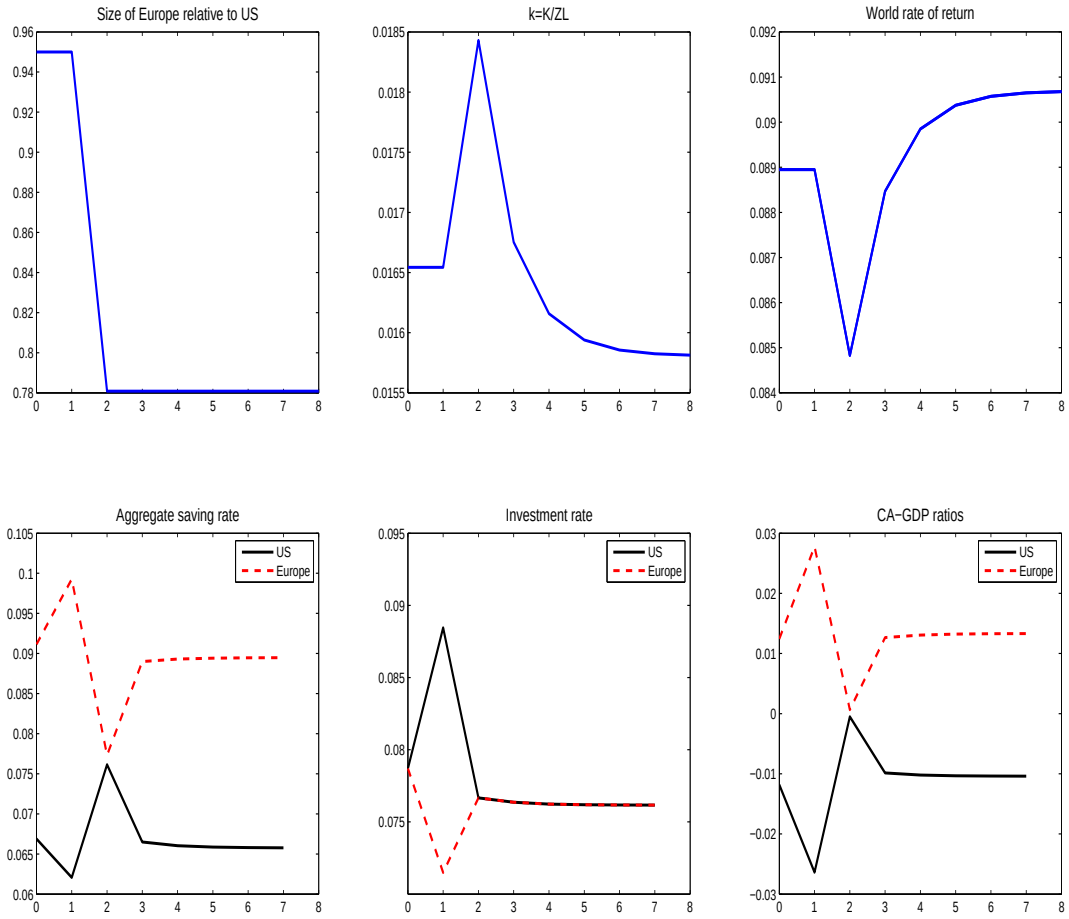


Figure 9: Growth experiment: Less constrained country grows faster

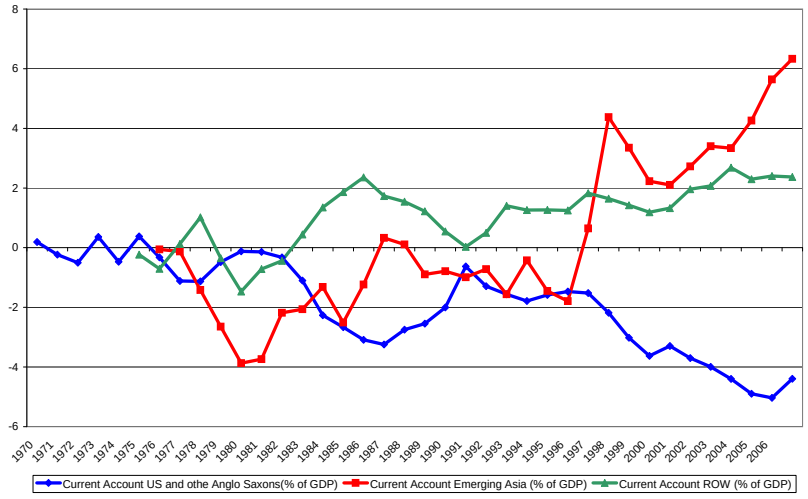


Figure 10: Current account imbalances: Three-region view

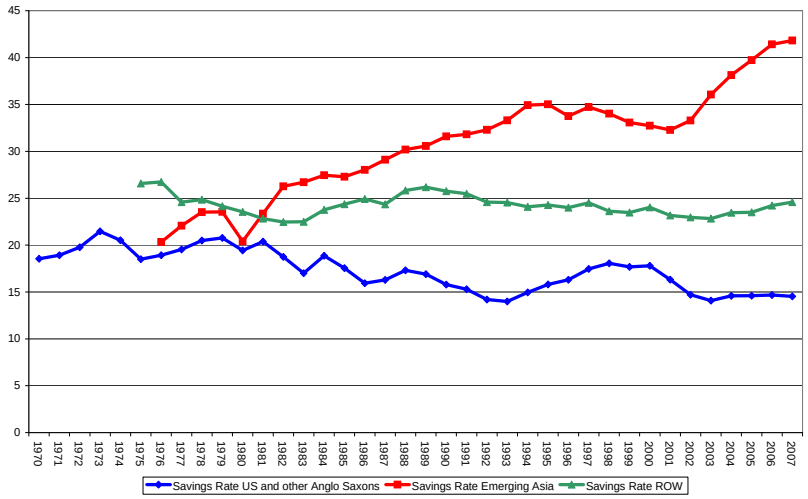


Figure 11: Saving rates

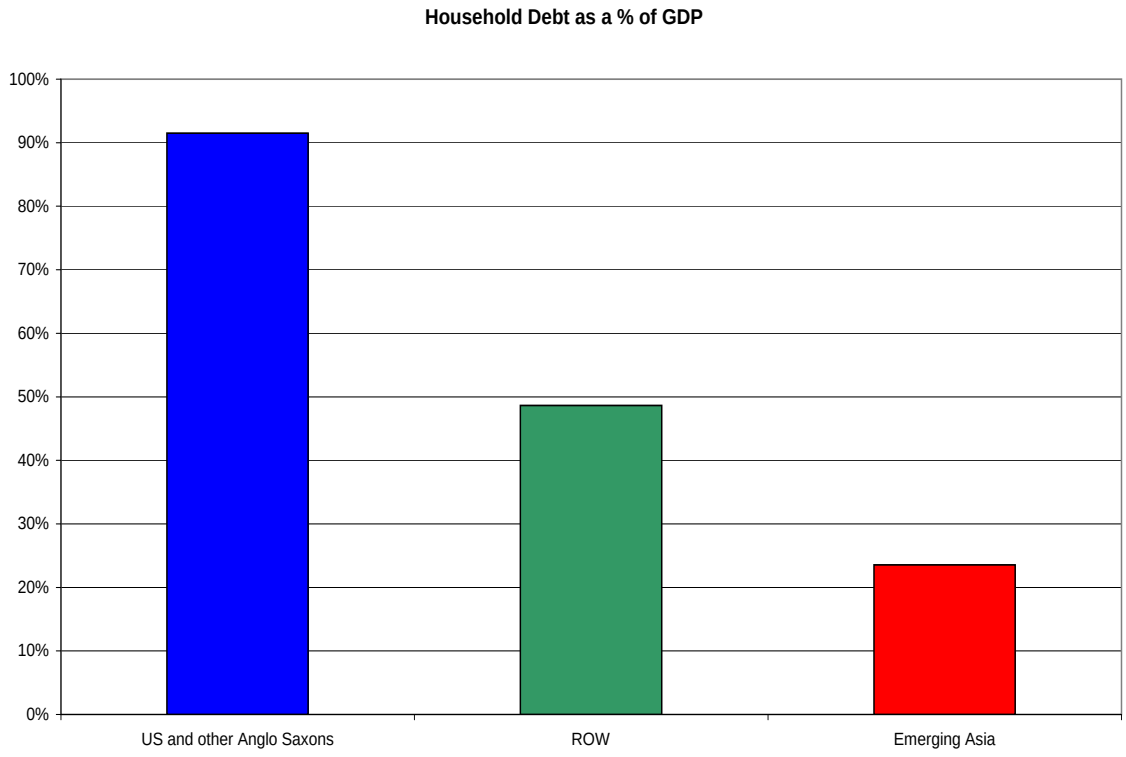


Figure 12: Household gross debt as % of GDP

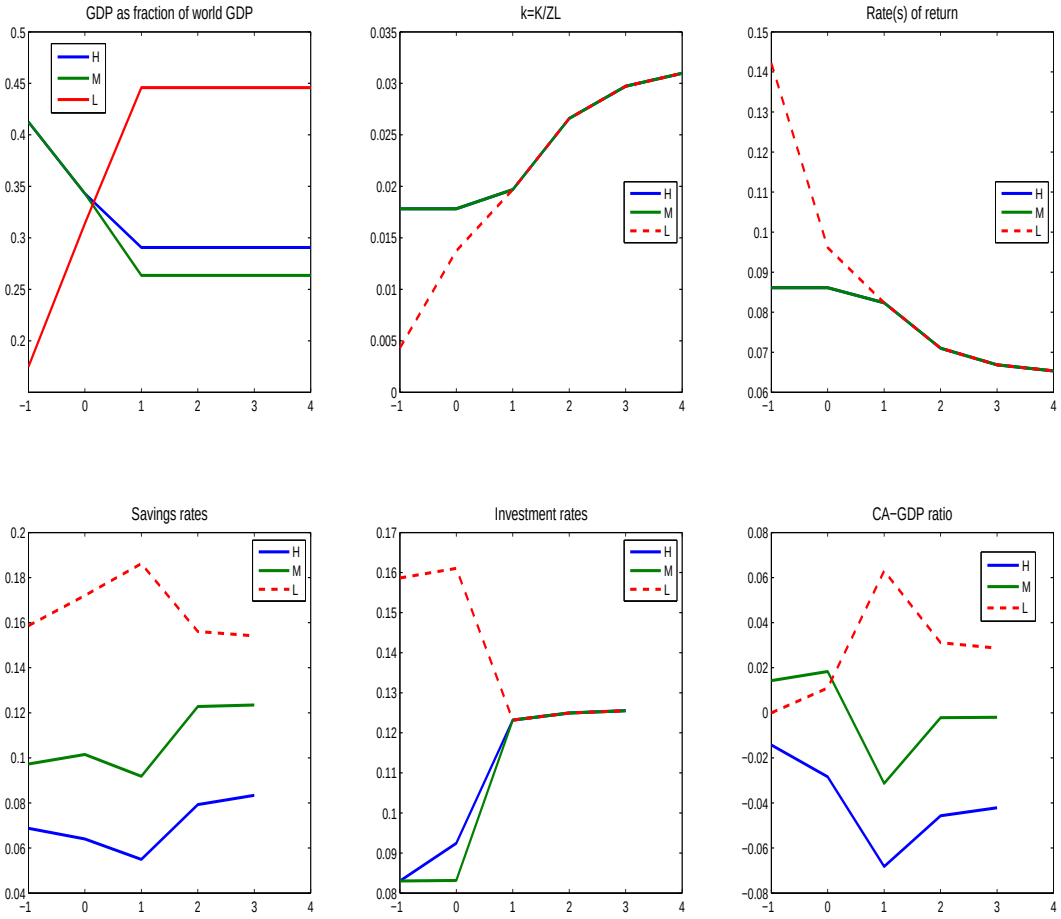


Figure 13: Three-country experiment