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Financial Development, International Capital Flows, and Aggregate Output

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Financial Development, International Capital Flows, and Aggregate Output*

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Abstract

We develop a tractable two-country overlapping-generations model and show that cross-country differences in financial development can explain three recent empirical patterns of international capital flows: Financial capital flows from relatively poor to relatively rich countries, while foreign direct investment flows in the opposite direction; net capital flows go from poor to rich countries; despite its negative net international investment positions, the United States receives a positive net investment income.

International capital mobility affects output in each country directly through the size of domestic investment and indirectly through the aggregate saving rate. Under certain conditions, the indirect effect may dominate the direct effect so that international capital mobility raises output in the poor country and globally, although net capital flows are in the direction to the rich country. We also explore the welfare and distributional effects of international capital flows and show that the patterns of capital flows may reverse along the convergence process of a developing country. Our model adds to the understanding of the costs and the benefits of international capital mobility in the presence of domestic financial frictions.

Keywords: Financial development, financial market imperfections, financial capital flows, foreign direct investment
JEL Classification: E44, F41

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1 Introduction

Standard international macroeconomics predicts that capital flows from capital-rich countries, where the marginal product of capital (MPK, henceforth) is low, to capital-poor countries, where the MPK is high. Furthermore, there should be no difference between gross and net capital flows, as capital movements are unidirectional.

The patterns of international capital flows observed in the past 20 years, however, stand in stark contrast to these predictions (Lane and Milesi-Ferretti, 2001, 2007b,c). First, since 1998, the average per-capita income of countries running current account surpluses has been below that of the deficit countries, i.e., net capital flows have been "uphill" from poor to rich countries (Prasad, Rajan, and Subramanian, 2006, 2007). Second, many developing economies, including China, Malaysia, and South Africa, are net importers of foreign direct investment (hereafter, FDI) and net exporters of financial capital at the same time, while developed countries such as France, the United Kingdom, and the United States exhibit the opposite pattern (Ju and Wei, 2010). Third, despite its negative net international investment position since 1986, the U.S. has been receiving a positive net investment income until 2005 (Gourinchas and Rey, 2007; Hausmann and Sturzenegger, 2007; Higgins, Klitgaard, and Tille, 2007).

Recent research offers two main explanations for these empirical facts. Devereux and Sutherland (2009) and Tille and van Wincoop (2010) focus on the cross-country risk-sharing investors can achieve by diversifying their portfolios globally. International portfolio investment is determined by the cross-correlation patterns of aggregate shocks at the country level. These models do not distinguish between FDI and portfolio equity investment and, therefore, offer no explanation for the second pattern.

The other strand of literature focuses on domestic financial market imperfections (Aoki, Benigno, and Kiyotaki, 2009; Caballero, Farhi, and Gourinchas, 2008). Matsuyama (2004) shows that, in the presence of credit market imperfections, financial market globalization may lead to a steady-state equilibrium in which fundamentally identical countries end up with different levels of per capita output, a result he calls "symmetry breaking". Furthermore, financial capital flows from poor to rich countries in the steady state. However, Matsuyama (2004) does not address FDI flows. Mendoza, Quadrini, and Rios-Rull (2009) analyze the joint determination of financial capital flows and FDI in a heterogeneous-agent model with uninsurable idiosyncratic endowment and investment risks. The precautionary savings motive plays the crucial role. Ju and Wei (2010) show in a static model that, when both FDI and financial capital flows are allowed, all financial capital leaves the country where credit market imperfections are more severe, while FDI flows into this country. Thus, capital mobility allows investors to fully *bypass* the underdeveloped financial system. The models mentioned above explain only one or two of the three facts.

While the literature does not explicitly address the implications of international capital mobility for aggregate output, it seems intuitively plausible that, due to the declining MPK, "uphill" capital flows make the poor countries and the world poorer.[1] The policy implications seem to be clear: The world would be better off without international capital movements between rich and poor countries.

We extend the second strand of literature and explain all three empirical facts. Following Matsuyama (2004), we take the tightness of the borrowing constraints as a measure of a country's level of financial development. The two countries in our model differ fundamentally only in the level of financial development.

Under international financial autarky (hereafter, IFA), interest rates are affected by two factors. First, for a given level of financial development, a lower capital-labor ratio implies a higher MPK and higher interest rates. We call this the *neoclassical* effect, as it arises from the concavity of the neoclassical production function with respect to the capital-labor ratio. Second, for a given capital-labor ratio, a lower level of financial development means less efficient enforcement of credit contracts and monitoring of borrowers. In this case, agents face tighter borrowing constraints and the lower aggregate credit demand leads to a lower loan rate and a higher equity rate. We call this the *financial-underdevelopment* effect. In the less financially developed country, the steady-state loan rate is lower and the steady-state equity rate is higher. In the case of interest-elastic saving, domestic financial frictions also distort aggregate saving through the interest rates, leading to lower investment and output.

Suppose that the two countries are initially in the steady state under IFA. Upon allowing full capital mobility, the initial cross-country interest rate differentials drive financial capital flows from the poor to the rich country and FDI flows in the opposite direction. Due to its larger credit capacity, the more financially developed country receives net capital inflows. Thus, net capital flows are "uphill" from the poor to the rich country. Since the rich country receives a higher return on its FDI assets than it pays on its foreign debts, it gets a positive net investment income despite its negative net international investment position. Intuitively, by "exporting" its superior financial services through two-way capital flows, the rich country receives a positive net reward, accordingly. Thus, our model predictions are consistent with the three empirical facts mentioned above.

Building upon this model, we make three contributions to the literature. First, we show that full capital mobility can raise output in the poor country as well as globally, despite "uphill" net capital flows. Intuitively, financial frictions depress the return on and, hence, the level of aggregate saving. Allowing for international capital mobility provides domestic households with better returns on savings. Thus, by ameliorating the interest rate distortions, capital mobility indirectly raises aggregate savings in the less financially developed country. If saving is sufficiently interest-elastic, the rise in aggregate saving

[1] Matsuyama (2004) and von Hagen and Zhang (2010) show that this may indeed be the case.

may exceeds net capital outflows so that aggregate investment and output in the less financially developed country as well as globally can be higher than under IFA.

The interest elasticity of saving has been the focus of the debates on the effectiveness of tax reform (Bernheim, 2002; Evans, 1983; Summers, 1981), financial liberalization (Bandiera, Caprio, Honohan, and Schiantarelli, 2000), and other public policies (Corbo and Schmidt-Hebbel, 1991) on capital accumulation. Our model complements the existing literature by emphasizing the relevance of interest-elastic saving to the output implications of capital account liberalization policies.[2] The empirical evidence on the magnitude of the interest elasticity of savings is rather mixed (Giovannini, 1983; Loayza, Schmidt-Hebbel, and Serven, 2000). In particular, Ogaki, Ostry, and Reinhart (1996) provide evidence that savings are more responsive to rates of return at higher income levels.

As our second contribution, we show that financial capital flows affect the owners of credit capital and equity capital in opposite ways and so do FDI flows. Capital flows also affect the intergenerational income distribution. Such distributional effects offer an explanation for why capital account liberalization often encounters both support and opposition in a given country.

Third, we analyze a scenario where one country is more financially developed and in its steady state, while the other country is less financially developed and below its steady state before capital account liberalization. We study the interactions of international capital flows and the economic convergence in the second country. The results show that the pattern of international capital flows may reverse along the convergence path, depending on the relative strength of the neoclassical effect and the financial underdevelopment effect. We then use the data from ten Central and Eastern European countries and five ASEAN countries to offer some suggestive evidence supporting these predictions.

Our model differs from the existing literature in the following aspects. The static model of Ju and Wei (2010) is useful for analyzing the immediate impacts of capital account liberalization, while our OLG model facilitates a short-run and long-run analysis. Devereux and Sutherland (2009), Mendoza, Quadrini, and Rios-Rull (2009), and Tille and van Wincoop (2010) capture international capital flows in settings with aggregate or idiosyncratic uncertainty, while our model features international capital flows in a deterministic setting. Buera and Shin (2010), Sandri (2010), Angeletos and Panousi (2011), Carroll and Jeanne (2011), and Song, Storesletten, and Zilibotti (2011) address "uphill" financial capital flows, while we focus on the joint determination of financial capital and FDI flows. Caballero, Farhi, and Gourinchas (2008) and Mendoza, Quadrini, and Rios-Rull (2009) analyze the joint determination of financial capital and FDI flows

[2]Interest-elastic saving is key to the output gains in our model. It results from the assumption that individuals work and consume in both periods of life. The higher the future labor income, the more interest-elastic the saving is, which is known as the human wealth effect (Summers, 1981). Our model predicts that saving is more interest elastic in fast-growing countries so that capital mobility is more likely to be beneficial for such economies.

in an endowment-economy model, while endogenous capital accumulation is crucial in our model. Caballero, Farhi, and Gourinchas (2008) assume that foreign direct investors from the more financially developed country have an advantage in capitalizing the return on investment in the host country and Mendoza, Quadrini, and Rios-Rull (2009) assume that investors from the more financially developed country can insure their foreign direct investment using the better risk-sharing opportunities in their home country. We do not need these extra assumptions. Sandri (2010) and Carroll and Jeanne (2011) feature the precautionary savings channel in a model with idiosyncratic risk and incomplete markets, while we feature interest-elastic savings in a model with limited commitment.

Caselli and Feyrer (2007) present a direct estimation of cross-country MPK differences to assess the importance of international credit market frictions. They abstract from domestic financial frictions so that the MPK is the rate of return to investors and the driving force behind international capital flows. They find that, if one focuses on reproducible capital and adjusts for the higher relative prices of capital goods in poor countries, the MPK does not differ much between developed and developing countries. Thus, they conclude that international credit market frictions cannot go far in explaining observed capital flows between these countries. We take this as a starting point and assume that there is no barriers to international capital flows in the scenario of full capital mobility. Instead, we focus on the implications of domestic financial frictions for international capital flows.

The rest of the paper is structured as follows. Section 2 sets up the model and shows the distortions of financial frictions on interest rates and output under IFA. Section 3 analyzes the output and welfare implications of full capital mobility. Section 4 concludes. The technical proofs and relevant discussions are available in the on-line appendix.

2 The Model under International Financial Autarky

The world economy consists of two countries, N (North) and S (South), which are fundamentally identical except in the level of financial development as specified later. In the following, variables in country $i \in \{N, S\}$ are denoted with the superscript i. A final good can be consumed or transformed into capital. The final good is internationally tradable and chosen as the numeraire, while capital goods are non-tradable.

Individuals live for two periods, young and old. There is no population growth and the size of each generation is normalized to one in each country. Each individual is endowed with one unit of labor when young and $\epsilon \geq 0$ units of labor when old, which are supplied to aggregate production. Aggregate labor supply is $L = 1 + \epsilon$ in each period.

At the beginning of each period, final goods Y_t^i are produced with capital K_t^i and labor L in a Cobb-Douglas fashion. Capital fully depreciates after production. Capital and labor are rewarded at their respective marginal products. To summarize,

$$Y_t^i = \left(\frac{K_t^i}{\alpha}\right)^{\alpha} \left(\frac{L}{1-\alpha}\right)^{1-\alpha}, \qquad \text{where} \qquad \alpha \in (0,1), \tag{1}$$

$$R_t^i K_t^i = \alpha Y_t^i \qquad \text{and} \qquad \omega_t^i L = (1-\alpha) Y_t^i, \tag{2}$$

where ω_t^i denotes the wage rate and R_t^i denotes the MPK. There is no uncertainty in the economy. In this section, we assume that international capital flows are not allowed.

Each generation consists of two types of individuals, *entrepreneurs* and *households*, of mass η and $1-\eta$, respectively. They have Cobb-Douglas preferences over consumption,

$$u_t^{i,j} = \left(\frac{c_{y,t}^{i,j}}{1-\beta}\right)^{1-\beta} \left(\frac{c_{o,t+1}^{i,j}}{\beta}\right)^{\beta}, \tag{3}$$

where superscript $j \in \{e, h\}$ denotes entrepreneurs or households; $c_{y,t}^{i,j}$ and $c_{o,t+1}^{i,j}$ denote individual j's consumption when young and when old; $\beta \in (0,1)$ denotes the degree of patience, i.e., a larger β means that individuals are more patient and care more about consumption when old. If $\beta = 1$, they only consume when old, $u_t^{i,j} = c_{o,t+1}^{i,j}$.

An individual j born in period t and country i receives a labor income ω_t^i, consumes $c_{y,t}^{i,j}$, and saves $s_t^{i,j} = \omega_t^i - c_{y,t}^{i,h}$ at a gross interest rate of $R_t^{i,j}$ in period t. In period $t+1$, after receiving the financial income $R_t^{i,j} s_t^{i,j}$ and a labor income $\epsilon\omega_{t+1}^i$, the individual consumes its total wealth $c_{o,t+1}^{i,j} = R_t^{i,j} s_t^{i,j} + \epsilon\omega_{t+1}^i$ and exits from the economy. Its lifetime budget constraint is $c_{y,t}^{i,j} + \frac{c_{o,t+1}^{i,j}}{R_t^{i,j}} = \mathbb{W}_t^{i,j}$, where $\mathbb{W}_t^{i,j} \equiv \omega_t^i + \frac{\epsilon\omega_{t+1}^i}{R_t^{i,j}}$ denotes its discounted lifetime wealth when young and $\frac{\epsilon\omega_{t+1}^i}{R_t^{i,j}}$ captures *human wealth* as defined by Summers (1981). Given Cobb-Douglas preferences, its optimal consumption-saving choices are

$$c_{y,t}^{i,j} = (1-\beta)\mathbb{W}_t^{i,j} \quad \text{and} \quad c_{o,t+1}^{i,j} = R_t^{i,j} \beta \mathbb{W}_t^{i,j}, \tag{4}$$

$$s_t^{i,j} = \omega_t^i - c_{y,t}^{i,j} = \beta\omega_t^i - (1-\beta)\frac{\epsilon\omega_{t+1}^i}{R_t^{i,j}}. \tag{5}$$

Substitute (4) into (3) to get the indirect lifetime utility function, $u_t^{i,j} = \mathbb{W}_t^{i,j}(R_t^{i,j})^{\beta}$.

We assume that only entrepreneurs can use final goods to produce capital goods. If an entrepreneur invests one unit of final goods in period t, it yields one unit of capital goods in period $t+1$. The gross rate of return to the investment made in period t is equal to the MPK in period $t+1$, R_{t+1}^i. With no other investment opportunity available, households lend their entire savings to the credit market at the gross interest rate $R_t^{i,h}$. As long as $R_{t+1}^i \geq R_t^{i,h}$, the entrepreneur prefers to finance his investment i_t^i using loans $d_t^{i,h}$. However, due to limited commitment, the entrepreneur can borrow only up to a fraction of his future project revenues,

$$R_t^{i,h} d_t^{i,h} = R_t^{i,h}(i_t^i - d_t^{i,e}) \leq \theta^i R_{t+1}^i i_t^i. \tag{6}$$

where $d_t^{i,e}$ denotes the entrepreneur's own funds, i.e., equity capital, in the project. Following Matsuyama (2004, 2007), we use $\theta^i \in [0,1]$ as a measure of financial development or the severity of credit market imperfections in country i. It captures a wide range of institutional factors and is higher in countries with more sophisticated financial and legal systems, better creditor protection, more liquid asset market, etc.

Define the equity rate as the rate of return to entrepreneurial equity capital,

$$R_t^{i,e} \equiv \frac{R_{t+1}^i i_t^i - R_t^{i,h} d_t^{i,h}}{d_t^{i,e}} = R_{t+1}^i + (R_{t+1}^i - R_t^{i,h})(\lambda_t^i - 1) \geq R_t^{i,h}, \tag{7}$$

where $\lambda_t^i \equiv \frac{i_t^i}{d_t^{i,e}}$ denotes the investment-equity ratio. For a unit of equity capital invested, the entrepreneur can borrow $(\lambda_t^i - 1)$ units of final goods in period t; in period $t+1$, he receives the net return from the leveraged investment, $(R_{t+1}^i - R_t^{i,h})(\lambda_t^i - 1)$, in addition to the marginal product of its equity capital, R_{t+1}^i. Iff $R_{t+1}^i > R_t^{i,h}$, he borrows to the limit defined by (6) to fully exploit the leverage effect; after repaying the debt in period $t+1$, he gets $(1-\theta^i)R_{t+1}^i i_t^i$ and the equity rate is $R_t^{i,e} = \frac{(1-\theta^i)R_{t+1}^i i_t^i}{d_t^{i,e}} = \frac{(1-\theta^i)R_{t+1}^i i_t^i}{i_t^i - d_t^{i,h}} = \frac{(1-\theta^i)R_{t+1}^i}{1-\frac{\theta^i R_{t+1}^i}{R_t^{i,h}}} > R_t^{i,h}$. If $R_t^{i,h} = R_{t+1}^i$, he does not borrow to the limit; after repaying the debt in period $t+1$, he gets $R_{t+1}^i d_t^{i,e}$ and the equity rate is $R_t^{i,e} = R_{t+1}^i$. The non-negative leverage effect ensures that the equity rate is no less than the loan rate and inequality (7) thus marks the entrepreneur's participation constraint.

In the following, the social rate of return refers to the MPK, while the private rates of return refer to the loan rate and the equity rate.

The markets for credit capital, equity capital, capital goods, and final goods clear,

$$S_t^{i,h} = (1-\eta)s_t^{i,h} = D_t^{i,h} = \eta d_t^{i,h}, \text{ and } S_t^{i,e} = \eta s_t^{i,e} = D_t^{i,e} = \eta d_t^{i,e}, \tag{8}$$

$$K_{t+1}^i = \eta i_t^i = D_t^{i,h} + D_t^{i,e}, \text{ and } C_t^i + K_{t+1}^i = Y_t^i \tag{9}$$

where $S_t^{i,h}$ and $D_t^{i,h}$ denote the aggregate credit supply and demand, $S_t^{i,e}$ and $D_t^{i,e}$ denote the aggregate equity supply and demand, and $C_t^i \equiv \eta(c_{y,t}^{i,e} + c_{o,t}^{i,e}) + (1-\eta)(c_{y,t}^{i,h} + c_{o,t}^{i,h})$ denotes aggregate consumption in country i and period t.

Definition 1. *Given the level of financial development θ^i, a market equilibrium in country $i \in \{N, S\}$ under IFA is a set of allocations of households, $\{c_{y,t}^{i,h}, s_t^{i,h}, c_{o,t}^{i,h}\}$, entrepreneurs, $\{i_t^i, c_{y,t}^{i,e}, s_t^{i,e}, c_{o,t}^{i,e}\}$, and aggregate variables, $\{Y_t^i, K_t^i, \omega_t^i, R_t^i, R_t^{i,h}, R_t^{i,e}\}$, satisfying equations (1)-(2), (4)-(9),*

2.1 The Model Solution

Some auxiliary parameters are needed to simplify notation, $\rho \equiv \frac{\alpha}{1-\alpha}$, $\mathbb{m} \equiv \frac{(1-\beta)\epsilon}{(1+\epsilon)\rho}$, $\bar{\theta} \equiv 1-\eta$, $\mathbb{R} \equiv \frac{(1+\epsilon)\rho}{\beta}(1+\mathbb{m})$, $\mathbb{A}^i \equiv 1 - \frac{\bar{\theta}-\theta^i}{1-\eta}$, $\mathbb{B}^i \equiv 1 + \frac{\bar{\theta}-\theta^i}{\eta}$, which are interpreted as follows.

With the Cobb-Douglas preferences, the income effect and the substitution effect of interest rates cancel out so that an individual consumes the fraction $(1-\beta)$ of its lifetime wealth when young. $\epsilon > 0$ makes its lifetime wealth interest-elastic through human wealth. Thus, according to equations (4) and (5), consumption and saving when young are interest elastic iff $\beta < 1$ and $\epsilon > 0$ and, hence, $\mathbb{m} > 0$. As shown below in Lemma 1, $\mathbb{m}$ captures the joint impacts of these two factors on the interest elasticity of saving.

$\bar{\theta}$ is a critical value. As shown below, for $\theta^i \geq \bar{\theta}$, the borrowing constraint is slack so that the social and the private rates of return are equal to $\mathbb{R}$ in the steady state. For $\theta^i \in [0, \bar{\theta})$, the borrowing constraint is binding, $\mathbb{A}^i$ and $\mathbb{B}^i$ measure the wedge between the private and the social rates of return with $0 < \mathbb{A}^i < 1 < \mathbb{B}^i$ and $\frac{\partial \mathbb{A}^i}{\partial \theta^i} > 0 > \frac{\partial \mathbb{B}^i}{\partial \theta^i}$.

The aggregate rewards to capital in period $t+1$ are distributed to individuals as the returns to their savings, $(1-\eta) s_t^{i,h} R_t^{i,h} + \eta s_t^{i,e} R_t^{i,e} = R_{t+1}^i K_{t+1}^i$, where $R_{t+1}^i K_{t+1}^i = \rho L \omega_{t+1}^i$ according to equation (2). Using equation (5) to substitute away $s_t^{i,j}$, we get

$$(1-\eta) R_t^{i,h} + \eta R_t^{i,e} = \frac{\omega_{t+1}^i}{\omega_t^i} \mathbb{R}, \tag{10}$$

which is called *the reward splitting rule.*

In the following, we first show the model solution in the case of the binding borrowing constraints and then discuss the condition under which this assumption is true.[3] Let X_{IFA} denote the steady-state value of variable X_t under IFA. The model solution is,

$$K_{t+1}^i = \frac{\beta \omega_t^i}{\mathbb{m}+1} \left[1 - \frac{\mathbb{m}(1-\mathbb{A}^i)(\mathbb{B}^i-1)}{(\mathbb{m}+\mathbb{A}^i)(\mathbb{m}+\mathbb{B}^i)} \right], \tag{11}$$

$$R_t^{i,e} = \frac{\omega_{t+1}^i}{\omega_t^i} \mathbb{R} \left(1 + \frac{\mathbb{B}^i - 1}{\mathbb{m}+1} \right), \tag{12}$$

$$R_t^{i,h} = \frac{\omega_{t+1}^i}{\omega_t^i} \mathbb{R} \left(1 - \frac{1 - \mathbb{A}^i}{\mathbb{m}+1} \right), \tag{13}$$

$$R_{t+1}^i = \frac{\omega_{t+1}^i}{\omega_t^i} \mathbb{R} \left[1 + \frac{\mathbb{m}(1-\mathbb{A}^i)(\mathbb{B}^i-1)}{(\mathbb{m}+1)(\mathbb{m}+\mathbb{A}^i\mathbb{B}^i)} \right], \tag{14}$$

$$\psi_t^i \equiv \frac{R_t^{i,h}}{R_{t+1}^i} = \psi_{IFA}^i = 1 - \frac{(1-\mathbb{A}^i)\mathbb{B}^i}{\mathbb{m}+\mathbb{B}^i}, \tag{15}$$

$$\omega_{t+1}^i = \left(\frac{\Lambda_t^i}{\mathbb{R}} \omega_t^i \right)^\alpha, \quad \text{where } \Lambda_t^i = \Lambda_{IFA}^i = \frac{(\mathbb{m}+\mathbb{A}^i\mathbb{B}^i)(\mathbb{m}+1)}{(\mathbb{m}+\mathbb{A}^i)(\mathbb{m}+\mathbb{B}^i)}, \tag{16}$$

$$\frac{\partial \ln \Lambda_{IFA}^i}{\partial \theta^i} = \frac{\mathbb{m}(\mathbb{B}^i-1)}{(\mathbb{m}+\mathbb{A}^i\mathbb{B}^i)(\mathbb{m}+\mathbb{A}^i)} \frac{\partial \mathbb{A}^i}{\partial \theta^i} - \frac{\mathbb{m}(1-\mathbb{A}^i)}{(\mathbb{m}+\mathbb{A}^i\mathbb{B}^i)(\mathbb{m}+\mathbb{B}^i)} \frac{\partial \mathbb{B}^i}{\partial \theta^i} \geq 0. \tag{17}$$

ψ_t^i is the relative loan rate and Λ_t^i is the aggregate efficiency indicator. Both are time-invariant under IFA. The model dynamics are characterized by equation (16). For $\alpha \in (0,1)$, a unique and stable steady state exists with the wage at $\omega_{IFA}^i = \left(\frac{\Lambda_{IFA}^i}{\mathbb{R}} \right)^\rho$.

$\bar{\theta}$ is the critical value for the borrowing constraints to be binding. If $\theta^i = \bar{\theta}$, $\mathbb{A}^i = \mathbb{B}^i = 1$ and thus, $R_t^{i,h} = R_{t+1}^i = \frac{\omega_{t+1}^i}{\omega_t^i} \mathbb{R}$, so that the borrowing constraints are weakly binding.

[3]See the proof of Proposition 1 in appendix A for the model solution.

In this case, the aggregate credit demand is strong enough to push the loan rate equal to the social rate of return, $\psi^i = 1$; according to equation (7), the zero spread implies that $R_t^{i,e} = R_{t+1}^i = R_t^{i,h} = \frac{\omega_{t+1}^i}{\omega_t^i}\mathbb{R} = \mathbb{R}^{1-\alpha}\rho^{\alpha(1-\alpha)}(\frac{K_t^i}{L})^{-\alpha(1-\alpha)}$. Intuitively, in the country with a lower capital-labor ratio $\frac{K_t^i}{L}$, the growth rate $\frac{\omega_{t+1}^i}{\omega_t^i}$ is higher and so are the interest rates. We call this the *neoclassical* effect, as it arises from the concavity of the neoclassical production function with respect to the capital-labor ratio. For $\theta^i > \bar{\theta}$, entrepreneurs do not have an incentive to borrow to the limit and the equilibrium allocation is identical as in the case of $\theta^i = \bar{\theta}$. In both cases, aggregate saving $\frac{\beta\omega_t^i}{1+\mathbb{m}}$ is transformed by entrepreneurs into capital so that the aggregate efficiency indicator is $\Lambda_{IFA}^i = 1$. In the steady state, the wage is $\omega_{IFA}^i = \mathbb{R}^{-\rho}$, and the interest rates are $R_{IFA}^{i,j} = R_{IFA}^i = \mathbb{R}$. Iff $\theta^i < \bar{\theta}$, it holds that $\mathbb{A}^i < 1 < \mathbb{B}^i$. According to equations (13) and (14), $R_t^{i,h} < \frac{\omega_{t+1}^i}{\omega_t^i}\mathbb{R} < R_{t+1}^i$ so that the borrowing constraints are strictly binding.

From now on, we focus on the case of $\theta \in (0, \bar{\theta})$. Let $S_t^i \equiv (1-\eta)s_t^{i,h} + \eta s_t^{i,e}$ denote aggregate saving. As ω_t^i is the individual's income when young and aggregate income of young individuals, the individuals' and aggregate saving rates are,

$$\frac{s_t^{i,h}}{\omega_t^i} = \beta - (1-\beta)\epsilon\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,h}} = \frac{\beta\mathbb{A}^i}{\mathbb{m}+\mathbb{A}^i} \quad \text{and} \quad \frac{\partial\frac{s_t^{i,h}}{\omega_t^i}}{\partial\mathbb{m}} < 0, \tag{18}$$

$$\frac{s_t^{i,e}}{\omega_t^i} = \beta - (1-\beta)\epsilon\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,e}} = \frac{\beta\mathbb{B}^i}{\mathbb{m}+\mathbb{B}^i} \quad \text{and} \quad \frac{\partial\frac{s_t^{i,h}}{\omega_t^i}}{\partial\mathbb{m}} < 0, \tag{19}$$

$$\frac{S_t^i}{\omega_t^i} = \beta - (1-\beta)\epsilon\frac{\omega_{t+1}^i}{\omega_t^i}\left(\frac{1-\eta}{R_t^{i,h}} + \frac{\eta}{R_t^{i,e}}\right) = \frac{\beta(\mathbb{m}+\mathbb{A}^i\mathbb{B}^i)}{(\mathbb{m}+\mathbb{A}^i)(\mathbb{m}+\mathbb{B}^i)} \quad \text{and} \quad \frac{\partial\frac{S_t^i}{\omega_t^i}}{\partial\mathbb{m}} < 0. \tag{20}$$

Let $\upsilon_t^{i,j} \equiv \frac{\partial \ln s_t^{i,j}}{\partial \ln R_t^{i,j}}$ denote the interest elasticity of saving for individual j and $\Upsilon_t^i \equiv \frac{\partial \ln S_t^i}{\partial \ln R_t^{i,h}}$ denote the elasticity of aggregate saving with respect to the loan rate under IFA.

Lemma 1. $\upsilon_t^{i,h} = \frac{\mathbb{m}}{A^i}$ *and* $\upsilon_t^{i,e} = \frac{\mathbb{m}}{B^i}$ *are linear in* $\mathbb{m}$*. Iff* $\theta^i < \bar{\theta}$, $\Upsilon_t^i > 0$ *and rises in* $\mathbb{m}$*.*

In subsections 2.2 and 2.3, we analyze the distortions of financial frictions on interest rates and output with inelastic saving ($\mathbb{m} = 0$) and elastic saving ($\mathbb{m} > 0$), respectively.

2.2 The Equilibrium with Inelastic Savings: $\mathbb{m} = 0$

The binding borrowing constraints depress aggregate credit demand and the loan rate is lower than the social rate of return. According to equation (7), the positive spread makes the equity rate higher than the social rate of return. Thus, financial frictions create a wedge between the private and the social rates of return, $\psi_t^i = \frac{R_t^{i,h}}{R_{t+1}^i} = \mathbb{A}^i < 1 < \frac{R_t^{i,e}}{R_{t+1}^i} = \mathbb{B}^i$. A lower θ^i leads to a larger the interest rate wedge. We call this the *financial-underdevelopment* effect and measure it by $1 - \psi_t^i$.

In the case of interest-inelastic saving, the saving rates are independent of θ^i, $\frac{s_t^{i,j}}{\omega_t^i} = \frac{S_t^i}{\omega_t^i} = \beta$, according to equations (18)-(20). Since domestic investment is fully financed by aggregate saving, financial frictions do not distort investment and output. See equations (11) and (16). In the steady state, output is independent of θ^i, $Y_{IFA}^i = \frac{L\omega_{IFA}^i}{1-\alpha} = \frac{1+\epsilon}{1-\alpha}\mathbb{R}^{-\rho}$.

2.3 The Equilibrium with Elastic Savings: $\mathbb{m} > 0$

Similar as in subsection 2.2, financial frictions distort interest rates through the financial underdevelopment effect. In the case of interest-elastic saving, the interest rate distortion depresses the household saving, $\frac{\partial \frac{s_t^{i,h}}{\omega_t^i}}{\partial \theta^i} > 0$, and raises the entrepreneurial saving, $\frac{\partial \frac{s_t^{i,e}}{\omega_t^i}}{\partial \theta^i} < 0$. See equations (18)-(19). According to equation (20), a lower θ^i leads to a lower aggregate saving rate, $\frac{\partial \frac{S_t^i}{\omega_t^i}}{\partial \theta^i} > 0$, implying that the distortion on household saving dominates that on entrepreneurial saving.[4] As domestic investment is financed purely by aggregate saving, financial frictions depress investment and output. We call this the *elastic saving* effect.[5] According to equations (18)-(20), it is stronger for a larger $\mathbb{m}$.

Proposition 1. *For $\theta^i \in [0, \bar{\theta})$, the borrowing constraint is binding and there is a unique and stable steady state in country i with the wage at $\omega_{IFA}^i = \left(\frac{\Lambda_{IFA}^i}{\mathbb{R}}\right)^\rho$. There is a wedge between the private and social rates of return, $R_t^{i,h} < R_{t+1}^i < R_t^{i,e}$. In the steady state, the loan rate rises and the equity rate falls in θ^i. If $\beta = 1$ or $\epsilon = 0$, $\mathbb{m} = 0$ and output is independent of θ^i; if $\beta < 1$ and $\epsilon > 0$, $\mathbb{m} > 0$ and output rises in θ^i.*

3 International Capital Mobility

Under full capital mobility, individuals are allowed to lend and make direct investments globally. Without loss of generality, we assume that country N is more financially developed, $0 \leq \theta^S < \theta^N \leq \bar{\theta}$. We first solve the equilibrium allocation analytically and show that the steady-state patterns of international capital flows under full capital mobility in our model are consistent with the three empirical facts mentioned in the introduction.

Let Φ_t^i and Ω_t^i denote the aggregate outflows of financial capital and FDI from country i in period t, respectively, with negative values indicating capital inflows. Financial capital outflows reduce the aggregate credit capital used for domestic investment, $D_t^{i,h} = (1-\eta)s_t^{i,h} - \Phi_t^i$, while FDI outflows reduce the aggregate equity capital used for domestic investment, $D_t^{i,e} = \eta s_t^{i,e} - \Omega_t^i$. Therefore, FDI flows raise the aggregate credit demand in

[4] This result can be proved by using the Jensen's Inequality theorem. See appendix B.1.

[5] von Hagen and Zhang (2009, 2011) develop a model with heterogenous projects and show that financial frictions distort aggregate investment among projects with different productivity and thus, aggregate output is inefficiently low. Although output is distorted through different channels in the current paper and in von Hagen and Zhang (2009, 2011), the implications of capital mobility are identical.

the host country and reduce that in the parent country. With these changes, the analysis in section 2 carries through for the cases of capital mobility, due to the (log-)linearity of preferences, projects, and borrowing constraints. Financial capital flows equalize loan rates and FDI flows equalize equity rates in the two countries. Credit and equity markets clear in each country as well as globally. To summarize,

$$\Phi_t^S + \Phi_t^N = \Omega_t^S + \Omega_t^N = 0, \quad R_t^{S,h} = R_t^{N,h} = R_t^{*,h}, \quad R_t^{S,e} = R_t^{N,e} = R_t^{*,e},$$
$$K_{t+1}^i = (1-\eta)s_t^{i,h} + \eta s_t^{i,e} - (\Phi_t^i + \Omega_t^i) = \lambda_t^i(\eta s_t^{i,e} - \Omega_t^i) \ .$$

The remaining conditions for market equilibrium in each country are the same as under IFA.

At the world level, aggregate revenue of capital in period $t+1$ is distributed to households and entrepreneurs as the returns to their respective savings,

$$(1-\eta)R_t^{*,h} \sum_{i\in\{N,S\}} s_t^{i,h} + \eta R_t^{*,e} \sum_{i\in\{N,S\}} s_t^{i,e} = \sum_{i\in\{N,S\}} R_{t+1}^i K_{t+1}^i = \rho L \sum_{i\in\{N,S\}} \omega_{t+1}^i.$$

Substituting away $s_t^{i,j}$ with equation (5), we get the world-level reward splitting rule,

$$(1-\eta)R_t^{*,h} + \eta R_t^{*,e} = \frac{\omega_{t+1}^w}{\omega_t^w}\mathbb{R}, \quad \text{where} \quad \omega_t^w \equiv \frac{\omega_t^S + \omega_t^N}{2}. \tag{21}$$

Lemma 2. *Under full capital mobility, there is a unique and stable steady state.*[6]

Let X_{FCM} denote the steady-state value of variable X under full capital mobility. Define a time-invariant auxiliary variable $\mathcal{Z}_{FCM}^i \equiv \frac{(\psi_{FCM}^i - \psi_{IFA}^i)\frac{\mathbb{m}+\mathbb{B}^i}{\mathbb{m}+1}}{(\psi_{FCM}^i - \psi_{IFA}^i)\frac{\mathbb{m}+\mathbb{B}^i}{\mathbb{m}+1} + \mathbb{B}^i\frac{\eta}{(1-\eta)}} R_{IFA}^{i,e}$. The solution to the equilibrium allocation is,

$$R_t^{i,e} = \frac{\omega_{t+1}^w}{\omega_t^w}(R_{IFA}^{i,e} - \mathcal{Z}_{FCM}^i), \tag{22}$$

$$R_t^{i,h} = \frac{\omega_{t+1}^w}{\omega_t^w}\left(R_{IFA}^{i,h} + \frac{\eta}{1-\eta}\mathcal{Z}_{FCM}^i\right), \tag{23}$$

$$\psi_t^i = \psi_{FCM}^i = \frac{(1-\theta^i)R_{FCM}^{*,h}}{R_{FCM}^{*,e}} + \theta^i, \tag{24}$$

$$\omega_{t+1}^i = \left(\frac{1-\theta^i}{R_t^{*,e}} + \frac{\theta^i}{R_t^{*,h}}\right)^\rho, \tag{25}$$

$$\Phi_t^i = (1-\eta)\beta\omega_t^i\left(1 - \frac{\omega_{t+1}^i}{\omega_t^i}\frac{R_{IFA}^{i,h}}{R_t^{*,h}}\right), \tag{26}$$

$$\Omega_t^i = \eta\beta\omega_t^i\left(1 - \frac{\omega_{t+1}^i}{\omega_t^i}\frac{R_{IFA}^{i,e}}{R_t^{*,e}}\right), \tag{27}$$

$$\Omega_t^i + \Phi_t^i = \beta\omega_t^i\left\{1 - \frac{\omega_{t+1}^i}{\omega_t^i}\left[\eta\frac{R_{IFA}^{i,e}}{R_t^{*,e}} + (1-\eta)\frac{R_{IFA}^{i,h}}{R_t^{*,h}}\right]\right\}. \tag{28}$$

[6] Zhang (2013) compares the stability property under financial integration in the current setting and in the setting of Matsuyama (2004). The symmetry breaking does not arise in the current setting.

Under full capital mobility, the steady-state interest rates and capital flows are,

$$R^{i,e}_{FCM} = R^{i,e}_{IFA} - \mathcal{Z}^i_{FCM}, \quad R^{i,h}_{FCM} = R^{i,h}_{IFA} + \frac{\eta}{1-\eta}\mathcal{Z}^i_{FCM}, \tag{29}$$

$$\Phi^i_{FCM} = (1-\eta)\beta\omega^i_{FCM}\left(1 - \frac{R^{i,h}_{IFA}}{R^{*,h}_{FCM}}\right) = \eta\beta\omega^i_{FCM}\frac{\mathcal{Z}^i_{FCM}}{R^{*,h}_{FCM}}, \tag{30}$$

$$\Omega^i_{FCM} = \eta\beta\omega^i_{FCM}\left(1 - \frac{R^{i,e}_{IFA}}{R^{*,e}_{FCM}}\right) = -\eta\beta\omega^i_{FCM}\frac{\mathcal{Z}^i_{FCM}}{R^{*,e}_{FCM}}, \tag{31}$$

$$\Phi^i_{FCM} + \Omega^i_{FCM} = \eta\beta\omega^i_{FCM}\mathcal{Z}^i_{FCM}\frac{(R^{*,e}_{FCM} - R^{*,h}_{FCM})}{R^{*,e}_{FCM}R^{*,h}_{FCM}}. \tag{32}$$

Proposition 2. *In the steady state under full capital mobility, the world interest rates are $R^{*,h}_{FCM} \in (R^{S,h}_{IFA}, R^{N,h}_{IFA})$ and $R^{*,e}_{FCM} \in (R^{N,e}_{IFA}, R^{S,e}_{IFA})$, implying the partial convergence in the relative loan rate, $\psi^S_{IFA} < \psi^S_{FCM} < \psi^N_{FCM} < \psi^N_{IFA}$. Aggregate output is higher in country N than in country S. The gross and net capital flows are $\Phi^S_{FCM} > 0 > \Phi^N_{FCM}$, $\Omega^S_{FCM} < 0 < \Omega^N_{FCM}$, and $\Phi^S_{FCM} + \Omega^S_{FCM} > 0 > \Phi^N_{FCM} + \Omega^N_{FCM}$. The gross international investment return sums up to zero in each country, $\Phi^i_{FCM}R^{*,h}_{FCM} + \Omega^i_{FCM}R^{*,e}_{FCM} = 0$.*

With a higher level of financial development, country N imports financial capital, exports FDI, and receives net capital inflows. Since the rate of return on its foreign asset (FDI outflow) exceeds the interest rate paid for its foreign liability (financial capital inflow), $R^{*,e}_{FCM} > R^{*,h}_{FCM}$, country N receives a positive net international investment income, $\Phi^N_{FCM}(R^{*,h}_{FCM} - 1) + \Omega^N_{FCM}(R^{*,e}_{FCM} - 1) = \Phi^N_{FCM}R^{*,h}_{FCM} + \Omega^N_{FCM}R^{*,e}_{FCM} - (\Phi^N_{FCM} + \Omega^N_{FCM}) = -(\Phi^N_{FCM} + \Omega^N_{FCM}) > 0$, despite its negative international investment positions, $\Phi^N_{FCM} + \Omega^N_{FCM} < 0$. Thus, our model predictions are consistent with the three empirical observations mentioned in the introduction.

In the following, we use this analytical framework to address the aggregate implications of capital mobility. Subsections 3.1 and 3.2 focus on the output and welfare implications, if both countries are initially in the steady state under IFA before capital mobility is allowed from period $t = 0$ on. Subsection 3.3 analyzes how the patterns of capital flows may change or even reverse along its convergence path if country S is initially below its steady state under IFA.

3.1 The Output Implications of Full Capital Mobility

Let us start with the case of inelastic saving ($\mathbb{m} = 0$). Since the output implications are qualitatively identical in the case of either $\epsilon = 0$ or $\beta = 1$, we focus on the case of $\epsilon = 0$ as follows. Individuals save a fraction β of labor income when young and financial frictions do not affect output under IFA, $Y^i_{IFA} = \frac{1}{1-\alpha}\mathbb{R}^{-\rho}$. Upon full capital mobility in period $t = 0$, aggregate saving is the same as under IFA, $S^i_0 = \beta\omega^i_0 = \beta\omega^i_{IFA}$, and net capital flows reallocate the funds for investment from country S to country N, which has two consequences on output. First, output in country S (N) is lower (higher) in period $t = 1$ than before; second, given the concave aggregate production with respect to capital at the country level, world output is lower than under IFA, because net capital flows are in equilibrium from country S where the MPK is high to country N where the MPK is low.

Corollary 1. *In the case of interest-inelastic saving, from period $t = 1$ on, output in country S and world output are lower than in the steady state under IFA.*

Under IFA, financial frictions do not distort investment so that steady-state output is the same in the two countries, even though they differ in the level of financial development. Capital mobility breaks the initial symmetry in the two countries in the sense that net capital flows are "uphill" in the new steady state, leading to world output losses, which is also present in Matsuyama (2004). This is a typical result of the theory of second best. In the presence of domestic financial frictions, capital account liberalization causes capital to flow to the country with the higher interest rates rather than to the country with the higher MPK. Obviously, the output responses at the country and the world level depends on the size of net capital flows, $|\Omega_t^i + \Phi_t^i|$.

In the case of elastic saving ($\mathbb{m} > 0$), besides the direct impact on output through cross-country capital reallocation, full capital mobility also has an indirect impact on output through aggregate saving. Take country S as an example. Financial capital outflows reduce the domestic credit supply and FDI inflows raise the domestic credit demand. Both push up the loan rate and domestic households save more. Net capital outflows reduce the domestic credit supply and the rising competition from foreign entrepreneurs reduces the MPK. Both push down the equity rate and domestic entrepreneurs save less. The opposite applies for country N. Thus, changes in aggregate savings depend on the size of gross capital flows, $|\Omega_t^i| + |\Phi_t^i|$. The aggregate saving rate in country i is,

$$\frac{S_t^i}{\omega_t^i} = \frac{(1-\eta)s_t^{i,h} + \eta s_t^{i,e}}{\omega_t^i} = \beta - (1-\beta)\epsilon \frac{\omega_{t+1}^i}{\omega_t^i}\left(\frac{1-\eta}{R_t^{*,h}} + \frac{\eta}{R_t^{*,e}}\right). \tag{33}$$

As shown in subsection 2.3, the aggregate saving rate is higher in the more financially developed country under IFA, $\frac{S_{IFA}^N}{\omega_{IFA}^N} > \frac{S_{IFA}^S}{\omega_{IFA}^S}$. Full capital mobility leads to the cross-country equalization of the interest rates, implying that the aggregate saving rates also equalize in the steady state, i.e., $\frac{S_{IFA}^S}{\omega_{IFA}^S} < \frac{S_{FCM}^S}{\omega_{FCM}^S} = \frac{S_{FCM}^N}{\omega_{FCM}^N} < \frac{S_{IFA}^N}{\omega_{IFA}^N}$, and thus, full capital mobility also indirectly affects output in the two countries through its effects on savings.

Proposition 3. *Let $\kappa \equiv \frac{1-\sqrt{1-4\mathbb{m}^2(1-\eta)\eta}}{2} < \frac{1}{2}$. For $\eta \in (0, 0.5)$, there are three scenarios:*[7]

1. *if $\mathbb{m} \in (0,1)$, $Y_{FCM}^S > Y_{IFA}^S$ for $\theta^S \in (0,\kappa)$, and $Y_{FCM}^N > Y_{IFA}^N$ for $\theta^N \in (\kappa, \bar{\theta})$;*

[7] The characterization for the case of $\eta \in (0.5, 1)$ is slightly different and available in the proof.

2. *if* $\mathbb{m} \in (1, \frac{1}{2\sqrt{\eta(1-\eta)}})$, $Y^S_{FCM} > Y^S_{IFA}$ *for* $\theta^S \in (0, \kappa) \cup (1-\kappa, \bar{\theta})$, *and* $Y^N_{FCM} > Y^N_{IFA}$ *for* $\theta^N \in (\kappa, 1-\kappa)$;

3. *if* $\mathbb{m} > \frac{1}{2\sqrt{\eta(1-\eta)}}$, $Y^S_{FCM} > Y^S_{IFA}$.

As explained above, a larger $\mathbb{m}$ implies that aggregate saving is more interest-elastic. The rise in aggregate saving in country S is more likely to exceed net capital outflows so that domestic investment can be higher than under IFA and so can output in country S.

Full capital mobility affects world output through both the direct and the indirect channel. First, "uphill" net capital flows directly lead to cross-country capital reallocation, which reduces world output. Second, both financial capital and FDI flows indirectly affect aggregate saving at the country level. For $\theta^S < \theta^N$, saving is more elastic in country S so that the rise in aggregate saving of country S dominates the decline in country N. Thus, world saving rises and so does world output. The size of the negative, direct effect depends on the size of net capital flows, while the size of the positive, indirect effect depends on the size of the gross capital flows. Thus, it is possible that full capital mobility raises world output, despite "uphill" net capital flows. Since the indirect effect essentially results from the elastic saving, its size depends on the interest elasticity of aggregate saving. According to Lemma 1, the higher $\mathbb{m}$, the more elastic the aggregate saving, the larger the indirect effect, the more likely full capital mobility raises world output.

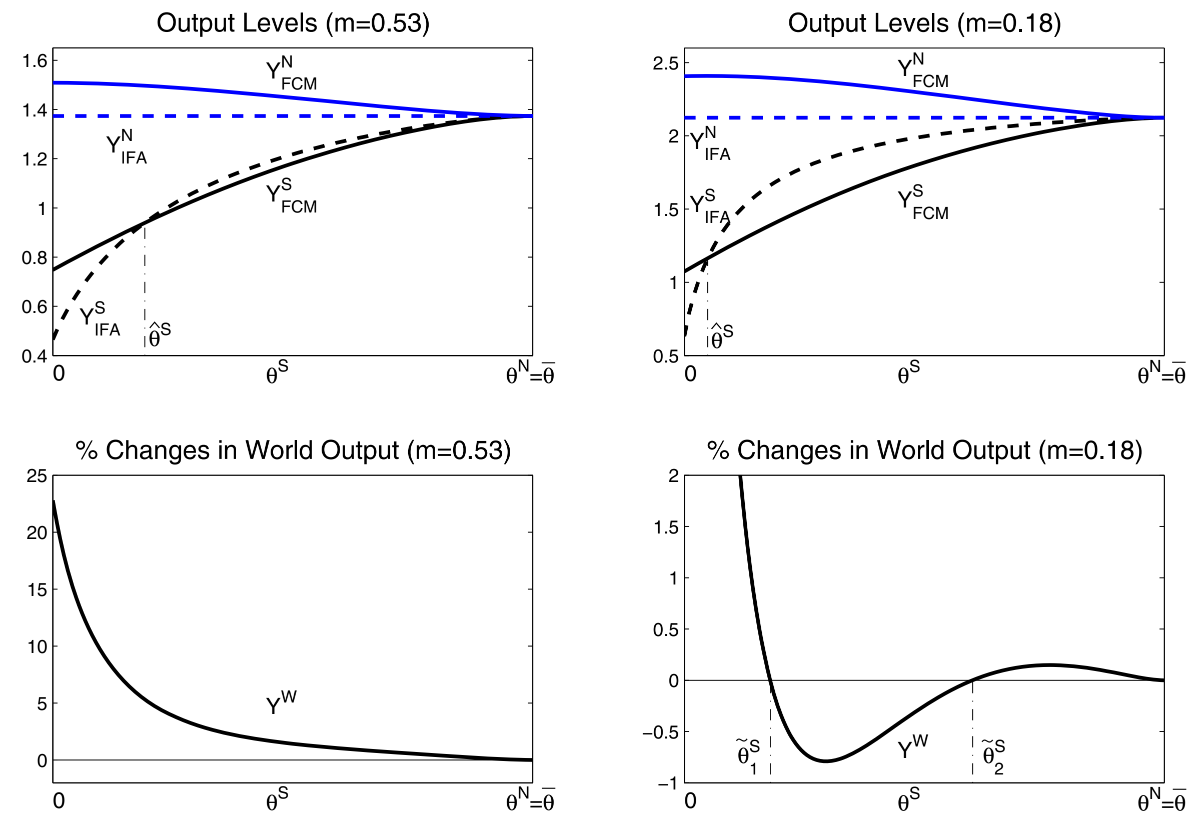

Figure 1: Comparing Steady-State Output under IFA and under Full Capital Mobility

We present a numerical example for illustration. We set the population share of entrepreneurs at $\eta = 10\%$, the share of labor income in aggregate output, $1-\alpha = 64\%$, and the patience factor $\beta = 0.4$. We consider two alternative cases with $\epsilon \in \{1, 0.2\}$ and correspondingly, $\mathbb{m} \in \{0.53, 0.18\}$.

Given $\theta^N = \bar{\theta}$, the upper-left and upper-right panels of figure 1 show the steady-state output levels in the two countries under full capital mobility versus under IFA, with $\theta^S \in [0, \bar{\theta})$ on the horizontal axes. Given the parameter values, full capital mobility strictly raises steady-state output in country N, while it raises steady-state output in country S if θ^S is below the threshold value $\hat{\theta}^S$. The lower-left and lower-right panels show the percentage changes of steady-state world output under full capital mobility versus under IFA, $\left(\frac{Y^w_{FCM}}{Y^w_{IFA}} - 1\right) 100$. For a large $\mathbb{m}$, the output gains in country N always exceed the output losses (if any) in country S so that world output is higher than under IFA; for a small $\mathbb{m}$, there exist two threshold values $\tilde{\theta}^S_1$ and $\tilde{\theta}^S_2$ such that, for $\theta^S \in (\tilde{\theta}^S_1, \tilde{\theta}^S_2)$, full capital mobility reduces steady-state world output, while, for $\theta^S \in (0, \tilde{\theta}^S_1) \cup (\tilde{\theta}^S_2, \bar{\theta})$, it raises steady-state world output.[8]

3.2 The Welfare Implications of Full Capital Mobility

Given the OLG structure, the model economy converges rather quickly to the new steady state upon allowing full capital mobility in period $t = 0$. Thus, we focus on the short-run and the long-run welfare impacts of full capital mobility by analyzing the welfare responses of the generations born in period $t = 0$ and $t \to \infty$, respectively.

When young, an individual receives the labor income, consumes a fraction $(1-\beta)$ of lifetime income, and saves the rest; when old, it consumes the financial income and the labor income. Its lifetime welfare is represented by the indirect utility,

$$u^{i,j}_t = \mathbb{W}^{i,j}_t (R^{i,j}_t)^\beta = \left(\omega^i_t + \epsilon \frac{\omega^i_{t+1}}{R^{i,j}_t}\right) (R^{i,j}_t)^\beta. \tag{34}$$

As shown above, full capital mobility affects the interest rates and output in both countries. Accordingly, the individual's welfare is affected through three channels, i.e., the financial return channel, $(R^{i,j}_t)^\beta$, the human wealth (the present value of future labor income) channel, $\epsilon \frac{\omega^i_{t+1}}{R^{i,j}_t}$, and the (current) labor income channel, ω^i_t.

- The smaller β is, the less patient the individual is, the less it saves when young, the less the lifetime welfare depends on the financial return. Thus, impatience dampens the welfare impacts of full capital mobility via the financial return channel.

- The larger ϵ is, the larger the future labor income is, the more the lifetime welfare depends on the human wealth, which is affected positively by the future labor income

[8] Appendix B.3 shows the output implications under the alternative scenarios of capital mobility.

and negatively by the relevant interest rate. Thus, a larger future labor endowment amplifies the welfare impacts via the human wealth channel.

- Allowing $\beta < 1$ and $\epsilon > 0$ leads to $\mathbb{m} > 0$ and interest-elastic saving so that full capital mobility may raise or reduce output in country S and globally, depending on θ^S. Thus, the presence of impatience and a positive future labor endowment may magnify or dampen the welfare impacts via the two labor income channels.[9]

In the following, we focus on the welfare impacts of full capital mobility in the presence of output gains in country S, i.e., $\beta < 1$, $\epsilon > 0$, $\theta^S < \hat{\theta}$, and $\theta^N = \bar{\theta}$.

Consider entrepreneurs in country S first. For the generation born in period $t = 0$, the decline in the equity rate, $R_0^{S,e} < R_{IFA}^{S,e}$, and the rise in labor income, $\omega_1^S > \omega_0^S$, tends to raise their welfare through the human wealth channel; the decline in the equity rate tends to reduce their welfare through the financial return channel. The smaller β, the smaller the financial return effect; the larger ϵ, the stronger the human wealth effect. In these cases, they are more likely to be better off. For the generation born in period $t \to \infty$, the output gains, $\omega_{FCM}^S > \omega_{IFA}^S$, tend to raise their welfare additionally through two labor income channels. The larger $\mathbb{m}$ is, the larger the output gains, the stronger the welfare gains via two labor income channels, the more likely they are better off.

Let us then consider households in country S. For the generation born in period $t = 0$, the rise in the loan rate, $R_0^{S,h} > R_{IFA}^{S,h}$, tends to raise their welfare through the financial return channel; the rises in the loan rate and labor income affect the human wealth in the opposite way. Rewrite their indirect utility as $u_0^{S,h} = \omega_0^S (R_t^{i,j})^{\beta} + \epsilon \omega_1^S (R_t^{i,j})^{\beta-1}$. Overall, the larger β, the more patient they are, the more the financial return matters for their welfare the more likely they are better off. For generation born in period $t \to \infty$, the output gains raise their welfare through the two labor income channels. As mentioned above, the larger $\mathbb{m}$ is, the larger the output gains, the more likely they are better off.

The welfare implications for country N can be addressed by the same logic. Given $\theta^N = \bar{\theta}$, full capital mobility raises output in country N. For the generation born in period $t = 0$, the changes in the interest rates tend to reduce (raise) the welfare of households (entrepreneurs) through the financial return channel, while the rise in labor income tends to make everyone better off through the human wealth channel. For the generation born in period $t \to \infty$, the output gains tend to make everyone better off through the two labor income channels. Similar as mentioned for country S, the magnitudes of the financial return effect and the labor income effects are affected by β and ϵ.

In short, full capital mobility affects welfare at the individual level through the three channels and the net welfare impact depends on the relative size of different factors. We show the results in the numerical example with the same parameter values as in subsection 3.1. In particular, we set $\beta = 0.4$ and $\epsilon = 1$. Figure 2 shows the percentage differences in

[9]See appendix B.4 for detailed welfare analysis in the case of inelastic saving.

welfare under full capital mobility versus under IFA. The dashed lines show the welfare changes for generation $t = 0$, $\left(\frac{u_0^{i,j}}{u_{IFA}^{i,j}} - 1\right) 100$, and the solid lines for generation $t \to \infty$, $\left(\frac{u_{FCM}^{i,j}}{u_{IFA}^{i,j}} - 1\right) 100$. Changes in the welfare of generation $t = 0$ ($t \to \infty$) reflect the short-run (long-run) welfare implications. The upper (lower) panels show the relevant variables in country S (N) and the horizontal axes denote $\theta^S \in (0, \bar{\theta})$.

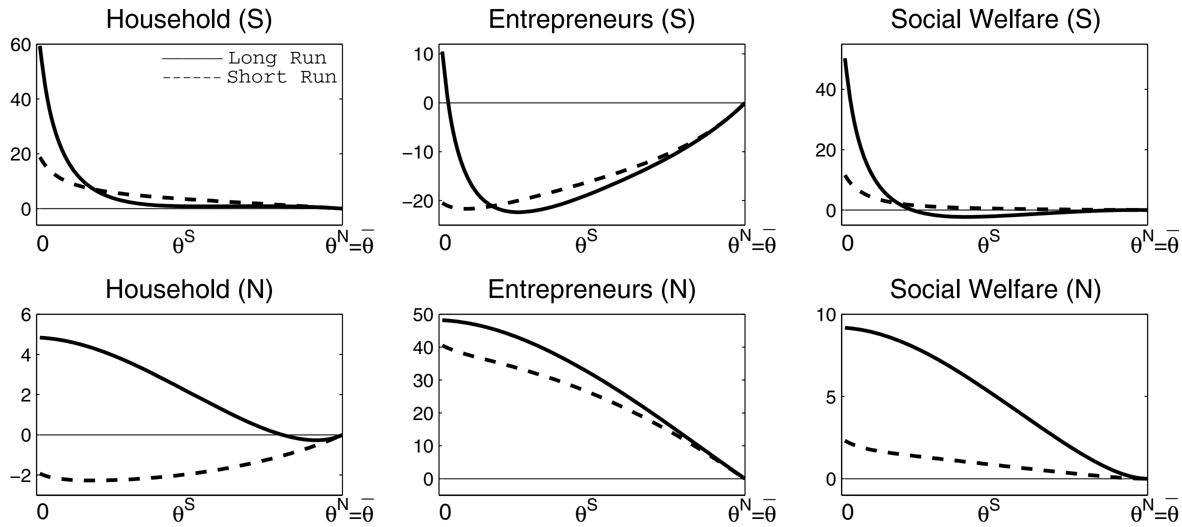

Figure 2: Percentage Changes in the Short-Run and Long-Run welfare: $\epsilon = 1$ and $\beta = 0.4$.

As we are interested in the parameter region with output gains, let us focus on the interval with θ^S close to zero. According to the lower-left panel, the decline in the loan rate dominates the rise in the human wealth so that households of generation $t = 0$ in country N are worse off than under IFA; for generation $t \to \infty$, the rise in the labor incomes in both periods of life dominates the decline in the loan rate so that households are better off than under IFA. Thus, full capital mobility has opposite welfare effects for individuals belonging to different generations. According to the lower-middle panel, the rise in the equity rate and in human wealth makes entrepreneurs of all generations better off. Thus, full capital mobility has opposite welfare effects on households and entrepreneurs in generation $t = 0$. Such opposite welfare impacts in the intergenerational and intergenerational dimensions are also present in country S.

Define the social welfare as the weighted sum of individual welfare, $U_t^i = (1-\eta)u_t^{i,h} + \eta u_t^{i,e}$. The dashed line and the solid line in the upper-right (lower-right) panel show the percentage changes in the social welfare of generation $t = 0$ and $t \to \infty$ in country S (N). Despite opposite welfare effects on individuals in the same generation, full capital mobility raises social welfare both in the short run and in the long run. Essentially, the output gains are key to social welfare gains. In the current setting, full capital mobility receives support from entrepreneurs and opposition from households of generation $t = 0$ in country N. One can make Pareto improvements by taxing entrepreneurs to make households in generation $t = 0$ as well off as under IFA. Similar results hold for country S.

3.3 Full Capital Mobility and Economic Convergence

The analysis in subsections 3.1 and 3.2 is based on the assumption that both countries are initially in the steady state under IFA before capital mobility is allowed in period $t = 0$. In this subsection, we assume that country N is initially in the steady state, $K_0^N = K_{IFA}^N$, but country S is below the steady state under IFA, $K_0^S < K_{IFA}^S$. By doing so, we address the interactions between international capital flows, domestic capital accumulation, and financial development along the convergence path of country S.

As shown in subsections 2.1-2.3, a lower level of capital $K_0^S < K_{IFA}^S \leq K_{IFA}^N = K_0^N$ tends to keep the interest rates higher in country S through the neoclassical effect, while a lower level of financial development $\theta^S < \theta^N$ tends to keep the loan rate lower and the equity rate higher in country S through the financial-underdevelopment effect. Thus, the equity rate is initially higher in country S so that it receives FDI inflows in period $t = 0$, while the loan rate can be initially higher or lower in country S, depending on the relative size of the neoclassical effect and the financial-underdevelopment effect. Thus, the direction of financial capital flows is ambiguous.

Lemma 3. *Given $0 \leq \theta^S < \theta^N$, there exists two threshold values $\underline{K}_0^S < \bar{K}_0^S < K_{FCM}^S$. If $K_0^S < \underline{K}_0^S$, $\Phi_0^S < 0$; if $K_0^S > \underline{K}_0^S$, $\Phi_0^S > 0$. If $K_0^S < \bar{K}_0^S$, $\Phi_0^S + \Omega_0^S < 0$; if $K_0^S > \bar{K}_0^S$, $\Phi_0^S + \Omega_0^S > 0$. Both $\underline{K}_0^S$ and $\bar{K}_0^S$ increase in θ^S.*

The intuitions behind Lemma 3 can be shown in a numerical exercise with the same parameter values as in subsection 3.2. Take the case of $\theta^S = 0.4$ as an example. In the left panel of figure 3, the dashed curve, the dash-dot curve, and the solid curve show the levels of financial capital flows, FDI flows, and net capital flows in period $t = 0$ as the functions of K_0^S, respectively. The horizontal axis denotes $K_0^S \in (0, K_{IFA}^S)$. The two threshold values, $\underline{K}_0^S$ and $\bar{K}_0^S$, are defined as the level of initial capital in country S where $\Phi_0^S = 0$ and $\Phi_0^S + \Omega_0^S = 0$.

Let us start with $K_0^S < \underline{K}_0^S$. Such a sufficiently low level of capital ensures that the neoclassical effect dominates the financial underdevelopment effect and the loan rate is initially higher in country S. Besides FDI inflows, country S also receives financial capital inflows in period $t = 0$, i.e., $\Phi_0^S, \Omega_0^S < 0$. In the right panel of figure 3, the thick solid curve and the dashed curve show the value of capital in country S in period $t = 1$ under full capital mobility, $K_{1,FCM}^S$, and under IFA, $K_{1,IFA}^S$, respectively; the thin solid curve shows the aggregate saving in country S under full capital mobility, $S_{0,FCM}^S$, and the thin solid line is the 45° line. The horizontal axis denotes $K_0^S \in (0, K_{IFA}^S)$. Under IFA, domestic investment is financed by aggregate saving, $K_{1,IFA}^S = S_{0,IFA}^S$. Under full capital mobility, domestic investment is the difference between aggregate saving and net capital outflows, $K_{1,FCM}^S = S_{0,FCM}^S - (\Phi_0^S + \Omega_0^S)$. Besides directly raising domestic investment, financial capital and FDI inflows indirectly depress aggregate savings through the interest rate channels, $S_{0,FCM}^S < S_{0,IFA}^S$. Given $\theta^S = 0.4$, the interest elasticity of aggregate saving is

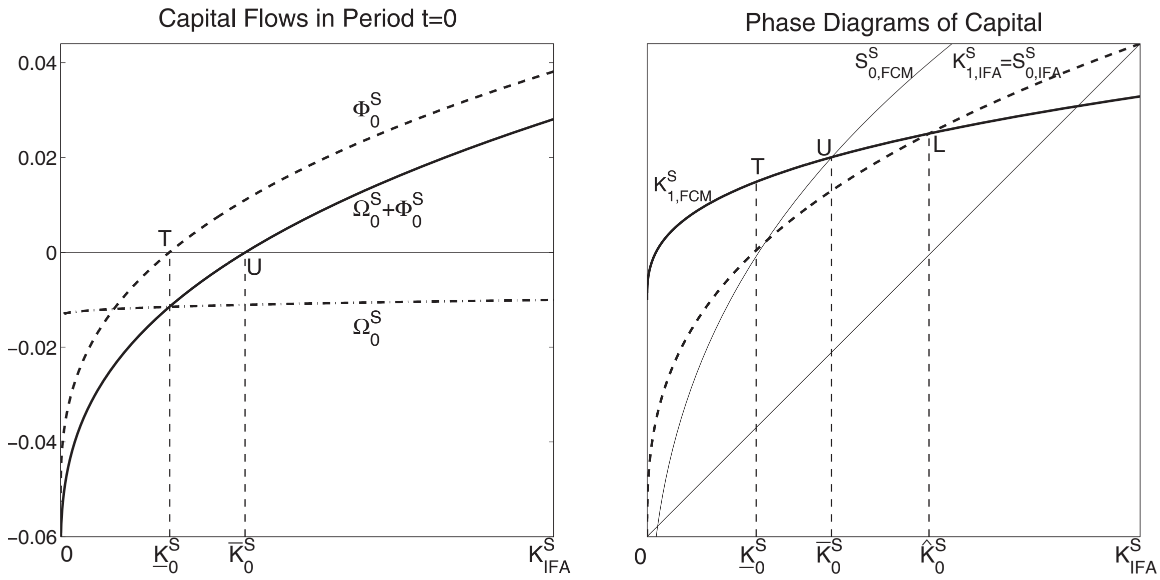

Figure 3: Patterns of Capital Flows and Economic Convergence

small so that the decline in aggregate savings is overcompensated by net capital inflows. Thus, domestic investment is higher than under IFA, $K_{1,FCM}^S > K_{1,IFA}^S$, and full capital mobility speeds up the convergence in country S.

If $K_0^S \in (\underline{K}_0^S, \bar{K}_0^S)$, the neoclassical effect is dominated by the financial underdevelopment effect so that the loan rate is initially lower in country S. Thus, country S witnesses financial capital outflows and FDI inflows in period $t = 0$, i.e., $\Phi_0^S > 0 > \Omega_0^S$. Given $K_0^S < \bar{K}_0^S$, the neoclassical effect is still strong so that the loan rate is initially a bit lower in country S. Thus, the size of financial capital outflows is small and dominated by FDI inflows. So, country S still receives net capital inflows, $\Phi_0^S + \Omega_0^S < 0$. Furthermore, FDI inflows depress entrepreneurial saving while financial capital outflows raise household saving through the interest rate channel. If K_0^S is slightly higher than $\underline{K}_0^S$, the loan rate is slightly lower in country S and full capital mobility only leads to a small rise in the loan rate and household saving. Thus, the decline in entrepreneurial saving dominates so that $S_{0,FCM}^S < S_{0,IFA}^S$. If $K_0^S \gg \underline{K}_0^S$, the rise in household saving dominates so that $S_{0,FCM}^S > S_{0,IFA}^S$. As net capital inflows always raise domestic investment in period $t = 0$, full capital mobility speeds up the convergence in country S.

If $K_0^S > \bar{K}_0^S$, the neoclassical effect is significantly dominated by financial underdevelopment effect so that financial capital outflows exceed FDI inflows and country S has net capital outflows in period $t = 0$. As mentioned in the previous case, financial capital outflows rise in K_0^S and so do net capital outflows and aggregate saving. As shown in the right panel of figure 3, there exists a threshold value $\hat{K}_0^S$ such that, for $K_0^S \in (\bar{K}_0^S, \hat{K}_0^S)$, the rise in aggregate saving dominates net capital outflows so that domestic investment in period $t = 0$ is still higher than under IFA; for $K_0^S \in (\hat{K}_0^S, K_{IFA}^S)$, domestic investment is lower than under IFA and full capital mobility slows down capital accumulation. Eventually, country S converges to a steady state with a lower level of capital.

Essentially, it is elastic saving that creates the possibility of output gains in the presence of net capital outflows. If saving is interest-inelastic, i.e., $\mathbb{m} = 0$, net capital outflows directly reduce domestic investment in period $t = 0$ without affecting saving. Thus, domestic investment is lower than under IFA. In other words, $\hat{K}_0^S$ coincides with $\bar{K}_0^S$.

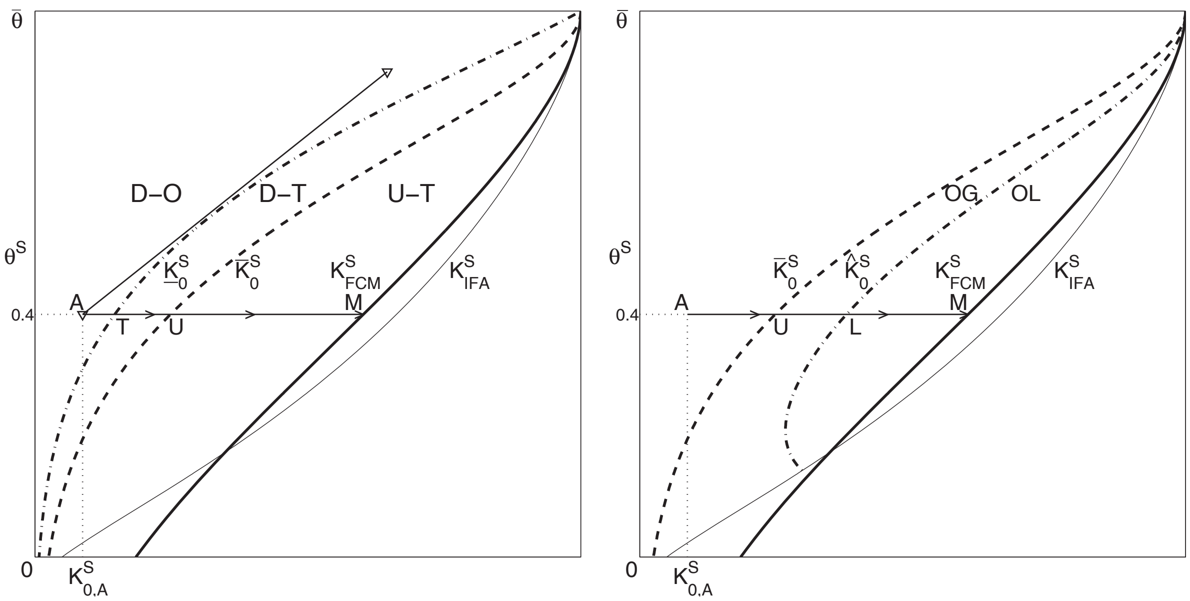

Figure 4: Threshold Values under Full Capital Mobility

In the left panel of figure 4, the dash-dotted curve and the dashed curve show two threshold values, $\underline{K}_0^S$ and $\bar{K}_0^S$, as the functions of θ^S in the space of (K^S, θ^S). The solid thin and thick curves show the steady-state value of capital under IFA and under full capital mobility, K_{IFA}^S and K_{FCM}^S, as the functions of θ^S, respectively. Given the assumption of $\theta^S \in (0, \bar{\theta})$ and $K_0^S \in (0, K_{IFA}^S)$, only the points to the left of the thin solid curve denoted by K_{IFA}^S are the relevant starting points for our analysis.

Given $\theta^S = 0.4$ and the initial value of K_0^S as represented by point A, K_t^S rises over time along the flat path and sequentially crosses the two threshold values as represented by points T and U where financial capital flows and net capital flows change directions. Region **D-O** refers to the region with **D**ownhill net flows and **O**ne-way gross flows, region **D-T** refers to the region with **D**ownhill net flows and **T**wo-way gross flows, and region **U-T** refers to the region with **U**phill net flows and **T**wo-way gross flows.

In the right panel of figure 4, the dashed curve and the dash-dotted curve show two threshold value, $\bar{K}_0^S$ and $\hat{K}_0^S$, as the functions of θ^S in the space of (K^S, θ^S), respectively. If country S starts from point A, given a constant $\theta^S = 0.4$, full capital mobility creates output gains there if K_t^S is in region OG (the region to the left of the dash-dotted curve); if K_t^S enters in region OL (the region between the dash-dotted curve and the thin solid curve), full capital mobility leads to output losses.

Since country S always receives FDI inflows, the direction of net capital flows along the convergence path depends essentially on the direction and the size of financial capital flows. Our model gives two theoretical predictions on the direction of financial capital flows. First, given the level of financial development, θ^S, the lower the initial capital stock, K_0^S, the stronger the neoclassical effect, the faster the economic growth rate, and the more likely country S receives financial and net capital inflows. So far, our analysis is based on the time-invariant level of financial development. Suppose that θ^S rises over time, as shown by the upward-sloping convergence path starting from point A in the left panel of figure 4. Our second prediction is that, the faster the rise in θ^S (the steeper the convergence path from point A), the stronger the financial development effect, the higher the loan rate in country S, the more likely it receives financial and net capital inflows.

3.4 Some Suggestive Empirical Evidence

It is beyond the scope of this paper to provide a full-fledged structural estimation for the determination of capital flows in emerging economies. Instead, we offer some suggestive evidence supporting the two predictions mentioned at the end of subsection 3.3.

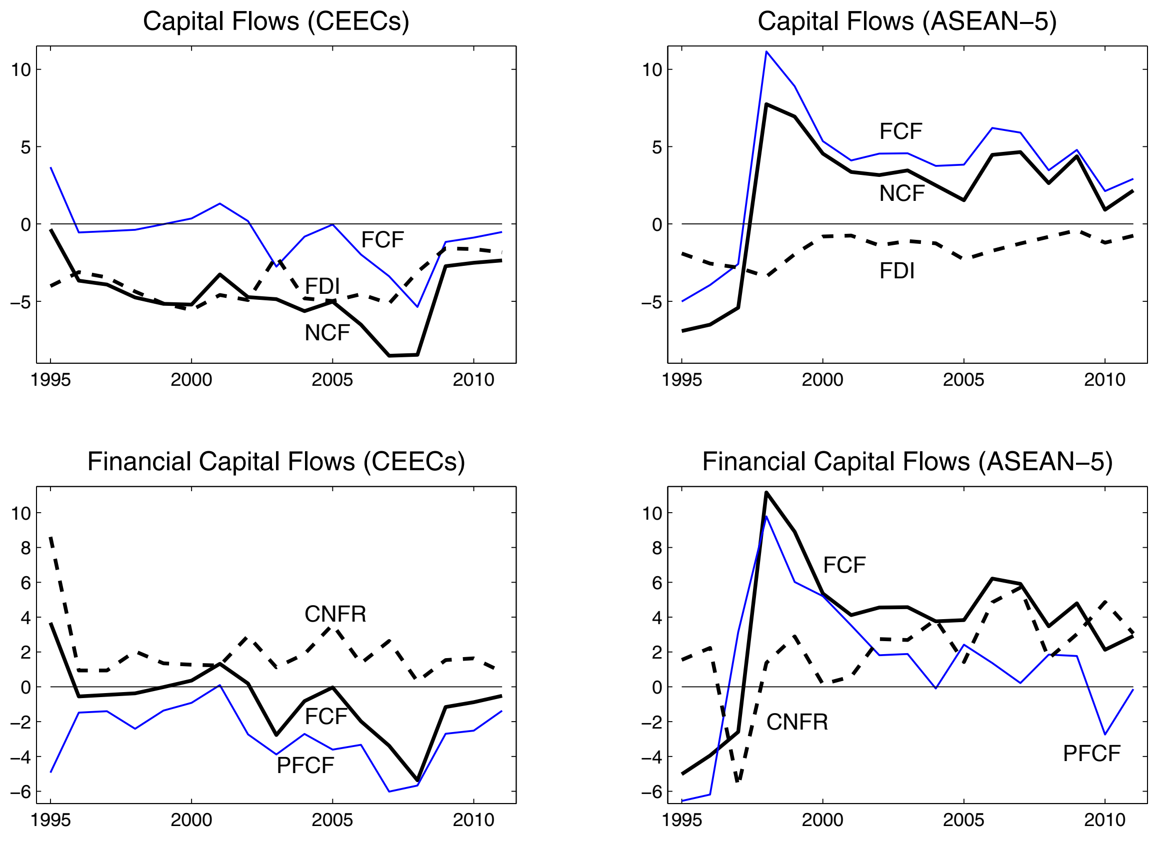

Figure 5: Capital Flows in Percentage of GDP: CEECs versus ASEAN-5

Lane and Milesi-Ferretti (2007a) show that, during the period from 1995-2004, the group of Central and Eastern European countries (CEECs) on average had current account deficits of over 5.5% of GDP, while the group of emerging Asian economies (EAEs) on average had current account surpluses of over 3% of GDP. Abiad, Leigh, and Mody (2009) obtain similar results. The upper panels of figure 5 show financial capital flows (denoted by FCF), FDI flows (denoted by FDI), and net capital flows (denoted by NCF) of CEECs and ASEAN-5 as a percentage of GDP between 1995-2011.[10] Note that the positive values represent capital outflows. CEECs received net capital inflows, FDI inflows, and financial capital inflows in most years. ASEAN-5 received FDI inflows but it had financial capital outflows and net capital outflows after 1998. The lower panels of figure 5 decompose financial capital flows as a percentage of GDP into private financial capital flows (denoted by PFCF), the empirical counterpart to the financial capital flows in our model, and changes in net foreign reserves (denoted by CNFR). Note that a positive value of CNFR represents an increase in net foreign reserves. Except the period of economic transition in 1995-1996, CEECs had the relatively stable rises in net foreign reserves. As widely documented in the literature, the net foreign reserves in ASEAN-5 rose at an increasing speed after the 1997 Asian financial crisis. CEECs received private financial capital inflows at the increasing speed in 2001-2008, while the ASEAN-5 witnessed private financial capital outflows in the most of the sample period after the 1997 Asian financial crisis.

According to our theoretical predictions at the end of subsection 3.3, the higher the economic growth rate (the neoclassical effect) and the faster the rise in the level of financial development (the financial development effect), the more likely an economy is to receive financial capital inflows. Following the literature (Arezki and Brückner, 2012; Chinn, Eichengreen, and Ito, 2013), the level of financial development is measured by domestic credit to private sector as a percentage of GDP (hereafter, the credit-to-GDP ratio) and

[10]CEECs refer to Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, which have become the member states of European Union by the end of 2012. We focus on CEECs' post-transition period, i.e., 1995-2011. According to IMF (2010), "emerging Asia" refers to China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand, and Vietnam. As our model predictions apply to developing economies, we exclude Hong Kong and Singapore. The rest of nine emerging Asian economies are referred as EAE-9. China and India impose strict capital controls on financial capital flows (Habermeier, Kokenyne, and Baba, 2011; Hutchison, Pasricha, and Singh, 2012; Klein, 2012), while Korea and Taiwan moved from middle-income to high-income economies in 1995-2011. In order to focus more closely on developing economies with relatively free capital mobility, we first test our results on ASEAN-5, i.e., Indonesia, Malaysia, Philippines, Thailand, and Vietnam. Then, we conduct the robustness check by augmenting the sample of ASEAN-5 with China, Indian, Korea, and Taiwan. Appendix B.5 shows that the qualitative results hold across various samples.
Data for capital flows are obtained from the annual data of financial account in the Balance of Payments from IMF International Financial Statistics. FDI flows are the sum of the entries under direct investment abroad and direct investment in reporting economy; changes in net foreign reserves (CNFR) are the entries under reserves and related items; private financial capital flows (PFCF) are the sum of the entries under portfolio investment assets and liabilities, under net financial derivatives, and under other investment assets and liabilities; financial capital flows are the sum of PFCF and CNFR; net capital flows are the sum of FDI flows and financial capital flows. According to the definition by IMF, a positive value of capital flows in the balance of payments represents capital inflows, while a positive value of capital flows is defined as capital outflows in our model. In order to be consistent with our model definition, the signs of the five time series computed above are reversed.

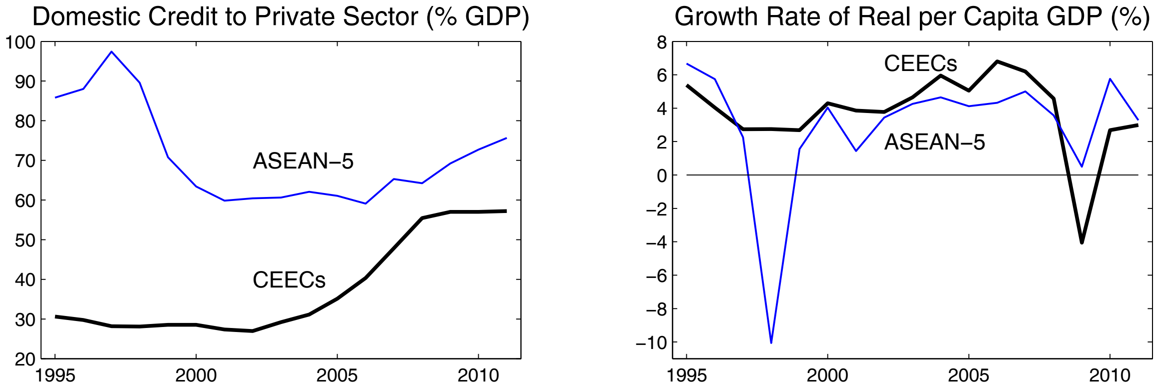

Figure 6: Financial Development and Growth Rate of GDP per Capita

the neoclassical effect is measured by the growth rate of real GDP per capita. Data are obtained from the World Bank's World Development Indicators. Figure 6 shows the evolutions of the two variables in 1995-2011 at the regional level. Due to the credit crunch after the 1997 Asian financial crisis, the credit-to-GDP ratio of ASEAN-5 fell dramatically from close 100% in 1997 to 60% in 2001. For the next six years, the ratio remained at that level. In contrast, following the 2004 EU enlargement, the adoption of EU laws and directives has significantly improved financial sector quality in CEECs by upgrading their legal, regulatory, and supervisory framework to the same standard as in the Western Europe. Furthermore, the significant dominance of foreign banks in the CEECs' financial markets also improved the quality of domestic banking sectors (Herrmann and Winkler, 2009a,b). The credit-to-GDP ratio of CEECs rose dramatically from below 30% in 2002 to close 60% in 2008. Meanwhile, the real per capita GDP growth was also higher in CEECs than in ASEAN-5 in 1998-2008. These facts are consistent with our model predictions.

We use a simple panel data model to test our predictions in the two regions,

$$PFCF_{i,t} = \gamma_1 g_{i,t} + \gamma_2 \Delta FD_{i,t} + \gamma_3 g_{w,t} + \gamma_4 FD_{i,t-1} + \gamma_5 \ln GDP_{i,t-1} + \gamma_6 D98 + \phi_i + \mu_{i,t}, \quad (35)$$

where the dependent variable $PFCF_t^i$ refers to the ratio of private financial capital flows over GDP in country i and year t; $g_{i,t}$ and $g_{w,t}$ refer to the year-t real GDP per capita growth in country i and in the world, respectively; $\Delta FD_{i,t} = FD_{i,t} - FD_{i,t-1}$ refers to the annual change in the credit-to-GDP ratio in year t; $FD_{i,t-1}$ and $\ln GDP_{i,t-1}$ are the lagged values of the credit-to-GDP ratio and the natural logarithm of real per capita GDP, capturing the initial conditions; $D98$ is a dummy variable for ASEAN-5 in year 1998, accounting for the Asian financial crisis in 1997;[11] ϕ_i measures country fixed effects and $\mu_{i,t}$ is the error term.[12] The positive (negative) values of PFCF refer to capital

[11] A dummy variable accounting for the 2009 global financial crisis is not statistically significant at the 10% level when included in the regression.

[12] The World Bank's Worldwide Governance Indicators (2012) measure six broad dimensions of gover-

Table 1: Private Financial Capital Flows: CEECs versus ASEAN-5

Sample	CEECs				ASEAN5				CEECs+ASEAN5			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
growth rate of	-0.54	-0.58	-0.60	-0.60	-0.66	-0.84	-0.39	-0.36	-0.48	-0.60	-0.55	-0.53
per capita GDP	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
annual change in the	-0.46	-0.53	-0.14	-0.16	-0.21	-0.22	-0.16	-0.19	-0.32	-0.33	-0.15	-0.17
credit-to-GDP ratio	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
growth rate of world	0.55	0.64	-0.63	-0.60		0.06		-0.39		0.38	-0.56	-0.51
per capita GDP	(0.05)	(0.03)	(0.01)	(0.01)		(0.85)		(0.24)		(0.08)	(0.00)	(0.01)
lagged credit-to-GDP		-0.05		-0.01		-0.02		0.02		-0.03		0.01
ratio		(0.06)		(0.81)		(0.38)		(0.37)		(0.18)		(0.63)
ln lagged GDP		0.05		0.02		-0.01		0.01		0.01		0.01
per capita		(0.06)		(0.55)		(0.78)		(0.80)		(0.46)		(0.65)
D98 for						-0.03	0.08	0.07		-0.01	0.07	0.07
ASEAN-5						(0.21)	(0.00)	(0.00)		(0.62)	(0.00)	(0.00)
number of observations	163	163	163	163	84	84	84	84	247	247	247	247
R^2	0.40	0.42	0.35	0.35	0.42	0.44	0.29	0.32	0.37	0.38	0.33	0.33

Figures in parenthesis are p-values.

Country fixed effects are included in all regressions.

outflows (inflows), consistent with the definition in our theoretical model. According to our model predictions, γ_1 and γ_2 are expected to take the negative values.

The regression is conducted under four alternative settings. In setting (2), the regression as described by equation (35) is conducted; in setting (1), the explanatory variables which are statistically significant at the 5% level in setting (2) are included in the regression. In setting (4), in order to address the potential endogeneity problem between $PFCF_{i,t}$, $g_{i,t}$, and $\Delta FD_{i,t}$, we use the lagged values of real per capita GDP growth $g_{i,t-1}$ and the annual change in the credit-to-GDP ratio $\Delta FD_{i,t-1}$ together with the current world growth rate[13] $g_{w,t}$ as the instruments for $g_{i,t}$ and $\Delta FD_{i,t}$, and other explanatory variables in equation (35) are also included in the regression; in setting (3), the explanatory variables which are statistically significant at the 5% level in setting (4) are included in the regression. To facilitate the cross-regional comparison, the regression is conducted for the respective samples of ten CEECs, ASEAN-5, and all fifteen countries.

Tables 1 reports the panel regression estimates in the four settings for the three samples. For all samples, the coefficients on per capita GDP growth and the change in credit-to-GDP ratio, i.e., γ_1 and γ_2, are statistically significant at the 1% level and negative in all settings and all samples, consistent with our theoretical predictions.

4 Conclusion

We develop a tractable, two-country, overlapping-generations model and show that cross-country differences in financial development can explain three recent empirical facts of international capital flows. International capital mobility may raise output at the country and the global level even when the less financially developed countries experience net capital outflows. The reason is that international capital flows not only lead directly to cross-country reallocation of aggregate saving but also trigger indirectly the adjustment along the consumption-saving margin. If aggregate saving is sufficiently interest-elastic, the indirect effect may override the prediction of conventional models in this literature, i.e., that net capital outflows from less financially developed countries raise output in these countries and globally. Output gains are more likely, the larger are gross compared to net capital flows and the larger the difference in the levels of financial development among the countries under consideration. An obvious question then is whether the patterns of

nance (http://www.govindicators.org) and can be used to control for institutional quality. Mean years of schooling of adults from the UNDP's International Human Development Indicators (http://hdrstats.undp.org/en/indicators/103006.html) describe the education attainment of population and can be used to control for the level of human capital. The levels and the annual changes of these indicators are not statistically significant at the 5% level when included in the regression.

[13]For the robustness check, instead of using the current world growth rate, we also use the current growth rate in Euro area for CEECs and the current growth rate in East Asia and Pacific (all income levels) for ASEAN-5. The qualitative results are the same as using the current world growth rate.

international capital flows observed in recent years are indeed output improving. Our model suggests two empirical indicators to consider. The first is the development of labor productivity after a less financially developed country opens up to international capital flows. Our model suggests that output gains come with the gains of labor productivity and, hence, real wages in this country. The second is that output gains come with a narrowing of the gap between the rate of return on equity and the rate of return on financial assets (equity premium) in the less financially developed country.

We also show that capital account liberalization may offer a developing country the short-run benefit of faster capital accumulation but possibly at the long-run cost of a lower level of output. In order to reduce the cost and exploit the benefit, the developing country should promote its level of financial development when liberalizing capital account.

We take the level of financial development as given and analyze how its differences affect capital flows. For future research, we plan to address how economic growth and various forms of capital flows reshape the level of financial development.

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A Proofs of Propositions, Lemmas, and Corrollary

Proof of Lemma 1

Proof. Without loss of generality, we suppress the country index for simplicity. According to equation (5), $\upsilon_t^j = \frac{1}{\frac{\omega_t R_t^j}{\omega_{t+1}}\frac{\beta}{(1-\beta)\epsilon}-1}$. Using equations (12) and (13) to substitute away R_t^j, we get $\upsilon_t^h = \frac{\mathbb{m}}{A}$ and $\upsilon_t^e = \frac{\mathbb{m}}{B}$ which are linear in $\mathbb{m}$.

According to the revenue splitting rule, $(1-\eta)R_t^h + \eta R_t^e = \frac{\omega_{t+1}}{\omega_t}\mathbb{R}$. The aggregate saving under IFA is rewritten as $S_t = \beta\omega_t - (1-\beta)\epsilon\omega_{t+1}\left[\frac{1-\eta}{R_t^h} + \frac{\eta}{R_t^e}\right]$. Let $\Upsilon_t \equiv \frac{\partial \ln S_t}{\partial \ln R_t^h}$ denote the elasticity of aggregate saving with respect to the loan rate.

$$\begin{aligned}\Upsilon_t = \frac{\partial S_t}{\partial R_t^h}\frac{R_t^h}{S_t} &= (1-\beta)\epsilon\omega_{t+1}(1-\eta)\left[\frac{1}{(R_t^h)^2} - \frac{1}{(R_t^e)^2}\right]\frac{R_t^h}{S_t} \\ &= \frac{(1-\beta)\epsilon\omega_{t+1}(1-\eta)}{\beta\omega_t - (1-\beta)\epsilon\omega_{t+1}\left(\frac{1-\eta}{R_t^h} + \frac{\eta}{R_t^e}\right)}\left[\frac{1}{R_t^h} - \frac{1}{R_t^e}\frac{R_t^h}{R_t^e}\right].\end{aligned}$$

Use equations (12) and (13) to substitute away R_t^j,

$$\begin{aligned}\Upsilon_t &= \frac{(1-\beta)\epsilon(1-\eta)}{(1+\epsilon)\rho - (1-\beta)\epsilon\left(\frac{1-\eta}{\mathbb{m}+\mathbb{A}} + \frac{\eta}{\mathbb{m}+\mathbb{B}}\right)}\left[\frac{1}{\mathbb{m}+\mathbb{A}} - \frac{1}{\mathbb{m}+\mathbb{B}}\frac{\mathbb{m}+\mathbb{A}}{\mathbb{m}+\mathbb{B}}\right] \\ &= \frac{\mathbb{m}(1-\eta)}{1-\mathbb{m}\left(\frac{1-\eta}{\mathbb{m}+\mathbb{A}} + \frac{\eta}{\mathbb{m}+\mathbb{B}}\right)}\left[\frac{(\mathbb{m}+\mathbb{B})^2 - (\mathbb{m}+\mathbb{A})^2}{(\mathbb{m}+\mathbb{A})(\mathbb{m}+\mathbb{B})^2}\right] \\ &= \frac{\mathbb{m}(1-\eta)}{(\mathbb{m}+\mathbb{AB})(\mathbb{m}+\mathbb{B})}(2\mathbb{m}+\mathbb{B}+\mathbb{A})(\mathbb{B}-\mathbb{A}).\end{aligned}$$

Iff $\theta < \bar{\theta}$, $\mathbb{B} > \mathbb{A}$ and $\Upsilon_t > 0$, implying that aggregate saving rises in the loan rate.

$$\begin{aligned}\frac{\partial \ln \Upsilon}{\partial \mathbb{m}} &= \frac{1}{\mathbb{m}} - \frac{1}{\mathbb{m}+\mathbb{B}} - \frac{1}{\mathbb{m}+\mathbb{AB}} + \frac{2}{(2\mathbb{m}+\mathbb{B}+\mathbb{A})} \\ &= \frac{\mathbb{AB}^2 - \mathbb{m}^2}{\mathbb{m}(\mathbb{m}+\mathbb{AB})(\mathbb{m}+\mathbb{B})} + \frac{2}{(2\mathbb{m}+\mathbb{B}+\mathbb{A})} \\ &= \frac{(\mathbb{B}-\mathbb{A})\mathbb{m}^2 + \mathbb{AB}(2\mathbb{m}^2 + 4\mathbb{B}\mathbb{m} + \mathbb{AB} + \mathbb{B}^2)}{\mathbb{m}(\mathbb{m}+\mathbb{AB})(\mathbb{m}+\mathbb{B})(2\mathbb{m}+\mathbb{B}+\mathbb{A})} > 0.\end{aligned}$$

Thus, Υ_t is positively related to $\mathbb{m}$. □

Proof of Proposition 1

Proof. If the borrowing constraints are binding, $R_t^{i,h} < R_{t+1}^i$, according to equation (7). We prove that equations (11)-(17) are the model solution in this case.

At the aggregate level, $\theta^i R_{t+1}^i K_{t+1}^i$ and $(1-\theta^i)R_{t+1}^i K_{t+1}^i$ are paid to households and entrepreneurs as the rewards to their respective contributions in the form of credit capital $D_t^{i,h}$ and equity capital $D_t^{i,e}$,

$$K_{t+1}^i = D_t^{i,h} + D_t^{i,e} = \frac{\theta^i R_{t+1}^i K_{t+1}^i}{R_t^{i,h}} + \frac{(1-\theta^i)R_{t+1}^i K_{t+1}^i}{R_t^{i,e}} \Rightarrow \frac{\theta^i}{R_t^{i,h}} + \frac{(1-\theta^i)}{R_t^{i,e}} = \frac{1}{R_{t+1}^i}. \quad (36)$$

We call it *the investment sharing rule.*

Aggregate capital stock consists of aggregate savings of households and entrepreneurs,

$$K_{t+1}^{i}=(1-\eta)s_{t}^{i,h}+\eta s_{t}^{i,e}=\beta\omega_{t}^{i}-(1-\beta)\epsilon\omega_{t+1}^{i}\left(\frac{\eta}{R_{t}^{i,e}}+\frac{1-\eta}{R_{t}^{i,h}}\right). \tag{37}$$

According to equations (2), the aggregate reward to capital is $R_{t+1}^{i}K_{t+1}^{i}=\rho(1+\epsilon)\omega_{t+1}^{i}$. Combine it with equation (37), we get *the aggregate capital reward rule*

$$\frac{\rho(1+\epsilon)\omega_{t+1}^{i}}{R_{t+1}^{i}}=\beta\omega_{t}^{i}-(1-\beta)\epsilon\omega_{t+1}^{i}\left(\frac{\eta}{R_{t}^{e}}+\frac{1-\eta}{R_{t}^{h}}\right). \tag{38}$$

Let $r_{t+1}^{i}\equiv\frac{R_{t+1}^{i}}{\frac{\omega_{t+1}^{i}}{\omega_{t}^{i}}\mathbb{R}}$, $r_{t}^{i,e}\equiv\frac{R_{t}^{i,e}}{\frac{\omega_{t+1}^{i}}{\omega_{t}^{i}}\mathbb{R}}$, and $r_{t}^{i,h}\equiv\frac{R_{t}^{i,h}}{\frac{\omega_{t+1}^{i}}{\omega_{t}^{i}}\mathbb{R}}$ denote the social and the private interest rates normalized by $\frac{\omega_{t+1}^{i}}{\omega_{t}^{i}}\mathbb{R}$. The aggregate capital reward rule (38), the reward splitting rule (10), and the investment sharing rule (36) are simplified as,

$$\begin{aligned}\frac{1}{r_{t+1}^{i}}&=1+\mathbb{m}-\mathbb{m}\left(\frac{1-\eta}{r_{t}^{i,h}}+\frac{\eta}{r_{t}^{i,e}}\right)\\ \frac{1}{r_{t+1}^{i}}&=\frac{\theta}{r_{t}^{i,h}}+\frac{1-\theta}{r_{t}^{i,e}}\\ 1&=(1-\eta)r_{t}^{i,h}+\eta r_{t}^{i,e}.\end{aligned}$$

Given the parameters θ, η, and $\mathbb{m}$, there exists a unique and time-invariant solution to the normalized interest rates, $r_{t}^{i,h}=\frac{\mathbb{m}+\mathbb{A}^{i}}{\mathbb{m}+1}$, $r_{t}^{i,e}=\frac{\mathbb{m}+\mathbb{B}^{i}}{\mathbb{m}+1}$, and $r_{t+1}^{i}=\frac{(\mathbb{m}+\mathbb{A}^{i})(\mathbb{m}+\mathbb{B}^{i})}{(\mathbb{m}+1)(\mathbb{m}+\mathbb{A}^{i}\mathbb{B}^{i})}$. Thus, equations (12)-(14) are the solutions to interest rates. Using equation (14) to substitute away R_{t+1}^{i} from the factor reward equation $K_{t+1}^{i}=\rho(1+\epsilon)\frac{\omega_{t+1}^{i}}{R_{t+1}^{i}}$, we get the solution to aggregate capital stock (11). Combining equations (1)-(2), the factor prices are

$$Y_{t+1}^{i}=\left(\frac{\frac{\alpha Y_{t+1}^{i}}{R_{t+1}^{i}}}{\alpha}\right)^{\alpha}\left(\frac{\frac{(1-\alpha)Y_{t+1}^{i}}{\omega_{t+1}^{i}}}{1-\alpha}\right)^{1-\alpha}=\frac{Y_{t+1}^{i}}{(R_{t+1}^{i})^{\alpha}(\omega_{t+1}^{i})^{1-\alpha}}\quad\Rightarrow\quad(R_{t+1}^{i})^{\alpha}(\omega_{t+1}^{i})^{1-\alpha}=1. \tag{39}$$

Using equation (14) to substitute away R_{t+1}^{i}, we get the dynamic equation of wages (16) with the aggregate efficiency indicator Λ^{i}. □

Proof of Lemma 2

Proof. The proof consists of three steps. First, we prove that equation (22) is the solution to the equity rate. Define $\Delta\psi_{t}^{i}\equiv\psi_{t}^{i}-\psi_{IFA}^{i}$. Given the binding borrowing constraints, use $\psi_{t}^{i}=\frac{R_{t}^{i,h}}{R_{t+1}^{i}}$ and $\psi_{IFA}^{i}=\frac{R_{IFA}^{i,h}}{R_{IFA}^{i}}$ to rewrite equation (36) under IFA and under full capital mobility,

$$\frac{\psi_{t}^{i}}{1-\theta^{i}}-\frac{R_{t}^{i,h}}{R_{t}^{i,e}}=\frac{\theta^{i}}{1-\theta^{i}}=\frac{\psi_{IFA}^{i}}{1-\theta^{i}}-\frac{R_{IFA}^{i,h}}{R_{IFA}^{i,e}},\quad\Rightarrow\quad\frac{\Delta\psi_{t}^{i}}{1-\theta^{i}}=\frac{R_{t}^{i,h}}{R_{t}^{i,e}}-\frac{R_{IFA}^{i,h}}{R_{IFA}^{i,e}}. \tag{40}$$

Substituting $R_{t}^{i,h}$ and $R_{IFA}^{i,h}$ with $R_{t}^{i,e}$ and $R_{IFA}^{i,e}$ using the reward splitting rules (21) and (10), we solve the equity rate from equation (40). Plug the solution to the equity rate into the reward splitting rule (21) to solve for $R_t^{i,h}$. Using the approach in the proof of Lemma 4 in appendix B.2.1, we can prove the solutions to financial capital and FDI flows (26) and (27).

Second, we prove that ψ_t^i is constant under full capital mobility. Suppose that ψ_t^i is time variant and so is $\mathcal{Z}_t^i$ defined in section 3. According to equation (22), the international equalization of the equity rate equalization implies that,

$$R_{IFA}^{S,e} - \mathcal{Z}_t^S = R_{IFA}^{N,e} - \mathcal{Z}_t^N, \tag{41}$$

$$\Delta\psi_t^S = \frac{\mathbb{B}^S}{\mathbb{B}^N}\Delta\psi_t^N + \frac{\mathbb{R}\mathbb{B}^S\eta}{1-\eta}\left(\frac{1}{R_{IFA}^{N,e}} - \frac{1}{R_{IFA}^{S,e}}\right). \tag{42}$$

Using equations (22), (27), and (40), we rewrite the condition, $\Omega_t^S + \Omega_t^N = 0$, into

$$\frac{R_{IFA}^{i,e}}{R_t^{i,e}} = \left(1 + \frac{R_{IFA}^{i,e}}{\mathbb{R}}\frac{1-\eta}{\eta}\frac{\Delta\psi_t^i}{\mathbb{B}^i}\right)\frac{\omega_t^w}{\omega_{t+1}^w}, \Rightarrow \omega_{t+1}^S\Delta\psi_t^S\frac{\mathbb{m}+\mathbb{B}^S}{\mathbb{B}^S} + \omega_{t+1}^N\Delta\psi_t^N\frac{\mathbb{m}+\mathbb{B}^N}{\mathbb{B}^N} = 0.$$

Given the international equalization of the loan rate, $R_t^{i,h} = R_t^{*,h}$, substitute away ω_{t+1}^i using equation (39) and the definition of the relative loan rate,

$$\mathcal{K}_t^S + \mathcal{K}_t^N = 0, \text{ where } \mathcal{K}_t^i \equiv (\Delta\psi_t^i + \psi_{IFA}^i)^\rho\Delta\psi_t^i\frac{\mathbb{m}+\mathbb{B}^i}{\mathbb{B}^i}, \tag{43}$$

$$\frac{\partial\mathcal{K}_t^i}{\partial\Delta\psi_t^i} = [(\rho+1)\Delta\psi_t^i + \psi_t^i](\Delta\psi_t^i + \psi_{IFA}^i)^{\rho-1}\frac{\mathbb{m}+\mathbb{B}^i}{\mathbb{B}^i} > 0. \tag{44}$$

According to equations (43)-(44), $\Delta\psi_t^S$ is an implicit function of $\Delta\psi_t^N$, which is downward sloping and cross the origin point; according to equation (42), $\Delta\psi_t^S$ is an implicit function of $\Delta\psi_t^N$, which is upward sloping and has a positive intercept on the vertical axis. Thus, there must exists a unique and, hence, time-invariant, solution with $\Delta\psi_t^S > 0 > \Delta\psi_t^N$.

Finally, we prove the existence of a unique and stable steady state under full capital mobility. ψ_t^i is time-invariant and so is $\mathcal{Z}_t^i$. Let $R_{FCM}^{i,h} \equiv R_{IFA}^{i,h} + \frac{\eta}{1-\eta}\mathcal{Z}_{FCM}^i$. It is the same across countries, $R_{FCM}^{i,h} = R_{FCM}^{*,h}$. Thus, according to equation (23), the loan rate depends on the dynamics of the world-average wages. So is the wage in country i,

$$\omega_{t+1}^i = (R_{t+1}^i)^{-\rho} = (\frac{R_t^{i,h}}{\psi_t^i})^{-\rho} = (\frac{\omega_{t+1}^w}{\omega_t^w}R_{IFA}^{*,h})^{-\rho}(\psi_t^i)^\rho.$$

Given the time-invariant relative loan rate, the dynamics of world-average wages are

$$\omega_{t+1}^w = \frac{\omega_{t+1}^S + \omega_{t+1}^N}{2} = (\frac{\omega_{t+1}^w}{\omega_t^w}R_{IFA}^{*,h})^{-\rho}\frac{(\psi_{FCM}^S)^\rho + (\psi_{FCM}^N)^\rho}{2},$$

$$\omega_{t+1}^w = \left(\frac{\omega_t^w}{R_{FCM}^{*,h}}\right)^\alpha\left[\frac{(\psi_{FCM}^S)^\rho + (\psi_{FCM}^N)^\rho}{2}\right]^{1-\alpha}$$

Given $\alpha \in (0,1)$, the phase diagram of the world-average wage is concave. Thus, there exists a unique and stable steady state. Proportional to wage, aggregate output in country i is determined by the world output dynamics. □

Proof of Proposition 2

Proof. According to equation (30), the world credit market clearing condition, $\Phi^S_{FCM}+\Phi^N_{FCM}=0$ implies that $\left(1-\frac{R^{S,h}_{IFA}}{R^{*,h}_{FCM}}\right)\left(1-\frac{R^{N,h}_{IFA}}{R^{*,h}_{FCM}}\right)<0$. Given $R^{S,h}_{IFA}<R^{N,h}_{IFA}$, the world loan rate must be $R^{*,h}_{FCM}\in(R^{S,h}_{IFA},R^{N,h}_{IFA})$. By analogy, we can prove $R^{*,e}_{FCM}\in(R^{N,e}_{IFA},R^{S,e}_{IFA})$.

According to equation (29), $R^{*,h}_{FCM}\in(R^{S,h}_{IFA},R^{N,h}_{IFA})$ implies $\mathcal{Z}^S_{FCM}>0>\mathcal{Z}^N_{FCM}$, which then implies that $\psi^S_{FCM}>\psi^S_{IFA}$ and $\psi^N_{FCM}<\psi^N_{IFA}$. Use the same approach as in the proof of Lemma 4, we can prove the partial convergence of the relative loan rate, $\psi^S_{IFA}<\psi^S_{FCM}<\psi^N_{FCM}<\psi^N_{IFA}$.

According to equations (30) and (31), the changes in the interest rates imply that $\Phi^S_{FCM}>0>\Phi^N_{FCM}$ and $\Omega^S_{FCM}<0<\Omega^N_{FCM}$. Since $R^{*,e}_{FCM}>R^{*,h}_{FCM}$, the steady-state net capital flows have the same sign as $\mathcal{Z}^i_{FCM}$, according to equation (32). Thus, $\mathcal{Z}^S_{FCM}>0>\mathcal{Z}^N_{FCM}$ implies that $\Phi^S_{FCM}+\Omega^S_{FCM}>0>\Phi^N_{FCM}+\Omega^N_{FCM}$.

According to equations (30) and (31), we get,

$$R^{*,h}_{FCM}\Phi^i_{FCM}+R^{*,e}_{FCM}\Omega^i_{FCM}=\beta\eta\omega^i_{FCM}(\mathcal{Z}^i_{FCM}-\mathcal{Z}^i_{FCM})=0.$$

□

Proof of Corolarry 1

Proof. Let $a_t\equiv\frac{\omega^N_t+\omega^S_t}{2\omega_{IFA}}$ and $b_t\equiv\frac{\omega^N_t-\omega^S_t}{2\omega_{IFA}}+\frac{\Phi^S_t+\Omega^S_t}{\beta\omega_{IFA}}$, where $t=0,1,2,3,....$ According to the aggregate resource constraint in country S, net capital outflows cannot exceed aggregate saving, $0<\Phi^S_t+\Omega^S_t<\beta\omega^S_t$, we get $b_t\in(0,a_t)$. In period $t\geq 0$, the aggregate investment in the two countries are $I^S_t=\beta\omega^S_t-(\Phi^S_t+\Omega^S_t)=(a_t-b_t)\beta\omega^S_{IFA}$ and $I^N_t=\beta\omega^N_t+(\Phi^S_t+\Omega^S_t)=(a_t+b_t)\beta\omega^N_{IFA}$, respectively. Given $\alpha\in(0,1)$, $b_t\in(0,a_t)$, and $\omega_{IFA}=\left(\frac{\beta}{\rho}\right)^{\rho}$, the world-average wage is reformulated into a condensed form,

$$\frac{\omega^S_{t+1}+\omega^N_{t+1}}{2}=\left(\frac{1}{\rho}\right)^{\alpha}\left[\frac{(I^S_t)^{\alpha}+(I^N_t)^{\alpha}}{2}\right]\Leftrightarrow a_{t+1}=\frac{(a_t-b_t)^{\alpha}+(a_t+b_t)^{\alpha}}{2}<(a_t)^{\alpha},\tag{45}$$

where the last inequality sign results from the Jensen's Inequality. The wage in period $t=0$ is the same in the two countries, $\omega^S_0=\omega^N_0=\omega_{IFA}$, and, thus, $a_0=1$. From period 0 on, full capital mobility is allowed. According to the inequality in equation (45), $a_1<1$. For $t=1,2,3,...$, given $b_t\in(0,a_t)$, we have $a_{t+1}<(a_t)^{\alpha}$ and, thus, the time series of a_t is below 1, or equivalently, $\frac{\omega^S_t+\omega^N_t}{2}<\omega_{IFA}$. Thus, the world output is smaller than before period $t=0$, $Y^S_t+Y^N_t=\frac{\omega^S_t+\omega^N_t}{1-\alpha}<\frac{2\omega_{IFA}}{1-\alpha}=Y^S_{IFA}+Y^N_{IFA}$. □

Proof of Proposition 3

Proof. The factor price equation (39), the reward splitting rule, (10), and the investment sharing rule (36) hold under full capital mobility and under IFA,

$$\omega^i_l=\left(\frac{R^{i,h}_l}{\psi^i_l}\right)^{-\rho},\quad \psi^i_l=\frac{R^{i,h}_l}{R^{i,e}_l}(1-\theta^i)+\theta^i,\quad \eta R^{i,e}_l+(1-\eta)R^{i,h}_l=\mathbb{R}.\tag{46}$$

where $l\in\{IFA,FCM\}$ refers to the scenarios of IFA and full capital mobility, respectively. Under full capital mobility, the international loan rate equalization and the partial convergence of the relative loan rate, $\psi^S_{FCM}<\psi^N_{FCM}$, implies that $\omega^S_{FCM}<\omega^N_{FCM}$, or $Y^S_{FCM}<Y^N_{FCM}$.

Define $r_l^{i,h} \equiv \frac{R_l^{i,h}}{\mathbb{R}}$ and $r_l^{i,e} \equiv \frac{R_l^{i,e}}{\mathbb{R}}$. According to equations (46), the steady-state wage under IFA and under full capital mobility is a function of $r_l^{i,e}$,

$$\omega_l^i = \frac{1}{\mathbb{R}^\rho}\left[\frac{(1-\theta^i)r_l^{i,h}}{r_l^{i,e}} + \theta^i\right]^\rho (r_l^{i,h})^{-\rho} \quad \text{and} \quad r_l^{i,h} = \frac{1-\eta r_l^{i,e}}{1-\eta}.$$

Given θ^i, if full capital mobility affects the equity rate in country i, the wage and hence output in this country change accordingly.

$$\mathcal{T}_l^i \equiv \frac{\partial \omega_l^i}{\partial r_l^{i,e}} = \frac{\rho\omega_l^i \mathcal{N}_l^i}{[(1-\theta^i)r_l^{i,h} + \theta^i r_l^{i,e}]r_l^{i,e}r_l^{i,h}}, \tag{47}$$

$$\text{where, } \mathcal{N}_l^i \equiv \theta^i\left[\frac{(1-r_l^{i,h})^2}{\eta} + \frac{1}{1-\eta}\right] - (r_l^{i,h})^2. \tag{48}$$

Thus, $\mathcal{T}_l^i$ has the same sign as $\mathcal{N}_l^i$.

According to equations (12)-(13), $r_{IFA}^{i,e} = \frac{\mathbb{m}+\mathbb{B}^i}{\mathbb{m}+1}$ and $r_{IFA}^{i,h} = \frac{\mathbb{m}+\mathbb{A}^i}{\mathbb{m}+1}$. Evaluate $\mathcal{T}_l^i$ in the steady state under IFA by substituting $r_{IFA}^{i,e}$ and $r_{IFA}^{i,h}$ into equation (47)-(48),

$$\mathcal{T}_{IFA}^i = \rho\omega_{IFA}^i(1+\mathbb{m})\frac{\frac{(\bar{\theta}-\theta^i)}{1-\eta}\left[\frac{\theta^i(1-\theta^i)}{\eta(1-\eta)} - \mathbb{m}^2\right]}{(\mathbb{m}+A^i)(\mathbb{m}+B^i)\left[\mathbb{m}+B\left(1-\frac{(\bar{\theta}-\theta^i)}{1-\eta}\right)\right]},$$

$$\mathcal{N}_{IFA}^i = \left[\frac{\theta^i(1-\theta^i)}{\eta(1-\eta)} - \mathbb{m}^2\right]\frac{(\bar{\theta}-\theta^i)}{(1-\eta)}\frac{1}{(1+\mathbb{m})^2}.$$

We take the following approach to provide the sufficient conditions on the output implications of full capital mobility. Consider country N. If θ^N can make $\mathcal{N}_{IFA}^N \geq 0$, full capital mobility reduces the steady-state loan rate so that $\mathcal{N}_{FCM}^N > \mathcal{N}_{IFA}^N \geq 0$. Thus, $\mathcal{T}_{FCM}^N > 0$ and $\mathcal{T}_{IFA}^N \geq 0$. As full capital mobility raises the steady-state equity rate for country N, we get $\omega_{FCM}^N > \omega_{IFA}^N$ or $Y_{FCM}^N > Y_{IFA}^N$. Consider country S. If θ^S can make $\mathcal{N}_{IFA}^S \leq 0$, full capital mobility raises the steady-state loan rate so that $\mathcal{N}_{FCM}^S < \mathcal{N}_{IFA}^S \leq 0$. Thus, $\mathcal{T}_{FCM}^S < 0$ and $\mathcal{T}_{IFA}^S \leq 0$. As full capital mobility reduces the steady-state equity rate for country S, we get $\omega_{FCM}^S > \omega_{IFA}^S$ or $Y_{FCM}^S > Y_{IFA}^S$.

It is trivial to prove the general results for $\theta^S = 0$ and $\theta^N = \bar{\theta}$. If $\theta^N = \bar{\theta}$, $\mathcal{N}_{IFA}^N = 0$ so that full capital mobility raises its steady-state output, $Y_{FCM}^N > Y_{IFA}^N$. If $\theta^S = 0$, $\mathcal{N}_{IFA}^S \leq 0$ so that full capital mobility raises its steady-state output, $Y_{FCM}^S > Y_{IFA}^S$.

For $\theta^i \in [0, \bar{\theta})$, the sign of $\mathcal{T}_{IFA}^i$ depends on that of $\mathcal{N}_{IFA}^i$, or, that of $\left[\frac{\theta^i(1-\theta^i)}{\eta(1-\eta)} - \mathbb{m}^2\right]$.

Figure 7 shows all possible cases on the relative size of $\frac{\theta^i(1-\theta^i)}{\eta(1-\eta)}$ and $\mathbb{m}^2$ where the three panels in the first row show the cases with $\eta \in (0, 0.5)$, the two panels in the second row show the cases with $\eta \in (0, 5, 1)$, and the horizontal axis shows $\theta^i \in (0, \bar{\theta})$.

Given $\eta \in (0, 0.5)$, $\frac{\theta^i(1-\theta^i)}{\eta(1-\eta)} \in (0, \frac{1}{4\eta(1-\eta)})$ is a hump-shaped function of $\theta^i \in (0, \bar{\theta})$. Point H denotes its highest value $\frac{1}{4\eta(1-\eta)} > 1$. Define $\kappa \equiv \frac{1-\sqrt{1-4\mathbb{m}^2(1-\eta)\eta}}{2}$.

- If $\mathbb{m} \in (0, 1)$, there exists a threshold value $\tilde{\theta}_1 = \kappa$ such that, for $\theta^i \in (0, \tilde{\theta}_1)$, $\mathcal{N}_{IFA}^i < 0$ and, for $\theta^i \in (\tilde{\theta}_1, \bar{\theta})$, the opposite applies.

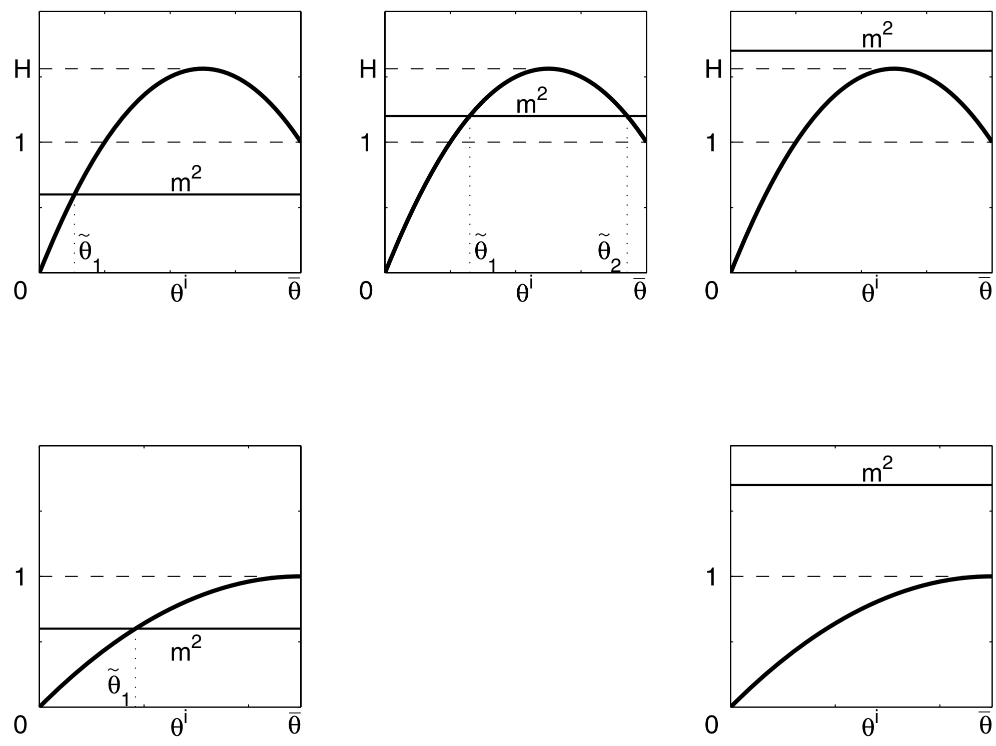

Figure 7: Threshold Values under Various Scenarios

- If $\mathbb{m} \in (1, \frac{1}{2\sqrt{\eta(1-\eta)}})$, there exists two threshold values $\tilde{\theta}_1 = \kappa$ and $\tilde{\theta}_2 = 1-\kappa$ such that for $\theta^i \in (\tilde{\theta}_1, \tilde{\theta}_2)$, $\mathcal{N}^i_{IFA} > 0$ and, for $\theta^i \in (0, \tilde{\theta}_1) \cup (\tilde{\theta}_2, \bar{\theta})$, the opposite applies.
- If $\mathbb{m} > \frac{1}{2\sqrt{\eta(1-\eta)}}$, for $\theta^i \in (0, \bar{\theta})$, it holds that $\mathcal{N}^i_{IFA} < 0$.

Given $\eta \in (0.5, 1)$, $\frac{\theta^i(1-\theta^i)}{\eta(1-\eta)} \in (0, 1)$ is a monotonically increasing function of $\theta^i \in (0, \bar{\theta})$.

- If $\mathbb{m} \in (0, 1)$, there exists a threshold value $\tilde{\theta}_1 = \kappa$ such that, for $\theta^i \in (0, \tilde{\theta}_1)$, $\mathcal{N}^i_{IFA} > 0$ and, for $\theta^i \in (\tilde{\theta}_1, \bar{\theta})$, the opposite applies.
- If $\mathbb{m} > 1$, for $\theta^i \in (0, \bar{\theta})$, $\mathcal{N}^i_{IFA} < 0$.

Using the approach mentioned above, we can provide the sufficient conditions as summarized in proposition 3. □

Proof of Lemma 3

Proof. Lemma 3 can be proved intuitively as follows. Start from a sufficiently low level of capital in country S. Under IFA, country S converges to its steady state at a positive growth rate of output and wage, i.e., $\frac{\omega_1^S}{\omega_0^S} > 1$, and the growth rate declines in K_0^S, due to the decreasing marginal product of capital (the neoclassical effect); according to Proposition 1, $\theta^N > \theta^S$ implies $R^{N,h}_{IFA} > R^{S,h}_{IFA}$ and, according to equation (13), $\frac{\omega_1^S}{\omega_0^S} > 1$ implies $R_0^{S,h} > R^{S,h}_{IFA}$. Thus, $R^{S,h}_{IFA} < \min\{R^{N,h}_{IFA}, R_0^{S,h}\}$. By assumption, country N is initially in the steady state under IFA, $R_0^{N,h} =$

$R_{IFA}^{N,h}$. Under full capital mobility, the cross-country equalization of the loan rate implies that $R_0^{*,h} > \min\{R_0^{N,h}, R_0^{S,h}\} = \{R_{IFA}^{N,h}, R_0^{S,h}\}$. Thus, $\frac{R_{IFA}^{S,h}}{R_0^{*,h}} < 1$.

Given θ^S, $\underline{K}_0^S$ is defined as a value of K_0^S such that $\frac{\omega_1^S}{\omega_0^S}\frac{R_{IFA}^{S,h}}{R_0^{*,h}} = 1$. If $K_0^S < \underline{K}_0^S$, the growth rate of wage is so high that, despite $\frac{R_{IFA}^{S,h}}{R_0^{*,h}} < 1$, $\frac{\omega_1^S}{\omega_0^S}\frac{R_{IFA}^{S,h}}{R_0^{*,h}} > 1$ and, according to equation (26), country S has financial capital inflows, $\frac{\Phi_0^S}{\beta\omega_0^S} = 1 - \frac{\omega_1^S}{\omega_0^S}\frac{R_{IFA}^{S,h}}{R_0^{*,h}} < 0$. If $K_0^S > \underline{K}_0^S$, $\frac{\Phi_0^S}{\beta\omega_0^S} = 1 - \frac{\omega_1^S}{\omega_0^S}\frac{R_{IFA}^{S,h}}{R_0^{*,h}} > 0$. As country S always receives FDI inflows, if K_0^S is slightly above $\underline{K}_0^S$, financial capital outflows are dominated by FDI inflows so that country S still has net capital inflows; according to Proposition 2, country S witnesses net capital outflows in the steady state under full capital mobility. Thus, there must exist another threshold value $\bar{K}_0^S \in (\underline{K}_0^S, K_{FCM}^S)$, such that, for $K_0^S > \bar{K}_0^S$, financial capital outflows exceed FDI inflows so that $\Phi_0^S + \Omega_0^S > 0$; for $K_0^S < \bar{K}_0^S$, FDI inflows dominate so that $\Phi_0^S + \Omega_0^S < 0$.

A higher θ^S implies a higher $R_{IFA}^{S,h}$ so that $\frac{R_{IFA}^{S,h}}{R_0^{*,h}}$ tends to be higher, too. Following the argument mentioned above, it is trivial to show that $\underline{K}_0^S$ and $\bar{K}_0^S$ rise in θ^S. $\square$

B Other Relevant Issues

B.1 Financial Development and Aggregate Saving in the Case of Elastic Saving under IFA

Here, we prove intuitively that, under IFA, aggregate saving is a decreasing function of θ^i in the case of elastic saving. Let $R^{i,j} \equiv \frac{\omega_t^i}{\omega_{t+1}^i} R_t^{i,j}$ denote the interest rate normalized by the the gross growth rate of wage. Define an auxiliary function $\mathbb{M}(x_1, x_2, p) \equiv (1-\eta)x_1^p + \eta x_2^p$. The aggregate saving rate is $\frac{S_t^i}{\omega_t^i} = \beta - (1-\beta)\epsilon\mathbb{M}(R^{i,h}, R^{i,e}, -1)$, where $\epsilon\mathbb{M}(R^{i,h}, R^{i,e}, -1) = \frac{1-\eta}{R^{i,h}} + \frac{\eta}{R^{i,e}}$ captures the normalized aggregate human wealth. Given that country N is more financially developed, $0 < \theta^S < \theta^N < \bar{\theta}$, the normalized loan rate (equity rate) is higher (lower) in country N than in country S. Let point S (N) in figure 8 represents the interest rates in country S (N). According to the reward splitting rule (10), the normalized interest rates are linearly related, $(1-\eta)R^{i,h} + \eta R^{i,e} = \mathbb{R}$. Thus, points S and N are on the same reward splitting line (the downward-sloping solid line). The convex isoquant represents the aggregate human wealth, $\epsilon\mathbb{M}(R^{i,h}, R^{i,e}, -1)$. A lower isoquant refers to a larger aggregate human wealth, $\epsilon\mathbb{M}(R^{S,h}, R^{S,e}, -1) > \epsilon\mathbb{M}(R^{N,h}, R^{N,e}, -1)$, and hence a lower aggregate saving rate, $\frac{S_t^S}{\omega_t^S} < \frac{S_t^N}{\omega_t^N}$.

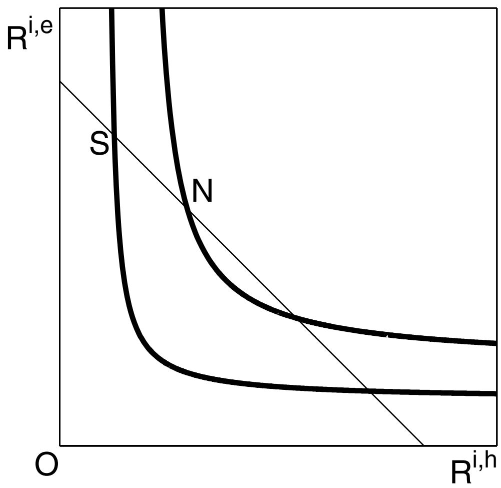

Figure 8: Graphic Illustration of the Aggregate Human Wealth Effect

B.2 Partial Capital Mobility

Here, we consider two cases of partial capital mobility. First, free mobility of financial capital refers to the case where individuals can freely borrow from and lend to foreign individuals but entrepreneurs are not allowed to make direct investment abroad in the production of capital goods. Second, free mobility of FDI refers to the case where entrepreneurs are allowed to make direct investment abroad in the production of capital goods but individuals are not allowed to borrow from and lend to foreign individuals.

B.2.1 Free Mobility of Financial Capital

Financial capital flows equalize the loan rate across the border and the credit markets clear in each country and globally, $R_t^{S,h} = R_t^{N,h} = R_t^{*,h}$, $(1-\eta)s_t^{i,h} - \Phi_t^i = (\lambda_t^i - 1)\eta s_t^{i,e}$, and $\Phi_t^S + \Phi_t^N = 0$. The remaining conditions for market equilibrium in each country are the same as under IFA. The solution to the equilibrium allocation is

$$R_t^{i,e} = \frac{\omega_{t+1}^i}{\omega_t^i} R_{IFA}^{i,e}, \tag{49}$$

$$R_t^{i,h} = \frac{\omega_{t+1}^i}{\omega_t^i} R_{IFA}^{i,h} \frac{\psi_t^i - \theta^i}{\psi_{IFA}^i - \theta^i}, \tag{50}$$

$$\Phi_t^i = (1-\eta)\beta\omega_t^i \left(1 - \frac{\omega_{t+1}^i}{\omega_t^i} \frac{R_{IFA}^{i,h}}{R_t^{i,h}}\right) = (1-\eta)\beta\omega_t^i \frac{\psi_t^i - \psi_{IFA}^i}{\psi_t^i - \theta^i}, \tag{51}$$

$$\omega_{t+1}^i = \left(\frac{\Lambda_t^i}{\mathbb{R}}\omega_t^i\right)^\alpha, \text{ where } \Lambda_t^i = \Lambda_{IFA}^i \frac{1 - \frac{\theta^i}{\psi_{IFA}^i}}{1 - \frac{\theta^i}{\psi_t^i}}, \tag{52}$$

$$\frac{\partial \ln \Lambda_t^i}{\partial \psi_t^i} = -\frac{\theta^i}{\psi_t^i(\psi_t^i - \theta^i)} < 0 \tag{53}$$

The relative loan rate ψ_t^i is key to the model mechanism. As the loan rate is initially lower in country S, $R_{IFA}^{S,h} < R_{IFA}^{N,h}$, financial capital flows from country S to country N in period $t = 0$, $\Phi_0^S > 0 > \Phi_0^N$, implying that $\psi_0^S > \psi_{IFA}^S$ and $\psi_0^N > \psi_{IFA}^N$, according to equation (51). Given $\psi_{IFA}^S < \psi_{IFA}^N$, financial integration leads to the (partial) convergence of the relative loan rate.

Lemma 4. *Under financial capital mobility, there is a unique and stable steady state.*[14]

Proof. The proof consists of three parts. First, we show that the model solution is characterized by equations (49)-(52). Under free mobility of financial capital, entrepreneurs invest their entire savings as equity in their projects. Use equation (5) and the investment-equity ratio λ_t^i to rewrite the aggregate domestic investment as

$$\eta s_t^{i,e}\lambda_t^i = \frac{\eta[\beta\omega_t^i - (1-\beta)\epsilon\frac{\omega_{t+1}^i}{R_t^{i,e}}]}{1 - \frac{\theta^i R_{t+1}^i}{R_t^{i,h}}} = K_{t+1}^i = (1+\epsilon)\rho\frac{\omega_{t+1}^i}{R_{t+1}^i}.$$

Multiplying both sides with $\frac{1 - \frac{\theta^i R_{t+1}^i}{R_t^{i,h}}}{\eta\beta\omega_t^i}$ and using the investment sharing rule (36), we get the solution to the equity rate (49),

$$1 - \frac{(1-\beta)\epsilon}{\beta}\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,e}} = \frac{(1+\epsilon)\rho}{\beta}\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1-\theta^i}{\eta R_t^{i,e}}, \Rightarrow R_t^{i,e} = \frac{\omega_{t+1}^i}{\omega_t^i}\mathbb{R}\frac{\mathbb{m} + \mathbb{B}}{\mathbb{m} + 1} = \frac{\omega_{t+1}^i}{\omega_t^i}R_{IFA}^{i,e}.$$

[14] Matsuyama (2004) shows that in the presence of financial market imperfections, financial integration may lead to symmetry breaking, i.e., financial capital flows may destablize the initial steady state under IFA so that countries with identical fundamentals may end up with different income levels. Matsuyama (2004) assumes the fixed investment size of individual project so that aggregate investment adjusts along the extensive margin. Zhang (2013) shows that Matsuyama's symmetry breaking results depend critically on this assumption; in the case of the varying investment size of individual project, aggregate investment adjusts along the intensive margin and financial integration does not lead to symmetry breaking.

Combining equations (49), (36), (12), (13) and using the definition of the relative loan rate, we get the solution to the loan rate (50),

$$
\begin{aligned}
R_t^{i,h} &= R_t^{i,e}\frac{(\psi_t^i-\theta^i)}{1-\theta^i} = \frac{\omega_{t+1}^i}{\omega_t^i}\mathbb{R}\frac{\mathbb{m}+\mathbb{A}}{\mathbb{m}+1}\frac{\mathbb{m}+\mathbb{B}}{\mathbb{m}+\mathbb{A}^i}\frac{(\psi_t^i-\theta^i)}{1-\theta^i} \\
&= \frac{\omega_{t+1}^i}{\omega_t^i}R_{IFA}^{i,h} + \frac{\omega_{t+1}^i}{\omega_t^i}R_{IFA}^{i,h}\left[\frac{\psi_t^i-\theta^i}{\psi_{IFA}^i-\theta^i}-1\right] \\
&= \frac{\omega_{t+1}^i}{\omega_t^i}R_{IFA}^{i,h} + \frac{\omega_{t+1}^i}{\omega_t^i}R_{IFA}^{i,h}\left[\frac{\psi_t^i-\psi_{IFA}^i}{\psi_{IFA}^i-\theta^i}\right].
\end{aligned}
$$

In equilibrium, financial capital outflows are essentially the excess aggregate saving, $\Phi_t^i = S_t^i - I_t^i = (1-\eta)s_t^{i,h} + \eta s_t^{i,e} - \lambda_t^i\eta s_t^{i,e}$. Using equation (5), the investment-equity ratio, $\lambda_t^i = \frac{1}{1-\theta^i\frac{R_{t+1}^i}{R_t^{i,h}}}$, and the definition of the relative loan rate, we get the solution to financial capital outflows, (51).

$$
\begin{aligned}
\Phi_t^i &= (1-\eta)\beta\omega_t^i\left[1-\frac{(1-\beta)\epsilon}{\beta}\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,h}}\right] - \eta\beta\omega_t^i\left[1-\frac{(1-\beta)\epsilon}{\beta}\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,e}}\right]\frac{\theta^i}{\psi_t^i-\theta^i} \\
&= (1-\eta)\beta\omega_t^i\left\{1-\frac{(1-\beta)\epsilon}{\beta}\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,h}} - \frac{\eta}{1-\eta}\left[1-\frac{(1-\beta)\epsilon}{\beta}\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,e}}\right]\frac{\theta^i}{\psi_t^i-\theta^i}\right\} \\
&= (1-\eta)\beta\omega_t^i\left\{1-\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,h}}\left[\frac{(1-\beta)\epsilon}{\beta} + \frac{\eta}{1-\eta}\frac{\theta^i}{\psi_t^i-\theta^i}\frac{R_t^{i,h}\omega_t^i}{\omega_{t+1}^i} - \frac{(1-\beta)\epsilon}{\beta}\frac{\eta}{1-\eta}\frac{\theta^i}{(1-\theta^i)}\right]\right\} \\
&= (1-\eta)\beta\omega_t^i\left\{1-\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,h}}\left[\frac{(1-\beta)\epsilon}{\beta}\left(1-\frac{\mathbb{A}}{\mathbb{B}}\right) + \frac{\eta}{1-\eta}\frac{\theta^i}{1-\theta^i}\frac{R_t^{i,e}\omega_t^i}{\omega_{t+1}^i}\right]\right\} \\
&= (1-\eta)\beta\omega_t^i\left\{1-\frac{\omega_{t+1}^i}{\omega_t^i}\frac{1}{R_t^{i,h}}\left[\frac{\mathbb{R}\mathbb{m}(\mathbb{B}-\mathbb{A})}{(\mathbb{m}+1)\mathbb{B}} + \frac{\mathbb{A}}{\mathbb{B}}R_{IFA}^{i,e}\right]\right\} \\
&= (1-\eta)\beta\omega_t^i\left(1-\frac{\omega_{t+1}^i}{\omega_t^i}\frac{R_{IFA}^{i,h}}{R_t^{i,h}}\right).
\end{aligned}
$$

Using the definition of the relative loan rate, the investment sharing rule, and equations (12), (13), (49), we get the solution to the social rate of return,

$$
R_{t+1}^i = \frac{R_t^{i,h}}{\psi_t^i} = R_t^{i,e}\frac{1-\frac{\theta^i}{\psi_t^i}}{1-\theta^i} = \frac{\omega_{t+1}^i}{\omega_t^i}R_{IFA}^i\frac{1-\frac{\theta^i}{\psi_t^i}}{1-\frac{\theta^i}{\psi_{IFA}^i}}.
$$

Substitute away R_{t+1}^i in equation (39), we get the dynamic equation of wages (52),

$$
\omega_{t+1}^i = \left(\frac{\omega_{t+1}^i}{R_{t+1}^i}\right)^\alpha = \left(\frac{\omega_t^i}{R_{IFA}^i}\frac{1-\frac{\theta^i}{\psi_{IFA}^i}}{1-\frac{\theta^i}{\psi_t^i}}\right)^\alpha = \left(\omega_t^i\frac{\Lambda_t^i}{\mathbb{R}}\right)^\alpha, \quad \text{with } \Lambda_t^i = \Lambda_{IFA}^i\frac{1-\frac{\theta^i}{\psi_{IFA}^i}}{1-\frac{\theta^i}{\psi_t^i}}.
$$

Second, prove the uniqueness and stability of the model economy. Given $R_t^{*,h}$, we use equations (50), (52), (39) to rewrite the dynamic equation of wages as,

$$
\ln\left(\frac{\omega_t^i}{\omega_{t+1}^i}R_t^{*,h}\frac{\psi_{IFA}^i-\theta^i}{R_{IFA}^{i,h}}+\theta^i\right) = \ln\psi_t^i = \ln R_t^{*,h} - \ln R_{t+1}^i = \ln R_t^{*,h} + \frac{1}{\rho}\ln\omega_{t+1}^i \tag{54}
$$

$$
\Rightarrow \quad \ln\omega_{t+1}^i = -\rho\ln R_t^{*,h} + \rho\ln\left(\frac{\omega_t^i}{\omega_{t+1}^i}R_t^{*,h}\frac{\psi_{IFA}^i-\theta^i}{R_{IFA}^{i,h}}+\theta^i\right). \tag{55}
$$

Let $\mathcal{W}^i \equiv \frac{\partial \ln \omega_{t+1}^i}{\partial \ln \omega_t^i}$. The first and the second derivatives of ω_{t+1}^i with respect to ω_t^i are

$$\frac{\partial \omega_{t+1}^i}{\partial \omega_t^i} = \frac{\omega_{t+1}^i}{\omega_t^i} \frac{\rho}{\rho + \frac{\psi_{t+1}^i}{\psi_{t+1}^i - \theta^i}}, \quad \Rightarrow \quad \mathcal{W}^i \equiv \frac{\partial \ln \omega_{t+1}^i}{\partial \ln \omega_t^i} = \frac{\rho}{\rho + \frac{\psi_{t+1}^i}{\psi_{t+1}^i - \theta^i}} \in (0,1),$$

$$\frac{\partial^2 \omega_{t+1}^i}{\partial (\omega_t^i)^2} = -(1 - \mathcal{W}^i)(\mathcal{W}^i)^2 \frac{\omega_{t+1}^i}{(\omega_t^i)^2} \frac{(1+\rho)}{\rho}$$

Since $\mathcal{W}^i \in (0,1)$, we get $\frac{\partial^2 \omega_{t+1}^i}{\partial (\omega_t^i)^2} < 0$. Thus, the phase diagram of wages is a concave function under free mobility of financial capital if the borrowing constraints are binding.

According to equation (55), for $\omega_t^i = 0$, the phase diagram has a positive intercept on the vertical axis at $\omega_{t+1}^i = (R_t^{*,h})^{-\rho}(\theta^i)^\rho$. Define a threshold value $\bar{\omega}_t^i = R_{IFA}^{i,e}(R_t^{*,h})^{-\frac{1}{1-\alpha}}$. For $\omega_t^i \in (0, \bar{\omega}_t^i)$, the phase diagram of wages is monotonically increasing and concave. For $\omega_t^i > \bar{\omega}_t^i$, aggregate saving and investment are so high that the relative loan rate is equal to one, or equivalently, $R_{t+1}^i = R_t^{*,h}$. Thus, the borrowing constraints are slack and the phase diagram is flat with $\omega_{t+1}^i = \bar{\omega}_{t+1}^i = (R_t^{*,h})^{-\rho}$. Given $R_t^{*,h} < \mathbb{R} < R_{IFA}^{i,e}$, we get $\bar{\omega}_{t+1}^i < \bar{\omega}_t^i$. In other words, the kink point is below the 45 degree line.

Thus, the phase diagram of wages crosses the 45 degree line once and only once from the left, and the intersection is in its concave part. Thus, the model economy has a unique and stable steady state under free mobility of financial capital.

Finally, we prove the (partial) convergence of the relative loan rate. As the loan rate is initially lower in country S, $R_{IFA}^{S,h} < R_{IFA}^{N,h}$, financial capital flows from country S to N, $\Phi_t^S > 0 > \Phi_t^N$, implying that $\psi_t^S > \psi_{IFA}^S$ and $\psi_t^N > \psi_{IFA}^N$, according to equation (51). In the steady state, given the world loan rate $R_{FCF}^{*,h}$, the relative loan rate under financial integration is,

$$R_{FCF}^{*,h} = R_{IFA}^{i,h} \frac{\psi_{FCF}^i - \theta^i}{\psi_{IFA}^i - \theta^i} = R_{IFA}^{i,e} \frac{\psi_{FCF}^i - \theta^i}{1 - \theta^i} = \mathbb{R} \frac{\mathbb{m} + \mathbb{B}^i}{\mathbb{m} + 1} \frac{\psi_{FCF}^i - \theta^i}{\eta \mathbb{B}^i},$$

$$\Rightarrow \quad \psi_{FCF}^i = \frac{R_{FCF}^{*,h}}{\mathbb{R}} \eta \mathbb{B}^i \frac{\mathbb{m}+1}{\mathbb{m} + \mathbb{B}^i} + \theta^i$$

In order to prove $\psi_{FCF}^S < \psi_{FCF}^N$, we just need to prove that

$$\frac{R_{FCF}^{*,h}}{\mathbb{R}} \eta (\mathbb{m}+1) \left(\frac{\mathbb{B}^S}{\mathbb{m} + \mathbb{B}^S} - \frac{\mathbb{B}^N}{\mathbb{m} + \mathbb{B}^N} \right) < \theta^N - \theta^S \tag{56}$$

$$\Leftarrow \quad \frac{R_{FCF}^{*,h}}{\mathbb{R}} \eta (\mathbb{m}+1) \frac{\mathbb{m}(\mathbb{B}^S - \mathbb{B}^N)}{(\mathbb{m} + \mathbb{B}^S)(\mathbb{m} + \mathbb{B}^N)} < \theta^N - \theta^S, \tag{57}$$

$$\Leftarrow \quad \frac{R_{FCF}^{*,h}}{\mathbb{R}} \frac{(\mathbb{m}+1)\mathbb{m}}{(\mathbb{m} + \mathbb{B}^S)(\mathbb{m} + \mathbb{B}^N)} < 1, \tag{58}$$

$$\Leftarrow \quad R_{FCF}^{*,h} \mathbb{m} < R_{IFA}^{N,h}(\mathbb{m} + \mathbb{B}^S). \tag{59}$$

Since $0 < R_{FCF}^{*,h} < R_{IFA}^{N,h}$ and $0 \le \mathbb{m} < \mathbb{m} + \mathbb{B}^S$, the inequality (59) must hold. Thus, we prove the partial convergence of the relative loan rate, $\psi_{IFA}^S < \psi_{FCF}^S < \psi_{FCF}^N < \psi_{IFA}^N$.

□

Let X_{FCF} denote the steady-state value of variable X under free mobility of financial capital. In the steady state, $\frac{\omega_{t+1}^i}{\omega_t^i} = 1$ and substitute it into the solution (49)-(52),

$$R^{i,e}_{FCF} = R^{i,e}_{IFA}, \quad R^{i,h}_{FCF} = R^{i,h}_{IFA} + R^{i,h}_{IFA}\frac{\psi^i_{FCF} - \psi^i_{IFA}}{\psi^i_{IFA} - \theta^i},$$

$$\Phi^i_{FCF} = (1-\eta)\omega^i_{FCF}\frac{\psi^i_{FCF} - \psi^i_{IFA}}{\psi^i_{FCF} - \theta^i}, \quad \omega^i_{FCF} = \left(\frac{1-\theta^i}{R^{i,e}_{FCF}} + \frac{\theta^i}{R^{i,h}_{FCF}}\right)^\rho.$$

Proposition 4. *In the steady state, the world loan rate is* $R^{*,h}_{FCF} \in (R^{S,h}_{IFA}, R^{N,h}_{IFA})$*, implying that* $\psi^S_{IFA} < \psi^S_{FCF} < \psi^N_{FCF} < \psi^N_{IFA}$*; the equity rate in each country is the same as under IFA,* $R^{i,e}_{FCF} = R^{i,e}_{IFA}$*; financial capital flows from country S to country N,* $\Phi^S_{FCF} > 0 > \Phi^N_{FCF}$*.*

If $\mathbb{m} > 0$, the household saving rate responds positively to the changes in the relative loan rate; if $\mathbb{m} = 0$, the household saving rate is time invariant and the same as under IFA. The entrepreneurial saving rate is time invariant and the same as under IFA.

$$\frac{s^{i,h}_t}{\omega^i_t} = \frac{s^{i,h}_{IFA}}{\omega^i_{IFA}}\left[1 + \frac{\mathbb{m}}{\mathbb{A}^i}\frac{\psi^i_t - \psi^i_{IFA}}{\psi^i_t - \theta^i}\right], \quad \text{and} \quad \frac{s^{i,e}_t}{\omega^i_t} = \frac{s^{i,e}_{IFA}}{\omega^i_{IFA}}$$

B.2.2 Free Mobility of FDI

The analysis for free mobility of FDI yields a mirror image of that for free mobility of financial capital and the main results are summarized as follows.[15]

Under free mobility of FDI, there exists a unique and stable steady state. Let X_{FDI} denote the steady-state value of variable X under free mobility of FDI. The loan rate is $R^{i,h}_t = \frac{\omega^i_{t+1}}{\omega^i_t}R^{i,h}_{IFA}$ with the same steady-state value as under IFA, $R^{i,h}_{FDI} = R^{i,h}_{IFA}$. FDI outflow from country i is $\Omega^i_t = \eta\beta\omega^i_t\left(1 - \frac{\omega^i_{t+1}}{\omega^i_t}\frac{R^{i,e}_{IFA}}{R^{*,e}_t}\right) = -\beta\eta\omega^i_t\left(\frac{\psi^i_t - \psi^i_{IFA}}{\psi^i_{IFA - \theta^i}}\right)$. Given the initial equity rate differential, $R^{S,e}_{IFA} > R^{N,e}_{IFA}$, FDI flows from country N to country S, $\Omega^N_t > 0 > \Omega^S_t$, implying the partial convergence of the relative loan rate, $\psi^S_{IFA} < \psi^S_t < \psi^N_t < \psi^N_{IFA}$. The equity rate responds negatively to the changes in the relative loan rate, $R^{i,e}_t = \frac{\omega^i_{t+1}}{\omega^i_t}R^{i,e}_{IFA} - \frac{\omega^i_{t+1}}{\omega^i_t}R^{i,e}_{IFA}\left[\frac{\psi^i_t - \psi^i_{IFA}}{\psi^i_t - \theta^i}\right]$. The dynamic equation of wage is $\omega^i_{t+1} = \left(\omega^i_t\frac{\Lambda^i_t}{\mathbb{R}}\right)$, with the aggregate efficiency indicator, $\Lambda^i_t = \Lambda^i_{IFA}\frac{\psi^i_t}{\psi^i_{IFA}}$, increasing in the relative loan rate. In the steady state, the world equity rate is $R^{*,e}_{FDI} \in (R^{N,e}_{IFA}, R^{S,e}_{IFA})$, FDI flows from country N to country S, $\Omega^N_{FDI} > 0 > \Omega^S_{FDI}$, where $\Omega^i_{FDI} = \eta\beta\omega^i_{FDI}\frac{(R^{*,e}_{FDI} - R^{i,e}_{IFA})}{R^{*,e}_{FDI}}$, and the wage rate is $\omega^S_{FDI} > \omega^S_{IFA}$ and $\omega^N_{FDI} < \omega^N_{IFA}$.

The household saving rate is time invariant and the same as under IFA. If $\mathbb{m} > 0$, the entrepreneurial saving rate responds negatively to the changes in the relative loan rate; if $\mathbb{m} = 0$, the entrepreneurial saving rate is time invariant and the same as under IFA.

$$\frac{s^{i,h}_t}{\omega^i_t} = \frac{s^{i,h}_{IFA}}{\omega^i_{IFA}}, \quad \text{and} \quad \frac{s^{i,e}_t}{\omega^i_t} = \frac{s^{i,e}_{IFA}}{\omega^i_{IFA}}\left[1 - \frac{\mathbb{m}}{\mathbb{B}^i}\frac{\psi^i_t - \psi^i_{IFA}}{\psi^i_{IFA} - \theta^i}\right].$$

B.3 Output Implications of Capital Mobility

Given $\mathbb{m} \in (0, 0.53)$ and $\theta^N = \bar{\theta}$, we compute $\tilde{\theta}^S$ for world output under full capital mobility as well as under the two alternative scenarios, i.e., *free mobility of financial capital* under

[15] See von Hagen and Zhang (2010) for detailed proofs and analysis.

which individuals are allowed to lend abroad but entrepreneurs are not allowed to make direct investments abroad, and *free mobility of FDI* under which entrepreneurs are allowed to make direct investments abroad but individuals are not allowed to lend abroad. Figure 9 shows these threshold values in the parameter space $(\theta^S, \mathbb{m})$, where the solid curve denoted by $\tilde{\theta}^S_{FCM}$, the dash curve denoted by $\tilde{\theta}^S_{FCF}$, and the dash-dot curve denoted by $\tilde{\theta}^S_{FDI}$ refer to the threshold values under the scenarios of full capital mobility, free mobility of financial capital, and free mobility of FDI, respectively. In each scenario, capital mobility raises the steady-state world output if the parameters are in the region above the respective curve. As mentioned above, the indirect effect, which contributes positively to world output, depends crucially on elastic saving. Given θ^N and θ^S, a larger ϵ leads to a larger interest elasticity of savings, represented by a larger $\mathbb{m}$. In this case, the output distortion of financial frictions under IFA is more severe. By ameliorating the output distortion, capital mobility generates a stronger indirect effect through elastic saving and world output is more likely to be higher than under IFA.

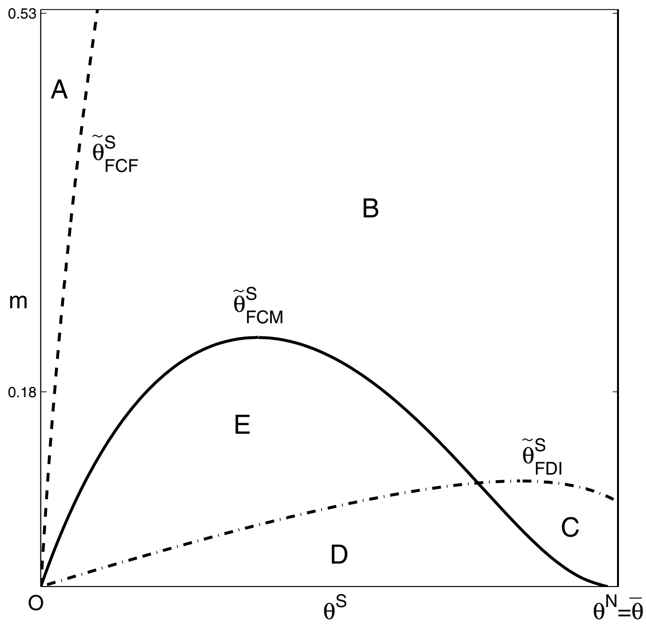

Figure 9: Threshold Values under Three Scenarios of Capital Mobility

Let us first compare the scenarios of full capital mobility and free mobility of financial capital. Under free mobility of financial capital, financial capital flows from country S to country N. "Uphill" capital flows directly widen cross-country output gap, leading to world output losses; by equalizing the loan rate across the border, financial capital flows indirectly induce households in country S (N) to save more (less) and aggregate saving at the world level is higher, leading to world output gains. The cross-country difference in θ^i has to be sufficiently large so that the indirect effect can be strong enough to override the direct effect. In our example, the parameters need to be in region A. Under full capital mobility, two-way capital flows imply that gross flows are significantly larger than net flows. Thus, even if the cross-country difference in θ^i is small, as in region B and C, the indirect effect may still dominate the direct effect. Thus, full capital mobility dominates free mobility of financial capital in generating world output gains.

Turning to free mobility of FDI alone, for parameters in region C, full capital mobility raises world output, while free mobility of FDI reduces world output. However, for parameters in region E, the opposite applies. Thus, full capital mobility does not necessarily dominate free mobility of FDI in creating world output gains. Consider parameters in region C. As the cross-country output gap under IFA is small in this case, free mobility of FDI reverses the output gap through cross-country capital reallocation and the direct effect on world output is negative. The indirect effect, which depends on gross capital flows, is small here. Under full capital mobility, gross flows are significantly larger than net flows so that the indirect effect easily dominates the direct effect and world output is higher. Consider parameters in region E where two countries differ modestly in θ^i. Given the relatively large initial cross-country output gap under IFA, free mobility of FDI directly narrows the cross-country output gap through cross-country capital reallocation, implying a positive direct effect on world output. Thus, free mobility of FDI strictly raises world output. In contrast, under full capital mobility, "uphill" net capital flows imply that the direct effect is always negative and full capital mobility reduces world output.

Here, elastic saving is a critical channel through which full capital mobility may raise output in the less financially developed country as well as globally. Shutting down either financial capital or FDI flows may undermine such world output gains.

B.4 Welfare Implications of Full Capital Mobility in the Case of Inelastic Saving

β and ϵ are two key parameters affecting the aggregate implications of capital mobility. Subsection 3.2 shows the welfare implications of full capital mobility in the case of elastic saving, $\epsilon > 0$ and $\beta < 1$. In the following, we analyze the welfare implications in two cases of inelastic saving.

Scenario I: $\epsilon = 0$ and $\beta \in (0, 1]$, i.e., individuals only have the labor income when young, $\mathbb{W}_t^{i,j} = \omega_t^i$. If the individual is fully patient ($\beta = 1$), it saves its entire labor income and its lifetime welfare only depends on its consumption when old, funded fully by its financial income, $u_t^{i,j} = c_{o,t+1}^{i,j} = \omega_t^i R_t^{i,j}$. If it is impatient ($\beta < 1$), it consumes a fraction $(1-\beta)$ of its labor income when young and save the rest. Its lifetime welfare depends on its consumption in both periods of life and the interest rate has smaller welfare impacts than in the case of $\beta = 1$, $u_t^{i,j} = \omega_t^i (R_t^{i,j})^{\beta}$. Here, *impatience weakens the welfare impacts of capital mobility via the interest rate channels.*

$\epsilon = 0$ is a sufficient condition for interest-inelastic saving where capital mobility reduces (raises) output in country S (N) and world output is lower than under IFA. For generation $t = 0$, given the predetermined labor income, $\omega_0^i = \omega_{IFA}^i$, capital mobility makes households better (worse) off and entrepreneurs worse (better) off in country S (N) through the interest rate channel. For generation $t \to \infty$, the declines (rises) in labor income and the equity rate make entrepreneurs in country S (N) worse (better) off than under IFA; as labor income and the loan rate move in the opposite direction, the welfare implications to households are ambiguous. Using equation (25) to substituting away ω_{FCM}^i, we rewrite the long-run household welfare as

$$u_{FCM}^{i,h} = \omega_{FCM}^i (R_{FCM}^{*,h})^{\beta} = \left[(1-\theta^i)\frac{R_{FCM}^{*,h}}{R_{FCM}^{*,e}} + \theta^i\right]^{\rho} (R_{FCM}^{*,h})^{\beta-\rho}.$$

The loan rate converges across the border and so does the equity rate, i.e., $R_{IFA}^{S,h} < R_{FCM}^{*,h} < R_{IFA}^{N,h}$, and $\frac{R_{IFA}^{S,h}}{R_{IFA}^{S,e}} < \frac{R_{FCM}^{*,h}}{R_{FCM}^{*,e}} < \frac{R_{IFA}^{N,h}}{R_{IFA}^{N,e}}$. Thus, $\beta \geq \rho$ is a sufficient condition for households in country S (N) to be better (worse) off in the long run than under IFA. Intuitively, being more patient (a larger β) amplifies the impacts of interest rates on welfare so that the interest rate effect is more likely to dominate the labor income effect.

Figure 10 shows the percentage change in welfare under full capital mobility versus under IFA in the case of $\epsilon = 0$ and $\beta = 1$. The dashed lines show the welfare changes for generation $t = 0$, $\left(\frac{u_0^{i,j}}{u_{IFA}^{i,j}} - 1\right) 100$, and the solid lines for generation $t \to \infty$, $\left(\frac{u_{FCM}^{i,j}}{u_{IFA}^{i,j}} - 1\right) 100$. The upper (lower) panels show the variables in country S (N) with $\theta^S \in (0, \bar{\theta})$ on the horizontal axes. The parameter values are the same as in the numerical example in subsection 3.1, except $\beta = 1$ and $\epsilon = 0$. Changes in the welfare of generation $t = 0$ ($t \to \infty$) reflect the short-run (long-run) welfare implications. Figure 11 shows the welfare changes in the case of $\epsilon = 0$ and $\beta = 0.4$.

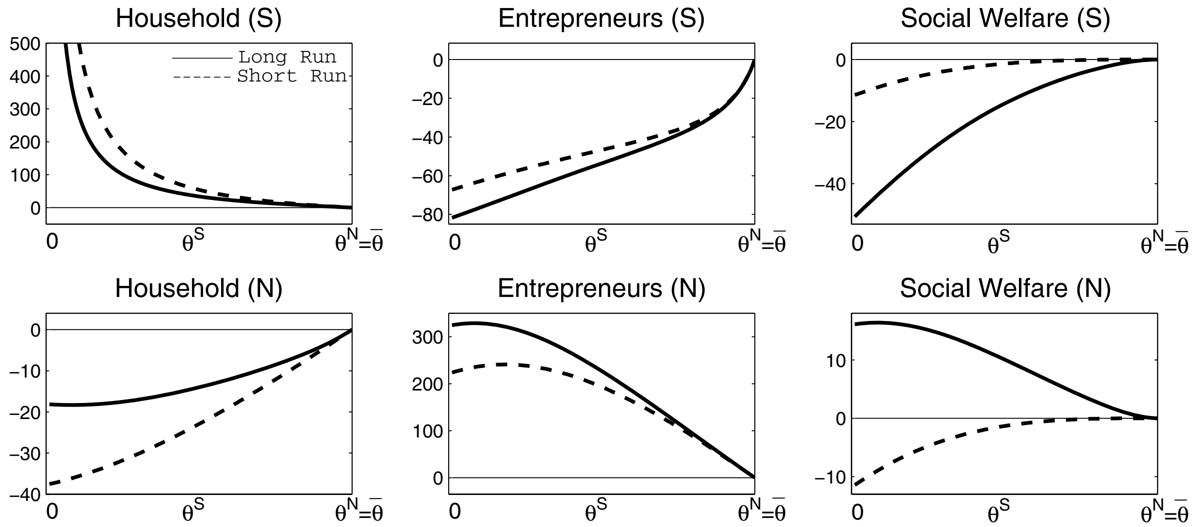

Figure 10: Percentage Changes in the Short- and Long-Run Welfare: $\epsilon = 0$ and $\beta = 1$

We choose the conventional value for the capital share in the aggregate production function, $\alpha = 0.36$. If $\beta = 1$, $\beta > \rho$ so that households in country S (N) are strictly better (worse) off in the long run, as shown in figure 10; if $\beta = 0.4$, $\beta < \rho$ so that households in country S (N) may be worse (better) off in the long run, as shown in figure 11. The welfare responses of other individuals are qualitatively the same in the two cases.

The social welfare of generation t is defined as the weighted sum of the welfare of individuals born in period t, $U_t^i \equiv (1-\eta)u_t^{i,h} + \eta u_t^{i,e} = \omega_t^i \mathbb{M}(R_t^{i,h}, R_t^{i,e}, \beta)$, where $\mathbb{M}(x_1, x_2, p)$ is the auxiliary function defined in subsection B.1. Full capital mobility affects social welfare of generation t through their labor income, ω_t^i, and a composite of interest rates in the form of a weighted average with power β, $\mathbb{M}(R_t^{i,h}, R_t^{i,e}, \beta)$. Upon capital mobility, the responses in labor income are unambiguous, while the responses in the composite of interest rates depend on β, which is analyzed as follows.

Figure 12 shows the composite of interest rates in the space of $(R^{i,h}, R^{i,e})$. Point S (N) denotes the interest rate combination in country S (N) in the steady state under IFA, point A

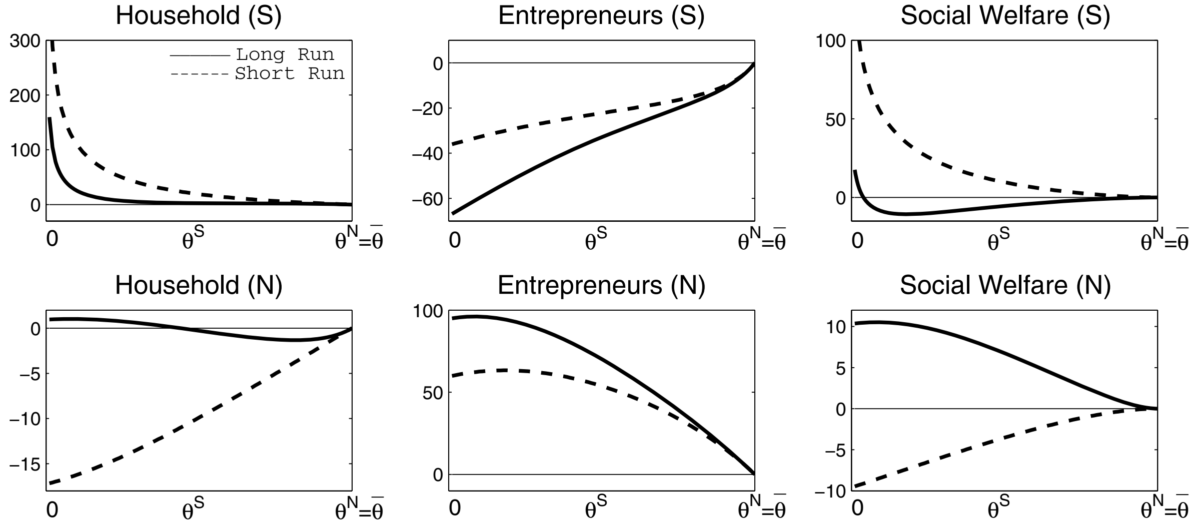

Figure 11: Percentage Changes in the Short- and Long-Run Welfare: $\epsilon = 0$ and $\beta = 0.4$

denotes that in period $t = 0$, and point L denotes that in period $t \to \infty$, i.e., in the steady state under full capital mobility.[16] According to equations (10) and (21), the reward splitting rules in the steady state under IFA and under full capital mobility, $(1-\eta)R^{i,h}_{IFA} + \eta R^{i,e}_{IFA} = \mathbb{R} = (1-\eta)R^{*,h}_{FCM} + \eta R^{*,e}_{FCM}$, implying that point S, N, and L are on the same isoquant (the thin solid straight line). As capital mobility reduces world output, the world-average wage in period $t = 1$ falls. The reward-splitting rule (21) in period $t = 0$, $(1-\eta)R^{*,h}_0 + \eta R^{*,e}_0 = \frac{\omega^w_1}{\omega^w_0}\mathbb{R} < \mathbb{R}$, implies that point A is on an isoquant (the thick solid straight line) below the previous one.

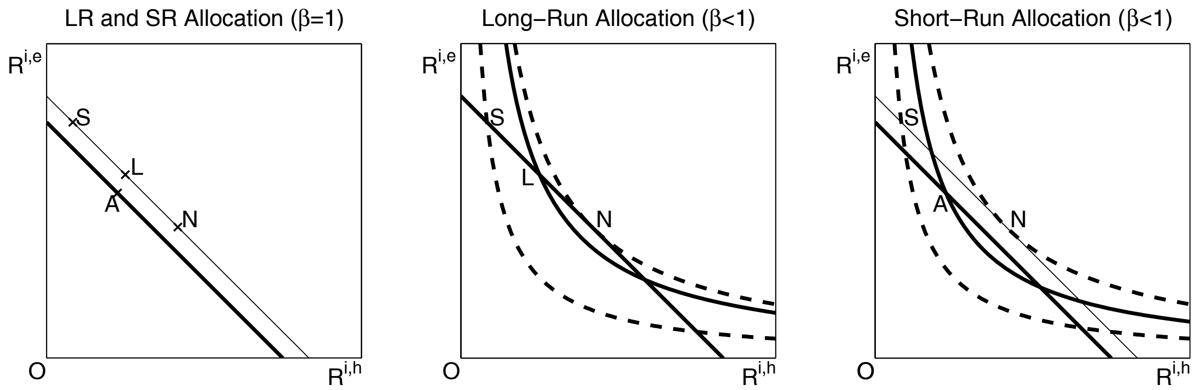

Figure 12: Graphic Illustration of $\mathbb{M}(R^{i,h}_t, R^{i,e}_t, \beta)$ under Full Capital Mobility versus IFA

$\mathbb{M}(R^{i,h}_t, R^{i,e}_t, \beta)$ can also be shown as the isoquant in the space of $(R^{i,h}, R^{i,e})$. In the case of $\beta = 1$, the isoquant of $\mathbb{M}(R^{i,h}_t, R^{i,e}_t, 1)$ is a downward-sloping straight line and coincides with the one representing the reward splitting rule. See the left panel of figure 12. In period $t = 0$, $\mathbb{M}(R^{i,h}_0, R^{i,e}_0, 1) = \frac{\omega^w_1}{\omega^w_0}\mathbb{R} < \mathbb{R}$, while in the steady state under IFA and under full capital mobility, $\mathbb{M}(R^{i,h}_{IFA}, R^{i,e}_{IFA}, 1) = \mathbb{M}(R^{i,h}_{FCM}, R^{i,e}_{FCM}, 1) = \mathbb{R}$. Thus, the composite of interest rates declines

[16]Under full capital mobility, the loan rate converges across the border and so does the equity rate. Thus, the interest rates in period $t = 0$ and in period $t \to \infty$ must be in the region to the lower-right of point S and to the upper-left of point N.

in period $t = 0$ and converges in the long run back to its initial level. It is driven by the world-average output growth effect.

In the case of $\beta < 1$, the isoquant of $\mathbb{M}(R_t^{i,h}, R_t^{i,e}, \beta)$ is convex and downward-sloping. The dashed curves and the solid curve in the middle panel of figure 12 are the isoquants of $\mathbb{M}(R_t^{i,h}, R_t^{i,e}, \beta)$ in the steady state under IFA and under full capital mobility. Due to the Jensen's inequality theorem, $\mathbb{M}(R_{IFA}^{S,h}, R_{IFA}^{S,e}, \beta) < \mathbb{M}(R_{FCM}^{i,h}, R_{FCM}^{i,e}, \beta) < \mathbb{M}(R_{IFA}^{N,h}, R_{IFA}^{N,e}, \beta)$. The dashed curves and the solid curve in the right panel of figure 12 show the isoquants of $\mathbb{M}(R_t^{i,h}, R_t^{i,e}, \beta)$ before and in period $t = 0$, respectively. The world-average growth effect reduces $\mathbb{M}(R_0^{i,h}, R_0^{i,e}, \beta)$, while the Jensen's inequality effect reduces $\mathbb{M}(R_{IFA}^{S,h}, R_{IFA}^{S,e}, \beta)$. If β is sufficiently small, the Jensen's inequality effect dominates so that $\mathbb{M}(R_0^{i,h}, R_0^{i,e}, \beta) > \mathbb{M}(R_{IFA}^{S,h}, R_{IFA}^{S,e}, \beta)$; if β is sufficiently close to one, the world-average growth effect dominates so that $\mathbb{M}(R_0^{i,h}, R_0^{i,e}, \beta) < \mathbb{M}(R_{IFA}^{S,h}, R_{IFA}^{S,e}, \beta)$. Nevertheless, $\mathbb{M}(R_0^{i,h}, R_0^{i,e}, \beta) < \mathbb{M}(R_{IFA}^{N,h}, R_{IFA}^{N,e}, \beta)$ always holds.

Let us analyze the responses of social welfare. For generation $t = 0$, given the labor income, $\omega_0^i = \omega_{IFA}^i$, social welfare is driven by the composite of interest rates $\mathbb{M}(R_0^{i,h}, R_0^{i,e}, \beta)$. Thus, the social welfare in country N declines while the responses of social welfare in country S depends on β. For generation $t \to \infty$, since the changes in the labor income and the composite of interest rates are opposite, the social welfare implications are ambiguous, depending on β.

Let us compare the social welfare responses in the cases of $\beta = 0.4$ versus $\beta = 1$ (the third columns of figures 11 and 10). For a decline in β from 1 to 0.4, the short-run social welfare responses in country S changes from negative to positive and so does the long-run social welfare responses for θ^S close to zero. Thus, *(im)patience is an important factor affecting the welfare implications of capital mobility.*

Scenario II: $\epsilon > 0$ and $\beta = 1$, i.e., individuals have the labor income in both periods but they consume only when old. Due to inelastic saving, the output implications are identical as in scenario I. Take the case of $\epsilon = 0$ and $\beta = 1$ in scenario I as the benchmark case. An individual's lifetime welfare depends on its financial income and labor income when old,

$$u_t^{i,j} = c_{o,t+1}^{i,j} = \omega_t^i R_t^{i,j} + \epsilon \omega_{t+1}^i = \omega_t^i \left(R_t^{i,j} + \epsilon \frac{\omega_{t+1}^i}{\omega_t^i} \right),$$

where $\epsilon \frac{\omega_{t+1}^i}{\omega_t^i}$ is the human wealth. A larger ϵ raises the relative importance of human wealth in the lifetime welfare.

For generation $t = 0$, given the predetermined labor income $\omega_0^i = \omega_{IFA}^i$, the welfare implications to entrepreneurs are qualitatively the same as in the benchmark case, because the equity rate and the wage move in the same direction; the welfare implications to households are weakened or may even be reversed, as the loan rate and the wage move in the opposite direction. For generation $t \to \infty$, an individual's welfare, $u_{FCM}^{i,j} = \omega_{FCM}^i (R_{FCM}^{i,j} + \epsilon)$, depends on the wage, the relevant interest rate, and ϵ. Compared with the benchmark case, $\epsilon > 0$ weakens but does not change qualitatively the welfare implications to entrepreneurs. [17]

[17] If both ω_{FCM}^S and $R_{FCM}^{S,e}$ fall by 1%, $u_{FCM}^{S,e}$ falls by 2% in the benchmark case and less than 2% in the current case.

Lemma 5. $\frac{\epsilon}{1+\epsilon} \leq \frac{\theta^i}{1-\eta}(1-\rho)$ *is a sufficient condition under which households of generation* $t \to \infty$ *in country S (N) are better (worse) off than under IFA.*

Proof. Use equation (25) to substitute away the wage in the steady state,

$$u^{i,h}_{FCM} = \omega^i_{FCM}(R^{i,h}_{FCM} + \epsilon) = \left[(1-\theta^i)\frac{R^{*,h}_{FCM}}{R^{*,e}_{FCM}} + \theta^i\right]^\rho [(R^{*,h}_{FCM})^{1-\rho} + \epsilon(R^{*,h}_{FCM})^{-\rho}].$$

Consider country S first. Compared with the scenario under IFA, $\frac{R^{*,h}_{FCM}}{R^{*,e}_{FCM}} > \frac{R^{*,h}_{IFA}}{R^{*,e}_{IFA}}$. Thus, a sufficient condition for $u^{S,h}_{FCM} > u^{S,h}_{IFA}$ is $[(R^{*,h}_{FCM})^{1-\rho} + \epsilon(R^{*,h}_{FCM})^{-\rho}] > [(R^{S,h}_{IFA})^{1-\rho} + \epsilon(R^{S,h}_{IFA})^{-\rho}]$, or equivalently to prove the function $Y = x^{1-\rho} + \epsilon x^{-\rho}$ is an increasing function of x for $x \in (R^{S,h}_{IFA}, R^{S,h}_{FCM})$. A sufficient condition for the latter is $(1-\rho)x^{-\rho} - \epsilon\rho x^{-\rho-1} > 0$ or $\frac{x(1-\rho)}{\rho} > \epsilon$. If $\frac{R^{S,h}_{IFA}(1-\rho)}{\rho} > \epsilon$ holds, Y is an increasing function of x for $x \in (R^{S,h}_{IFA}, R^{S,h}_{FCM})$. Use equation (13) to plug in the analytical solution of $R^{S,h}_{IFA} = \frac{\theta^i}{1-\eta}(1+\epsilon)\rho$, we get $\frac{\epsilon}{1+\epsilon} \leq \frac{\theta^i}{1-\eta}(1-\rho)$. $\square$

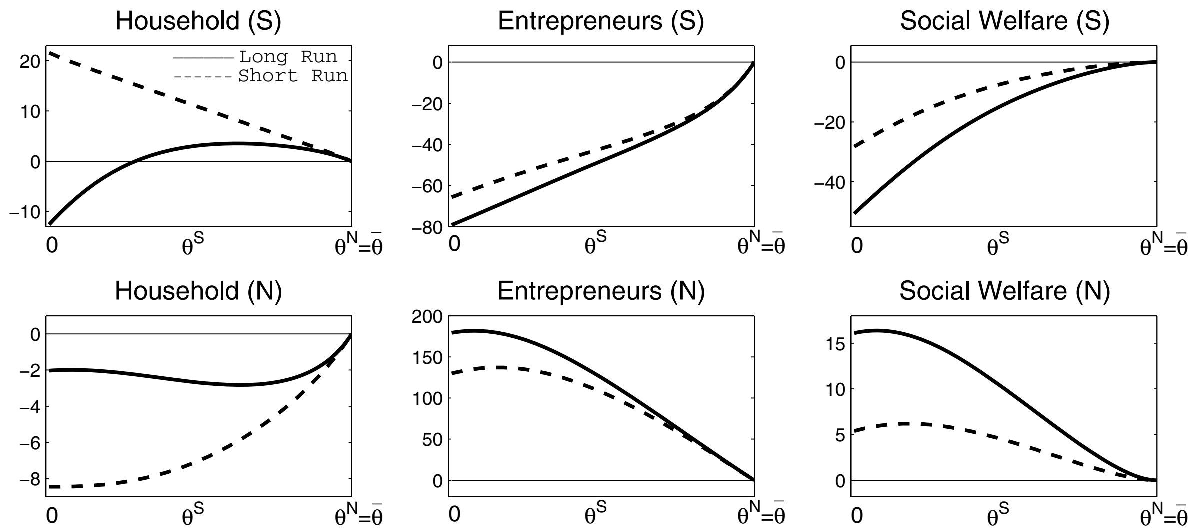

Figure 13: Short-Run and Long-Run Welfare Analysis with $\beta = 1$ and $\epsilon = 1$

A larger ϵ weakens the impact of the loan rate on the household's welfare. Similarly, a smaller θ^i implies a smaller $R^{i,h}_{IFA}$ and thus, given the positive constant ϵ, the impact of the loan rate is weakened. In both cases, the labor income effect is more likely to dominate and the condition in lemma 5 is less likely to hold.

Given the reward splitting rule (21), the social welfare of generation t is

$$U^i_t = (1-\eta)c^{i,h}_{o,t+1} + \eta c^{i,e}_{o,t+1} = \omega^i_t[(1-\eta)R^{i,h}_t + \eta R^{i,e}_t] + \epsilon\omega^i_{t+1} = \omega^i_t\left(\frac{\omega^w_{t+1}}{\omega^w_t}\mathbb{R} + \epsilon\frac{\omega^i_{t+1}}{\omega^i_t}\right).$$

Compared with the benchmark case, $\epsilon > 0$ does not change the social welfare implications, except for generation $t = 0$ in country N. The wage rise in period $t = 1$ weakens or even reverse the welfare implications to generation $t = 0$ in country N through the term $\epsilon\frac{\omega^N_{t+1}}{\omega^N_t}$.

Figure 13 shows the welfare implications of moving from IFA to full capital mobility. Similar as in the benchmark case, full capital mobility has the opposite welfare implications in the intraand intergenerational dimensions. As discussed above, households in country S are worse off in the long run for θ^S close to zero and the social welfare of generation $t = 0$ in country N rises, different from the results in the benchmark case. This way, *the positive human wealth ($\epsilon > 0$) becomes an additional channel through which capital mobility affects welfare.*

In the benchmark case and in scenario II, output is a sufficient statistics for social welfare. Due to world output losses, social welfare at the world level is lower than under IFA.

B.5 Robustness Tests for Emerging Asian Economies

We check the robustness of our results reported in subsection 3.4 by considering three alternative samples of emerging Asian economies. Sample (A) includes ASEAN-5, China, India, Korea, and Taiwan, which is called EAE-9 in short; sample (B) includes ASEAN-5, China and India; and sample (C) includes ASEAN-5, Korea, and Taiwan.

Take the right panels of figure 5 as the benchmark. Figure 14 shows that "two-way" gross capital flows and net capital outflows exist in the three alternative samples of emerging Asia; the upper-right panel of figure 14 shows that the size of FDI inflows in sample (C) is smaller than in ASEAN-5, which is driven by FDI outflows from Korea and Taiwan; the lower-middle panel of figure 14 shows that the size of PFCF outflows in sample (B) is smaller, which is driven by PFCF inflows to India. In particular, financial capital flows in the three alternative samples are essentially driven by the enormous foreign reserve accumulation in China, India, Korea, and Taiwan in 2000s, which eventually drives net capital flows, given the relatively stable FDI flows. Figure 15 shows the patterns of domestic credit to private sector in percentage of GDP and per capita GDP growth rate in the three alternative samples.

Table 2 report the regression results in four alternative settings for three alternative samples. Take table 1 as the benchmark. Including the four economies in the three alternative ways do not change the regression results qualitatively in the sense that γ_1 and γ_2 are negative and statistically significant at the 10% level, except in setting (4) and sample (C).

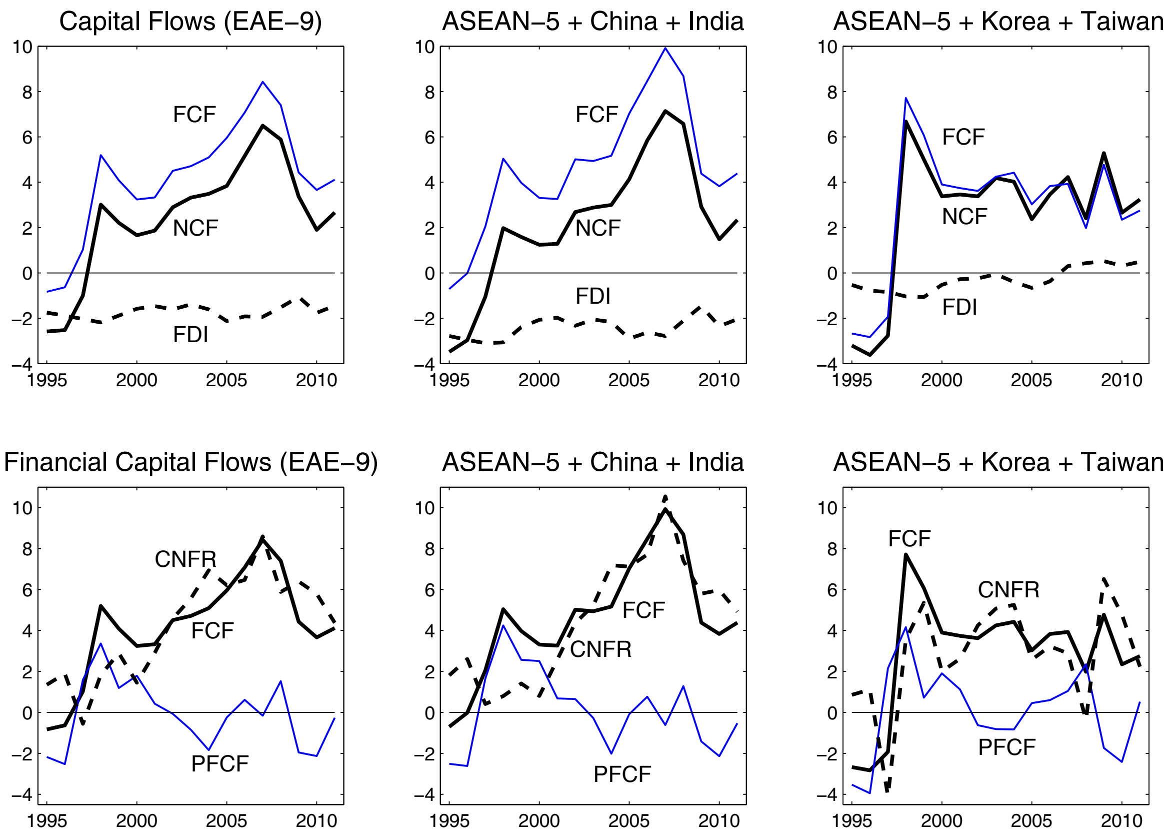

Figure 14: Patterns of Capital Flows in Emerging Asian Economies

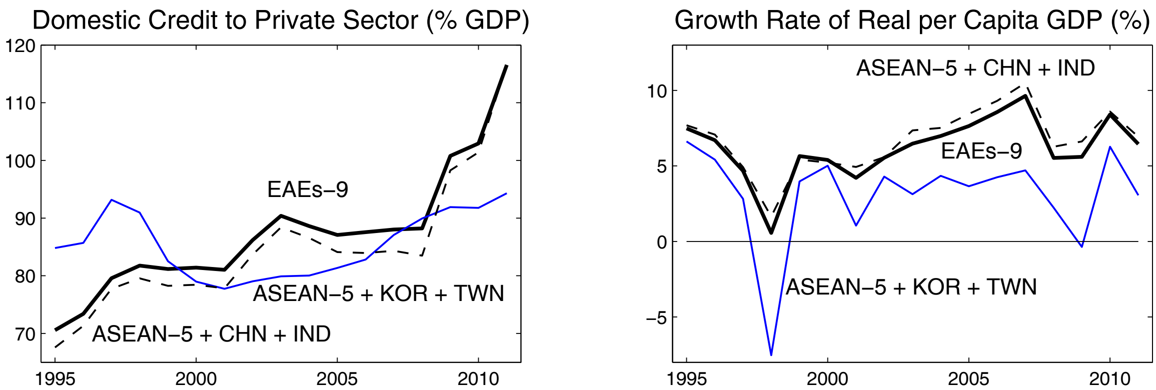

Figure 15: Financial Development and Growth Rate of GDP per Capita in EAEs

Table 2: Private Financial Capital Flows of Emerging Asian Economies

Samples	(A) EAE9				(B) ASEAN5+CHN+IND				(C) ASEAN5+KOR+TWN			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
growth rate of	-0.52	-0.61	-0.23	-0.19	-0.65	-0.70	-0.38	-0.34	-0.52	-0.70	-0.23	-0.18
per capita GDP	(0.00)	(0.00)	(0.01)	(0.06)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.12)
annual change in the	-0.18	-0.18	-0.14	-0.16	-0.20	-0.21	-0.14	-0.16	-0.20	-0.20	-0.16	-0.19
credit-to-GDP ratio	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
growth rate of world		0.24		-0.06		-0.05		-0.25		0.42		-0.08
per capita GDP		(0.26)		(0.78)		(0.82)		(0.29)		(0.13)		(0.76)
lagged credit-to-GDP		-0.01		0.04		-0.02		0.03		-0.01		0.04
ratio		(0.47)		(0.08)		(0.29)		(0.22)		(0.53)		(0.13)
ln lagged GDP		0.00		-0.01		0.00		-0.01		0.00		0.00
per capita		(0.93)		(0.62)		(0.85)		(0.77)		(0.99)		(0.91)
D98 for		0.00	0.05	0.05		-0.01	0.06	0.06		-0.02	0.06	0.06
ASEAN-5		(0.74)	(0.00)	(0.00)		(0.65)	(0.00)	(0.00)		(0.32)	(0.00)	(0.00)
number of observations	151	151	151	151	117	117	117	117	118	118	118	118
R^2	0.30	0.31	0.17	0.19	0.40	0.42	0.26	0.28	0.32	0.33	0.18	0.21

Figures in parenthesis are p-values.

Country fixed effects are included in all regressions.