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Abstract

We develop a two-country overlapping-generations model with domestic financial frictions and show that cross-country differences in financial development explain three recent patterns of international capital flows. In our model, domestic financial frictions distort the interest rates and production efficiency in the less financially developed country. Capital flows not only lead to cross-country resource reallocation, but also trigger within-country resource reallocation among firms. From the efficiency perspective, full capital mobility raises the world output higher than under international financial autarky. If the mobility of either financial capital or foreign direct investment is restricted, the world output may be lower.

JEL Classification: E44, F41

Keywords: Capital account liberalization, financial frictions, financial development, foreign direct investment, world output gains

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1 Introduction

This paper analyzes how the recent empirical patterns of international capital flows may affect production efficiency in a two-country overlapping-generations model. According to the standard neoclassical macroeconomic theory, capital should flow "downhill" from the rich country where the marginal return on capital is low to the poor country where the marginal return on capital is high, which would make the world output higher than under international financial autarky. Meanwhile, there would be no difference between gross and net capital flows because capital flows would be unidirectional.

The recent empirical patterns of international capital flows are in stark contrast to these predictions (Lane and Milesi-Ferretti, 2001, 2006, 2007). First, capital in the net term flows "uphill" from poor to rich countries (Prasad, Rajan, and Subramanian, 2006, 2007). Second, financial capital flows from poor to rich countries, while foreign direct investment (hereafter, FDI) flows in the opposite direction (Ju and Wei, 2007). Third, despite of its negative net positions of international investment 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). According to neoclassical models, the recent pattern of "uphill" net capital flows tends to reduce the world output. However, in order to evaluate its efficiency effects, we need a model having the theoretical predictions in line with the current patterns of capital flows.

Recent research offers two main explanations to these empirical facts. Devereux and Sutherland (2009) and Tille and van Wincoop (2008a,b) focus on the risk-sharing that investors can achieve by diversifying investment globally. International portfolio investment is determined by the cross-correlation patterns of aggregate shocks hitting individual economies. These models do not distinguish between FDI and portfolio investment.

The second strand of literature emphasizes the implications of domestic financial market imperfections on the patterns of international capital flows (Antras and Caballero, 2009; Antras, Desai, and Foley, 2009; Aoki, Benigno, and Kiyotaki, 2009a,b; Caballero, Farhi, and Gourinchas, 2008; Mendoza, Quadrini, and Ríos-Rull, 2009; Smith and Valderrama, 2008). Matsuyama (2004) shows that in the presence of domestic credit market imperfections, financial market globalization may lead to a steady-state equilibrium in which fundamentally identical countries end up with different levels of output per capita, a result he calls "symmetry breaking". In the steady state, capital flows "uphill" from the poor to the rich country. Given the concave production function on the country level, the world output is lower than under international financial autarky. Ju and Wei (2007, 2008) analyze how the cross-country differences in various institutional aspects jointly generate the two-way flows of financial capital and FDI. The distinction between FDI and portfolio investment plays a key role in their models.

von Hagen and Zhang (2010) follow the second strand of the literature and prove analytically that the cross-country difference in financial development is sufficient to explain the three recent empirical facts. Intuitively, individuals differ in productivity and the credit markets channel savings from those with low to those with high productivity. If the credit market were perfect, production would be efficiently conducted by the most productive individuals and the rates of return on loans and equity capital would be equal to the social rate of return. However, due to domestic financial frictions, the most productive individuals are subject to borrowing constraints. The constraint on the aggregate credit demand keeps the rate of return on loan, i.e., the loan rate, inefficiently lower while the rate of return to equity capital, i.e., the equity rate, higher than social rate of return. Thus, financial frictions distort the two interest rates. Under full capital mobility, since the more financially developed country has a larger credit market, it receives net capital inflows and becomes richer. Thus, in the steady state, net capital flows are "uphill" from the poor to the rich country. Since the loan rate is lower while the equity rate is higher in the less financially developed country under international financial autarky, financial capital flows from the poor to the rich country while FDI flows in the opposite direction. Since the rich country receives a higher return on its foreign assets than it pays for its foreign liabilities, it receives a positive net investment income despite of its negative net position of international investment. Thus, von Hagen and Zhang (2010) generates the theoretical predictions in line with the three recent empirical facts.

For the tractability purpose, von Hagen and Zhang (2010) assume that only some individuals are endowed with the productive projects while others just lend all the savings inelastically to them. The loan rate adjusts to clear the credit market and the total savings are entirely invested by the most productive individuals. Thus, financial frictions in the model of von Hagen and Zhang (2010) do not distort production efficiency under international financial autarky. Under capital mobility, net capital flows widen the cross-country output gap so that the world output is lower than under international financial autarky. The world output losses in Matsuyama (2004) are caused by the same reason. This result can be explained intuitively by the theory of second best. Given that domestic financial frictions distort the two interest rates, capital mobility causes financial capital (FDI) flowing to the country where the loan rate (the equity rate) is higher rather than to the country where the marginal product of capital is higher. Thus, in the presence of domestic financial frictions, factor mobility may not increase the world output.

As widely documented in the empirical literature (Barlevy, 2003; Hsieh and Klenow, 2009; Jeong and Townsend, 2007; Levine, 1997; Midrigan and Xu, 2009), financial frictions also distort production efficiency in the sense that some resources are inefficiently allocated into the less productive projects. If this distortion is not considered in the model, the efficiency analysis of international capital flows will be incomplete and misleading.

In this paper, we extend the models of Matsuyama (2004) and von Hagen and Zhang (2010) by assuming that all individuals can produce, but they differ in productivity. As a result, financial frictions create two distinct distortions on the interest rates and on production efficiency under international financial autarky. Under capital mobility, the cross-country interest rate differential drives international capital flows. In equilibrium, the interest rates in the less financially developed country converge towards their respective efficient levels. Meanwhile, capital flows trigger the capital reallocation both across and within the border from the less to the more productive individuals. This way, international capital flows mitigate the two distinct distortions of financial frictions.

Similar as von Hagen and Zhang (2010), this model generates the patterns of capital flows qualitatively in line with the recent empirical facts mentioned above. Then, we use the model to analyze how such patterns affect the world output. As mentioned above, "uphill" net capital flows widen the cross-country output gap and tend to reduce the world output, while FDI and financial capital flows improve production efficiency in the less financially developed country, which tends to raise the world output. The first effect depends on net capital flows, while the second effect depends on gross capital flows. Under full capital mobility, two-way capital flows imply large gross flows and small net flows, which strengthens the second effect and weakens the first effect, respectively. Thus, the world output is higher. While, if the mobility of either FDI or financial capital is restricted, net flows and gross flows are same. Thus, the second effect may not be strong enough to dominate the first one and capital mobility may reduce the world output. In the net shell, capital reallocation within and across the border is the key mechanism behind the output effect on the country and world level.

We also analyze how capital mobility affects the convergence process of a developing country. We show that full capital mobility speeds up capital accumulation in the early stage of its convergence process at the cost of lower output in the long run.

The rest of this paper is organized as follows. Section 2 describes the basic model under international financial autarky and discusses how domestic financial frictions may distort the interest rates and production efficiency. Section 3 analyzes how the cross-country difference in financial development may drive the patterns of capital flows and affect the world production efficiency. Section 4 concludes with the main findings. The appendix collects proofs and other related issues.

2 The Model under International Financial Autarky

2.1 The Model Setting

We use an overlapping-generations model closely related to Matsuyama (2004) and von Hagen and Zhang (2010). The world economy consists of two countries, Home (H) and Foreign (F). There are two types of goods, a final good, which is internationally tradable and serves as the numeraire, and a capital good, which is not traded internationally. The price of the capital good in country $i \in \{H, F\}$ and period t is denoted by v_t^i. The final good can be either consumed or transformed into capital goods. At the beginning of each period, final goods Y_t^i are produced with capital goods K_t^i and labor L_t^i in a Cobb-Douglas fashion. Capital goods fully depreciate after production. Capital goods and labor are priced at their respective marginal products in terms of final goods. To summarize,

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

$$v_t^i K_t^i = \alpha Y_t^i \qquad \text{and} \qquad w_t^i L_t^i = (1-\alpha) Y_t^i. \tag{2}$$

There is no uncertainty in the economy. In this section, we assume that capital flows are not allowed between the two countries.

In both countries, the population consists of two generations, the old and the young, which live for two periods each. There is no population growth and the population size of each generation in each country is normalized to one. Agents consume only when old. Young agents are endowed with a unit of labor which they supply inelastically to the production of final goods $L_t^i = 1$ at the wage rate w_t^i in period t.

Each generation consists of two types of agents of mass η and $1-\eta$, respectively, which we call *entrepreneurs* and *households*. They are endowed with productive projects and it takes one period to produce capital goods using final goods. By assumption, the project of entrepreneurs has a higher marginal product than that of households. In equilibrium, entrepreneurs prefer to borrow from households to finance their investment.

Consider any particular household born in period t and country i. The household invests $i_t^{i,h}$ in his project, and lends the rest of his labor income, $d_t^i = w_t^i - i_t^{i,h}$, at the gross interest rate of r_t^i. In period $t+1$, he receives the deposit returns, $r_t^i d_t^i$, and his project produces $G(i_t^{i,h})$ units of capital goods. As summarized in Assumption 1, the household project is strictly concave with an upper bound of R on the marginal product,

Assumption 1. *$G(i_t^{i,h}) > 0$, $G'(i_t^{i,h}) > 0$, $G''(i_t^{i,h}) < 0$, $\forall\ i_t^{i,h} > 0$; $G(0) = 0$, $G'(0) = R$.*

In period t, the household chooses $i_t^{i,h}$ to maximize his consumption when old,

$$c_{t+1}^{i,h} = r_t^i (w_t^i - i_t^{i,h}) + v_{t+1}^i G(i_t^{i,h}). \tag{3}$$

In equilibrium, he is indifferent between lending and investing in his own project,

$$r_t^i = v_{t+1}^i G'(i_t^{i,h}). \tag{4}$$

Consider any particular entrepreneur born in period t and country i. The entrepreneur invests $i_t^{i,e}$ units of final goods in the project which produces $R i_t^{i,e}$ units of capital goods in period $t+1$. Assumption 1 ensures that the entrepreneurial project is always more productive than the household project. The entrepreneur finances his investment $i_t^{i,e}$ using the loan $z_t^i = i_t^{i,e} - w_t^i$ and the equity capital, w_t^i. Due to limited commitment problems, however, his debt repayment cannot exceed a fraction of his project revenues,

$$r_t^i z_t^i = r_t^i (i_t^{i,e} - w_t^i) \le \theta^i R i_t^{i,e} v_{t+1}^i, \quad \text{where} \;\; \theta^i \in [0,1]. \tag{5}$$

As in Matsuyama (2004, 2007), the level of financial development in country i is measured by $\theta^i \in [0,1]$, which is higher in countries with more sophisticated financial and legal systems, better creditor protection, and more liquid asset market. Thus, θ^i captures a wide range of institutional factors.[1] We assume that country H and country F differ only in the level of financial development, $0 \leq \theta^H < \theta^F \leq 1$.

After repaying the debt in period $t+1$, the entrepreneur receives $Ri_t^{i,e} v_{t+1}^i - r_t^i z_t^i$ as the return on equity capital. The equity rate is the rate of return on equity capital,

$$\Gamma_t^i \equiv \frac{Ri_t^{i,e} v_{t+1}^i - r_t^i z_t^i}{w_t^i} = Rv_{t+1}^i + (Rv_{t+1}^i - r_t^i)(\lambda_t^i - 1) \geq r_t^i, \tag{6}$$

where $\lambda_t^i \equiv \frac{i_t^{i,e}}{w_t^i}$ denotes the investment-equity ratio. For each unit of the equity capital invested in the project, the entrepreneur gets Rv_{t+1}^i as the marginal return. In addition, he can borrow $(\lambda_t^i - 1)$ units of debt which provides him an extra rate of return, $(Rv_{t+1}^i - r_t^i)$. The term, $(Rv_{t+1}^i - r_t^i)(\lambda_t^i - 1)$, captures the *leverage* effect, which can be decomposed into two parts, the *debt-equity ratio* $(\lambda_t^i - 1)$ and the *spread*, $(Rv_{t+1}^i - r_t^i)$. In equilibrium, the equity rate should be no less than the loan rate; otherwise, the entrepreneur would rather lend than borrow. The inequality in (6) is equivalent to $r_t^i \leq Rv_{t+1}^i$ and we call it the participation constraint for the entrepreneur.

If $r_t^i < Rv_{t+1}^i$, the entrepreneur borrows to the limit, i.e., he finances the investment $i_t^{i,e}$ using $\frac{\theta^i v_{t+1} Ri_t^{i,e}}{r_t^i}$ units of loan and w_t^i units of equity capital in period t. After repaying the debt in period $t+1$, the entrepreneur gets $(1-\theta^i)v_{t+1}Ri_t^{i,e}$ as the project return. If $r_t^i = Rv_{t+1}^i$, the entrepreneur does not borrow to the limit. According to equation (6), the equity rate is equal to the loan rate, $\Gamma_t^i = r_t^i$. To summarize,

$$\Gamma_t^i = \begin{cases} \frac{(1-\theta^i)Rv_{t+1}^i i_t^{i,e}}{w_t^i} = \frac{(1-\theta^i)Rv_{t+1}^i}{1-\frac{\theta^i Rv_{t+1}^i}{r_t^i}}, & \text{if } r_t^i < Rv_{t+1}^i, \\ Rv_{t+1}^i & \text{if } r_t^i = Rv_{t+1}^i. \end{cases} \tag{7}$$

The entrepreneur chooses his investment $i_t^{i,e}$ to maximize his consumption when old,

$$c_{t+1}^{i,e} = v_{t+1}^i Ri_t^{i,e} - r_t^i z_t^i = w_t^i \Gamma_t^i, \tag{8}$$

subject to the borrowing constraint (5) and the participation constraint (6). Note that only one of the two constraints can be strictly binding in equilibrium.

Aggregate capital goods available for aggregate production in period $t+1$ is

$$K_{t+1}^i = \eta Ri_t^{i,e} + (1-\eta)G(i_t^{i,h}). \tag{9}$$

[1] The pledgeability, θ^i, can be argued in various forms of agency costs (Hart and Moore, 1994; Holmstrom and Tirole, 1997; Townsend, 1979). The strictness of the borrowing constraint may also depend on idiosyncratic features of entrepreneurs and their projects, e.g., the credit records, the availability of collateral assets, the project rating, etc. Since we focus here on the aggregate implications of financial development, we assume that the entrepreneurial projects invested in country i are homogeneous and subject to the same θ^i for simplicity.

The credit market and the final goods market clear in equilibrium,

$$\eta z_t^i = (1-\eta) d_t^i \quad \text{or} \quad \eta(i_t^{i,e} - w_t^i) = (1-\eta)(w_t^i - i_t^{i,h}), \tag{10}$$

$$C_t^i + I_t^i = Y_t^i, \tag{11}$$

where $C_t^i \equiv \eta c_t^{i,e} + (1-\eta) c_t^{i,h}$ and $I_t^i \equiv \eta i_t^{i,e} + (1-\eta) i_t^{i,h}$ denote aggregate consumption and aggregate investment in country i and period t. As the household project is less productive than the entrepreneurial project, aggregate production is efficient when investment is entirely conducted by entrepreneurs. We measure production inefficiency by $\frac{(1-\eta) i_t^{i,h}}{I_t^i}$.

Definition 1. *Given the level of financial development θ^i, the market equilibrium in country $i \in \{H, F\}$ under international financial autarky is a set of allocations of households, $\{i_t^{i,h}, c_t^{i,h}\}$, entrepreneurs, $\{i_t^{i,e}, c_t^{i,e}\}$, and aggregate variables, $\{Y_t^i, K_t^i, w_t^i, v_t^i, r_t^i, \Gamma_t^i\}$, satisfying equations* (1)-(5), (7)-(10),

Under international financial autarky, young individuals invest their labor income in the production of capital goods, $I_t^i = w_t^i = (1-\alpha) Y_t^i$. The social rate of return to the aggregate investment is defined as the ratio of the aggregate project revenue in period $t+1$ over the aggregate investment in period t, $\Psi_t^i \equiv \frac{v_{t+1}^i K_{t+1}^i}{w_t^i} = \frac{\alpha Y_{t+1}^i}{(1-\alpha) Y_t^i}$, which is constant in the steady state at $\Psi^i = \rho \equiv \frac{\alpha}{1-\alpha}$.

Given the size of the working population normalized at one, the capital-labor ratio coincides with the aggregate capital stock, K_t^i. For simplicity, we use K_t^i to denote the capital-labor ratio, too. According to equations (1) and (2), the wage rate $w_t^i = \left(\frac{K_t^i}{\rho}\right)^\alpha$ is uniquely determined by the capital-labor ratio. According to equation (9), the capital-labor ratio in period t is determined in period $t-1$ by the size and the distribution of the aggregate investment among entrepreneurs and households.

2.2 Existence, Uniqueness, and Stability of The Steady State

We show the existence, uniqueness and stability of the steady state under international financial autarky by analyzing the phase diagram of wages. For simplicity, we drop the country superscripts in the following analysis.

Proposition 1. *Let $\bar{\theta} \equiv 1-\eta$. For $\theta \in [\bar{\theta}, 1]$, aggregate production is efficient, $i_t^h = 0$; the economic allocation is independent of θ and identical as in the case of $\theta = \bar{\theta}$.*

Proof. See appendix A. □

In the case of $\theta \in [\bar{\theta}, 1]$, the aggregate labor income in period t is entirely invested into the entrepreneurial projects, $I_t = \eta i_t^e = w_t$, and, thus, aggregate capital goods available for production in period $t+1$ is $K_{t+1} = R\eta i_t^e = R w_t$. The model dynamics can be characterized by a first-order difference equation on the wage dynamics,

$$w_{t+1} = (1-\alpha) Y_{t+1} = \left(\frac{R w_t}{\rho}\right)^\alpha. \tag{12}$$

Given $\alpha \in (0,1)$, the phase diagram of wages is concave and starts from the origin. Its slope, $\frac{dw_{t+1}}{dw_t} = \alpha \left(\frac{R}{\rho}\right)^{\alpha} (w_t)^{\alpha-1}$, converges to $+\infty$ for $w_t \to 0$ and to 0 for $w_t \to +\infty$. Thus, there exists a unique and stable non-zero steady state with the wage at

$$w_{IFA} = \left(\frac{R}{\rho}\right)^{\rho}, \tag{13}$$

where the subscript IFA denotes the steady-state value of a variable under international financial autarky. According to equations (12) and (13), the wage dynamics are independent of θ and the wage converges globally and monotonically to the steady-state value w_{IFA}, same in the two countries. So do aggregate output and the capital-labor ratio.

Proposition 2. *For $\theta \in [0, \bar{\theta})$, some resources are inefficiently allocated into the household projects, $i_t^h > 0$. Given the capital-labor ratio, financial development facilitates resource reallocation from the less to the more productive projects, $\frac{\partial i_t^h}{\partial \theta} < 0 < \frac{\partial i_t^e}{\partial \theta}$, and the improvement in production efficiency raises the wage in the next period, $\frac{\partial w_{t+1}}{\partial \theta} > 0$.*

Proof. See appendix A. □

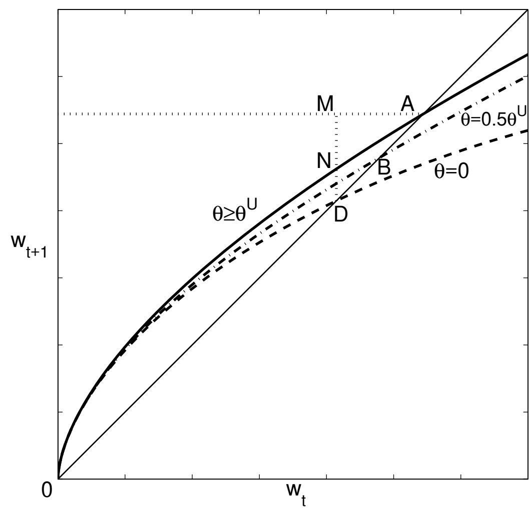

Figure 1: The Phase Diagram of Wages

Figure 1 shows the phase diagrams of wages in three cases, $\theta \in \{0, 0.5\theta^U, \theta^U\}$, where $\theta^U \equiv \bar{\theta}$. For the illustrative purpose, consider the case where the credit market is inactive ($\theta = 0$) and the economy is in the steady state (point D) before period $t = 0$. From period $t = 0$ on, the credit market is fully developed with $\theta \geq \bar{\theta}$ and thus, entrepreneurs are not credit-constrained. In period $t = 0$, the investment in the household project falls to zero and the aggregate labor income is fully invested in the entrepreneurial project in period $t = 0$. DN measures the *short-run efficiency gains* in terms of the rise in the labor income in period $t = 1$. From period $t = 1$ on, the wage converges to the new steady state (point A) and NM measures the *long-run efficiency gains* due to capital accumulation. Figure 1 also shows that there exists a unique and stable steady state if the borrowing constraints are binding, $\theta \in [0, \bar{\theta})$.

2.3 Decomposition of The Two Interest Rates

The interest rate patterns with respect to financial development deserve special attention, because the cross-country interest rate differentials essentially drive capital flows in section 3. In this subsection, we identify the various channels through which financial development may affect the two interest rates under international financial autarky.

Proposition 3. *For $\theta \in [\bar{\theta}, 1]$, the borrowing constraints are not binding and two interest rates are equal to the social rate of return, $r_t = \Gamma_t = \Psi_t = Rv_{t+1} = R^{\alpha}\rho^{1-\alpha^2}(K_t)^{\alpha(\alpha-1)}$.*

Proof. See appendix A. □

According to equation (1), the neoclassical aggregate production function is concave in the capital-labor ratio, K_t. The marginal rate of return to investment Rv_{t+1} declines with K_t and so does the social rate of return, which we call the *neoclassical* effect. For $\theta \in [\bar{\theta}, 1]$, the two interest rates are equal to the social rate of return, independent of θ.

Proposition 4. *For $\theta \in [0, \bar{\theta})$, the borrowing constraints are binding and the loan rate is lower while the equity rate is higher than the social rate of return, $r_t < \Psi_t < Rv_{t+1} \leq \Gamma_t$.*

Proof. See appendix A. □

Given $\theta \in [0, \bar{\theta})$, we first analyze how financial development measured by a marginal increase in θ affects the loan rate. Combining equations (5) and (10), the loan rate is,

$$r_t = Rv_{t+1}\frac{\theta}{(1-\eta)}\left[\frac{\eta w_t}{(1-\eta)(w_t - i_t^h)} + 1\right](1-\eta).$$

Besides the neoclassical effect Rv_{t+1}, the loan rate is also affected by the *financial-development* effect $\frac{\theta}{1-\eta}$, and the *credit-supply* effect, $(1-\eta)(w_t - i_t^h)$.

The aggregate credit demand, $D_t = \eta\frac{\theta Rv_{t+1} i_t^e}{r_t}$, declines with the loan rate and the curve is downward sloping. According to equation (4), given a rise in the loan rate, households reduce the project investment, $\frac{\partial i_t^h}{\partial r_t} < 0$, and raise their lending. Thus, the aggregate credit supply, $S_t = (1-\eta)(w_t - i_t^h)$, rises in the loan rate and the curve is upward sloping.

Figure 2 illustrates how the credit market equilibrium responds immediately to a marginal increase in the level of financial development from θ^A to θ^B in period t, where $0 \leq \theta^A < \theta^B < \bar{\theta}$. Given w_t and θ^A, the aggregate credit demand curve and the aggregate credit supply curve jointly determine the credit market equilibrium at point A. With a marginal increase in θ, entrepreneurs can borrow against a larger fraction of the project revenues and the aggregate credit demand curve shifts to the right. It tends to raise the loan rate and is captured by the financial-development effect. At the same time, the resource reallocation from households to entrepreneurs improves production efficiency and the aggregate output of capital goods in period $t+1$ increases. The decline in the price of capital goods in period $t+1$ has a negative impact on the loan rate, which is captured by

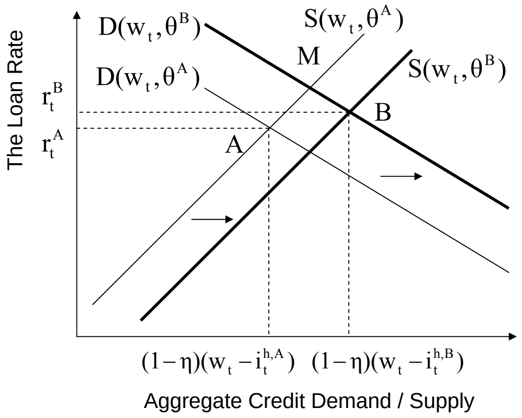

Figure 2: Immediate Impacts of Financial Development on the Loan Rate

the neoclassical effect. The decline in the price of capital goods also induces households to reduce the project investment and the aggregate credit supply curve shifts to the right. It tends to reduce the loan rate and is captured by the credit-supply effect. Overall, given the labor income, an increase in θ shifts the equilibrium from point A to point B[2] and the net impact on the loan rate in period t depends on the relative size of the three effects.

For $\theta = 0$, aggregate production is least efficient in the sense that households invest all the labor income in their own projects and the marginal productivity differential is largest, $R - G'(i_t^h)$. A marginal increase in θ generates large short-run efficiency gains and the price of capital goods in period $t+1$ declines significantly. As a result, both the neoclassical effect and the credit-supply effect are strong, which partially offsets the financial-development effect. In the net term, the loan rate rises slightly with θ. In contrast, for θ close to $\bar{\theta}$, the household project investment is small and so is the marginal productivity differential. A marginal increase in θ only generates small efficiency gains and the price of capital goods declines slightly in period $t+1$. As a result, both the neoclassical effect and the credit-supply effect are weak, which is dominated by the financial-development effect. In the net term, the loan rate rises significantly with θ.

Proposition 5. *Given the capital-labor ratio, the loan rate has the highest value at $\theta = \bar{\theta}$.*

Proof. See appendix A. □

Proposition 5 confirms that the loan rate pattern is upward sloping near the upper bound of $\theta = \bar{\theta}$. Overall, the loan rate has a non-linear pattern with respect to $\theta \in [0, \bar{\theta}]$, due to the endogenous credit supply. Be specific, it is rather flat near the lower bound of $\theta = 0$ but strictly upward sloping near the upper bound of $\theta = \bar{\theta}$.

Up to now, we focus on the immediate impact of financial development on the loan rate in period t, given the capital-labor ratio. As shown in figure 1, an increase in

[2]Figure 2 is only for the illustrative purpose. Exact changes in the supply and demand curves are more complicated, e.g., the neoclassical effect may further shift credit demand and supply curves. We only show the equilibria before and after the change for simplicity.

θ immediately generates the short-run efficiency gains and then, capital accumulation generates the long-run efficiency gains over time. Thus, besides its immediate impacts via the three effects mentioned above, financial development affects the loan rate in the long run indirectly through capital accumulation.

Proposition 6. *For $\theta \in (0, \bar{\theta})$, the labor income has a positive and less-than-proportional effect on the household project investment, $0 < \frac{\partial i_t^h}{\partial w_t} < \frac{i_t^h}{w_t}$.*

Proof. See appendix A. □

A marginal increase in θ in period t improves production efficiency and the labor income in period $t+1$ is higher. According to Proposition 6, households invest the extra labor income less-than-proportional into their own projects but lend more-than-proportional to the credit market in period $t+1$. This way, capital accumulation further strengthens resource reallocation and improves production efficiency over time. Due to the enhanced neoclassical effect, the loan rate tends to be lower in the long run.

For a smaller initial value of θ, a marginal increase in θ generates a stronger short-run efficiency gains and so are the long-run efficiency gains due to capital accumulation. Thus, the long-run pattern of the loan rate becomes flatter or even downward sloping near the lower bound of $\theta = 0$. Since the social rate of return is constant at $\Psi = \rho$ in the long run, the loan rate pattern is steeper near the upper end of $\theta = \bar{\theta}$ than its short-run pattern, depending on the functional form of the household project.

For $\theta \in [0, \bar{\theta})$, let us analyze how financial development may affect the equity rate. Combining equations (6) and (10), we reformulate the equity rate as

$$\Gamma_t = Rv_{t+1} + (Rv_{t+1} - r_t)(\lambda_t - 1), \quad \text{where} \quad \lambda_t - 1 = \frac{1-\eta}{\eta}\left(1 - \frac{i_t^h}{w_t}\right). \tag{14}$$

Financial development has an immediate impact on the equity rate in period t through three channels. First, the improvement in production efficiency leads to the decline in the price of capital goods in period $t+1$. It tends to reduce the equity rate and is captured by the neoclassical effect Rv_{t+1}. Second, the decline in the price of capital goods induces households to lend more to the credit market. It raises the debt-equity ratio $(\lambda_t - 1)$ and tends to raise the equity rate. Third, the decline in the project investment of households reduces the marginal product differential. It reduces the spread, $v_{t+1}R - r_t = v_{t+1}[R - G'(i_t^h)]$ and tends to reduce the equity rate. The net impact depends on the relative size of the three effects.

Given the capital-labor ratio, production is least efficient at $\theta = 0$ in the sense that the marginal product differential is largest, $R - G'(w_t)$ and so is the spread $(Rv_{t+1} - r_t) = v_{t+1}[R - G'(w_t)]$. For a marginal increase in θ at the lower bound of $\theta = 0$, the credit-supply effect is strong and so is the rise in the debt-equity ratio. It dominates the declines in the price of capital goods and the spread. Thus, the equity rate rises with θ. For θ close to $\bar{\theta}$, the household project investment is small. Given a marginal increase in θ, resource reallocation is small and so is the rise in the debt-equity ratio. The declines in the spread and in the price of capital goods dominate. Thus, the equity rate declines with θ.

Proposition 7. *Given the capital-labor ratio, the equity rate has the lowest value at $\theta = \bar{\theta}$.*

Proof. See appendix A. □

Proposition 7 confirms that the equity rate pattern is downward sloping near the upper bound of $\theta = \bar{\theta}$. Overall, the equity rate has a hump-shaped pattern with respect to $\theta \in [0, \bar{\theta}]$, mainly due to the flat pattern of the loan rate at the lower bound of θ.

Financial development also affects the equity rate in the long run via capital accumulation and the hump-shaped pattern of the equity rate is reinforced.

2.4 Parameterization

Introducing the concave household project into the analytical framework of von Hagen and Zhang (2010) makes the model less tractable. Since we focus here more on the qualitative results, a numerical example is used to show the intuition explicitly.

We set $\eta = 0.2$ and $R = 1$ implying that entrepreneurs account for 20% of the population and produce capital goods one-to-one from final goods. According to Proposition 1, $\bar{\theta} = 1 - \eta = 0.8$. The household project has a linear-quadratic form, $G(i_t^h) = Ri_t^h - \frac{(i_t^h)^2}{2}$, where $G'(i_t^h) = R - i_t^h > 0$, $G''(i_t^h) = -1 < 0$, for $i_t^h \in (0, R)$. The functional form of household project and the values of α, R and η do not matter for our qualitative results.

In the standard neoclassical growth model, the capital share has a conventional value around $\alpha = \frac{1}{3}$. If so, our model economy under international financial autarky becomes dynamically inefficient in the sense that the social rate of return is smaller than one in the steady state, $\Psi = \frac{\alpha}{1-\alpha} < 1$. Thus, we have to set $\alpha > 0.5$ to ensure $\Psi > 1$ in our model. Alternatively, we may assume the preference of an agent born in period t as $U(c_t^y, c_{t+1}^o) = \ln c_t^y + \beta \ln c_{t+1}^o$, where $\beta \in (0, 1)$ denotes the time discount factor, c_t^y and c_{t+1}^o denote his consumption when young and when old. In this case, even if we set $\alpha = \frac{1}{3}$, the economy is still dynamically efficient $\Psi = \frac{\alpha}{1-\alpha}\frac{1+\beta}{\beta} > 1$. Under the alternative assumption, our results and the key mechanisms still hold but the analysis becomes more complicated. For simplicity, we set $\alpha = 0.6$ so that $\Psi = 1.5$.

2.5 Steady-State Patterns of Endogenous Variables

Figure 3 shows the steady-state patterns of endogenous variables with respect to the level of financial development $\theta \in [0, 1]$ denoted by the horizontal axis.

For $\theta \in [0, \bar{\theta})$, the constraint on the aggregate credit demand keeps the loan rate inefficiently lower and the equity rate inefficiently higher than the marginal return on the entrepreneurial project. Due to the depressed loan rate, the less productive projects

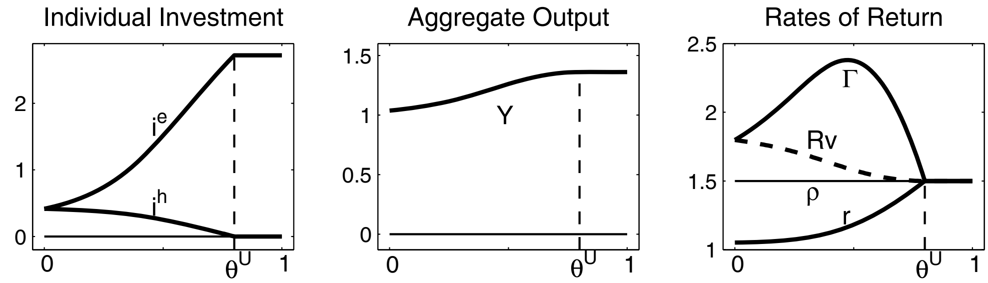

Figure 3: The Steady-State Patterns under International Financial Autarky

are financed in equilibrium and aggregate production is inefficient. This way, financial underdevelopment distorts the two interest rates and production efficiency.

Financial development measured by an increase in θ enables entrepreneurs to borrow against a larger fraction of their project revenue. As shown in the first and second panels, such an increase in the aggregate credit demand leads to the resource reallocation from households to entrepreneurs and aggregate production becomes more efficient. The decline in the price of capital goods induces households to reduce their project investment and raise lending. This way, financial development affects the aggregate credit demand and supply. As discussed in subsection 2.3, the net effect on the two interest rates depends on the initial level of θ. Be specific, the steady-state pattern of the loan rate is rather flat near the lower bound of $\theta = 0$ but steep near the upper bound of $\theta = \bar{\theta}$, with the highest value at the threshold of $\bar{\theta}$; the equity rate has a hump-shaped pattern with the lowest value at the threshold of $\bar{\theta}$. Given the Cobb-Douglas production function, the social return on investment in the steady state is constant at $\Psi = \frac{vK}{I} = \frac{\alpha Y}{(1-\alpha)Y} = \rho$ and independent of θ. See the third panel.

For $\theta \in [\bar{\theta}, 1]$, the aggregate credit demand is large enough to raise the loan rate equal to the marginal return on the entrepreneurial project. In this case, households do not invest in their own project and capital goods are produced entirely by entrepreneurs. Thus, aggregate production is efficient and an increase in θ does not affect the allocation.

3 International Capital Flows

We consider three scenarios of capital mobility, *free mobility of FDI* under which entrepreneurs are allowed to make direct investment abroad[3] but individuals are not allowed to lend abroad, *free mobility of financial capital* under which individuals are allowed to lend abroad but entrepreneurs are not allowed to make direct investment abroad, and *full capital mobility* under which individuals are allowed to lend abroad and entrepreneurs are

[3]Entrepreneurs can either bring their funds and projects abroad for investment or make equity investment in the foreign entrepreneurial project. The two alternatives are analytically equivalent in our model. Without the necessary skills, households cannot make direct or equity investment abroad.

allowed to make direct investments abroad.

We assume that country F is financially developed, $\theta^F = \bar{\theta}$, while country H is not, $\theta^H \in [0, \bar{\theta})$. As shown in appendix C, this assumption guarantees that the borrowing constraints are strictly binding in the steady state in both countries under capital mobility, endogenous variables are continuous and differentiable in $\theta^H \in [0, \bar{\theta})$ in the steady state.

In subsections 3.1, 3.2, and 3.3, we assume that both countries are initially in the steady state under international financial autarky before capital mobility is allowed from period $t = 0$ on. We analyze the short-run and the long-run impacts of capital mobility.[4]

In subsection 3.4, we analyze a more general and realistic case of capital flows between developed and developing countries. Be specific, we assume that country F is initially in the steady state while country H below its steady state before capital mobility from period $t = 0$ on. We discuss how the patterns of capital flows may change along the convergence process of a developing country, i.e., country H, and how capital mobility may affect its aggregate investment and output along the convergence process.

Let Υ_t^i and Ω_t^i denote aggregate outflows of financial capital and equity capital (FDI) from country i in period t, respectively, with negative values indicating capital inflows. Financial capital flows affect the domestic credit supply, $(1 - \eta)(w_t^i - i_t^{i,h}) - \Upsilon_t^i$. Through affecting the aggregate equity capital for the domestic investment, $\eta w_t^i - \Omega_t^i$, FDI flows increase the aggregate credit demand in the host country and reduce that in the parent country.[5] With these changes, the analysis in section 2 carries through, due to the linearity of the preferences, the productive projects, and the borrowing constraints.

Given our parameter values, it can be shown that there exists a unique and stable non-zero steady state under the three scenarios of capital mobility.

3.1 Free Mobility of FDI

Given that the borrowing constraints are binding in country i, the investment-equity ratio and the debt-equity ratio of the entrepreneurial project are $\lambda_t^i = \frac{1}{1 - \frac{\theta_t^i R v_{t+1}^i}{r_t^i}}$ and $\lambda_t^i - 1$, respectively. Under free mobility of FDI, the aggregate output of capital goods produced by entrepreneurs in country i, $R\lambda_t^i(\eta w_t^i - \Omega_t^i)$, and the aggregate credit demand, $(\lambda_t^i - 1)(\eta w_t^i - \Omega_t^i)$, are linear in the aggregate equity capital invested in country i, $(\eta w_t^i - \Omega_t^i)$.

[4]Given the model structure of overlapping generations, capital mobility from period $t = 0$ on does not affect the behaviors of individuals born before period $t = 0$, even if announced in advance.

[5]In the case of debt default, the project liquidation value depends on the efficiency of the legal institution, the law enforcement, and the asset market in the host country. Thus, we assume that entrepreneurs making FDI borrow only from the host country and are subject to the borrowing constraints there. Alternatively, we can assume that entrepreneurs borrow only in their parent country no matter where they invest, because the financial institutions in their parent country have better information on their credit record, social network, and business activities. The realistic case should be a hybrid of the two. Our results hold under the alternative assumption.

The equilibrium conditions under free mobility of FDI are almost same as under international financial autarky except for a few conditions. In equilibrium, the cross-border flows of FDI sum up to zero; the equity rate is equal across the border; the credit-market-clearing condition and the aggregate output of capital goods in country i are specified by equations (16) and (17), respectively,

$$\Omega_t^H + \Omega_t^F = 0, \quad \text{and} \quad \Gamma_t^H = \Gamma_t^F = \Gamma_t^*, \tag{15}$$

$$(\lambda_t^i - 1)(\eta w_t^i - \Omega_t^i) = (1-\eta)(w_t^i - i_t^{i,h}), \tag{16}$$

$$K_{t+1}^i = R\lambda_t^i(\eta w_t^i - \Omega_t^i) + (1-\eta)G(i_t^{i,h}). \tag{17}$$

In subsection 3.1.1, we analyze the model dynamics with respect to free mobility of FDI from period $t = 0$ on, given $\theta^H = \frac{\bar{\theta}}{2}$ and $\theta^F = \bar{\theta}$. In subsection 3.1.2, we analyze the long-run impacts of free mobility of FDI, given $\theta^H \in [0, \bar{\theta})$ and $\theta^F = \bar{\theta}$.

3.1.1 Dynamic Impacts of Free Mobility of FDI

Figure 4 shows the impulse responses of variables in terms of the percentage deviations from their steady-state values under international financial autarky, with the horizontal axis denoting the time periods. The vertical axes of panels entitled "Capital Flows (Level)" and "Country Output (Level)" show the levels of relevant variables.

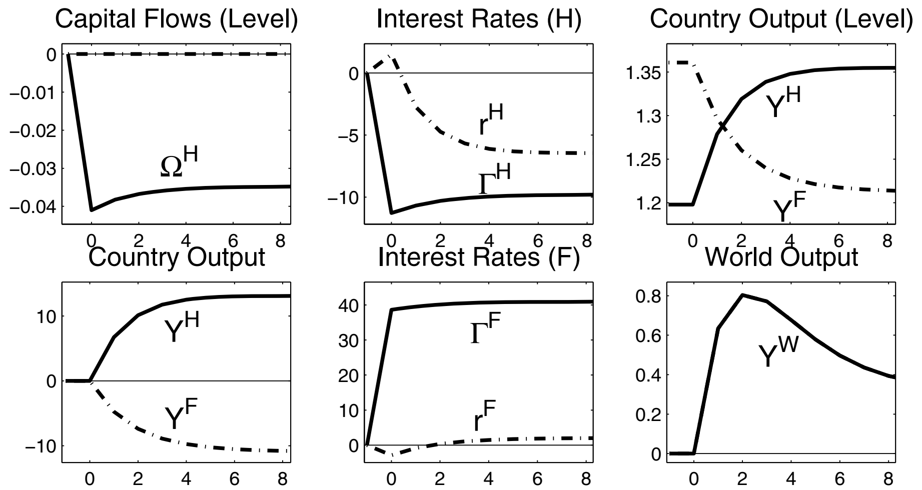

Figure 4: From International Financial Autarky to Free Mobility of FDI

According to figure 3, the steady-state equity rate is higher in country H than in country F under international financial autarky. Thus, from period $t = 0$ on, entrepreneurs born in country F make direct investment in country H. The cross-country equity rate equalization implies that the equity rate declines (rises) in country H (F).

Consider country F first. FDI outflows reduce the aggregate domestic investment. The decline in the aggregate output of capital goods raises the price of capital goods in period $t = 1$. Meanwhile, FDI outflows reduce the aggregate domestic equity capital and the aggregate credit demand declines in period $t = 0$. The rise in the price of capital goods and the decline in the aggregate credit demand induce households to lend less and start to invest in their own projects in period $t = 0$. Thus, FDI outflows reduce aggregate output in period $t = 1$ directly via the size and indirectly via the composition of the aggregate domestic investment in period $t = 0$. Since the decline in the aggregate credit demand dominates that in the aggregate credit supply, the loan rate falls in period $t = 0$.

Consider country H then. Similar as the analysis for country F, FDI inflows ($\Omega_t^H < 0$) raise aggregate output in period $t = 1$ directly via the size and indirectly via the composition of the aggregate domestic investment in period $t = 0$.

Combining equations (5) and (16), the loan rate is reformulated as

$$r_t^H = Rv_{t+1}^H \frac{\theta^H}{(1-\eta)} \left[\frac{\eta w_t^H - \Omega_t^H}{(1-\eta)(w_t^H - i_t^{H,h})} + 1 \right] (1-\eta). \tag{18}$$

Given θ^H and the financial-development effect $\frac{\theta^H}{(1-\eta)}$, the loan rate is affected by the neoclassical effect Rv_{t+1}^H, the credit-supply effect $(1-\eta)(w_t^H - i_t^{H,h})$, and the credit-demand effect measured by the aggregate equity capital $\eta w_t^H - \Omega_t^H$. The net impact of FDI inflows depends on the relative size of the three components, which eventually depends on θ^H.

For θ^H close to zero, $i_t^{H,h}$ is large before period $t = 0$ and so is the productivity differential between the entrepreneurial and the household projects. FDI inflows strongly improve production efficiency via the composition of aggregate investment. The large decline in the price of capital goods in period $t = 1$ strongly raises the aggregate credit supply in period $t = 0$. Meanwhile, given θ^H close to zero, FDI inflows does not raise the aggregate credit demand very much. Overall, the neoclassical effect and the credit-supply effect dominate the credit-demand effect so that the loan rate falls in period $t = 0$. Conversely, for θ^H close to $\bar{\theta}$, the credit-demand effect dominates so that the loan rate rises. Given $\theta^H = \frac{\bar{\theta}}{2}$ and $\theta^F = \bar{\theta}$, the loan rate rises in period $t = 0$.

Consider the world as a whole. FDI flows affect the world output in period $t = 1$ via three effects. First, FDI inflows reduce the household project investment in country H, which generates efficiency gains. Second, FDI outflows raise the household project investment in country F, which generates efficiency losses. Third, given the concave aggregate production on the country level, if capital flows reduce (widen) the cross-country output gap, the world output would be higher (lower) than under international financial autarky, according to the Jensen's inequality. The net impact depends on the relative size of the three effects, which depends on θ^H.

Before period $t = 0$, due to the positive household project investment $i_t^{H,h} > i_t^{F,h} = 0$, production is less efficient in country H than in country F, as measured by the productivity differential between the entrepreneurial and the household project, $v^H[R - G'(i^{H,h})] > 0 = v^F[R - G'(i^{F,h})]$. Thus, in period $t = 0$, the efficiency gains in country H dominate the efficiency losses in country F. Given $\theta^H = \frac{\bar{\theta}}{2}$ and $\theta^F = \bar{\theta}$, since FDI flows reduce the cross-country output gap in period $t = 1$, the third effect is positive. Overall, the world output in period $t = 1$ is higher than before period $t = 0$.

We have analyzed the immediate impacts of FDI flows in period $t = 0$ and $t = 1$. The world economy converges to the new steady state from period $t = 1$ on and capital accumulation over time may change or even reverse the immediate impacts.

Consider country F first. The decline in aggregate output in period $t = 1$ reduces the aggregate domestic investment, which then further reduces aggregate output in the long run. The higher price of capital goods enhances the neoclassical effect, which keeps the loan rate in the long run higher than before period $t = 0$. This way, due to capital accumulation, the loan rate effect of FDI flows reverses from negative in the short run to positive in the long run. Conversely, in country H, capital accumulation further reduces the price of capital goods and the enhanced neoclassical effect keeps the loan rate in the long run lower than before period $t = 0$.

Given $\theta^H = \frac{\bar{\theta}}{2}$ and $\theta^F = \bar{\theta}$, capital accumulation triggered by FDI flows further raises (reduces) aggregate output in country H (F). The cross-country output gap widens from period $t = 2$ on, but is still smaller than before period $t = 0$, implying that the third effect on the world output is still positive but declines over time. Thus, the world output declines from period $t = 2$ on but still higher than before period $t = 0$.

3.1.2 Long-Run Impacts of Free Mobility of FDI

Given $\theta^F = \bar{\theta}$, figure 5 shows the percentage differences of variables in the steady state under free mobility of FDI and under international financial autarky, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$. The vertical axes of the panels entitled "Capital Flows (Level)" and "Country Output (Level)" show the levels of relevant variables. Y^i_{IFA} and Y^i_{FDI} denote the steady-state values of aggregate output under international financial autarky and under free mobility of FDI in country $i \in \{H, F\}$, respectively.

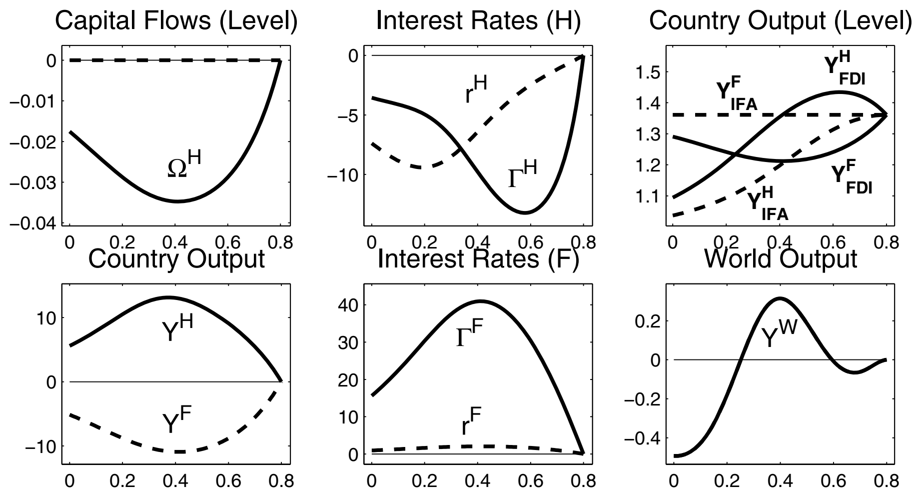

Figure 5: Free mobility of FDI versus International Financial Autarky

Since FDI flows are essentially driven by the cross-country equity-rate differential under international financial autarky, the inverse hump-shaped pattern of FDI flows into country H shown in the first panel of figure 5 follows the pattern of the cross-country equity-rate differential shown in figure 3. Given $\theta^F = \bar{\theta}$, if the financial sector in country H is severely underdeveloped (θ^H close to zero), a marginal improvement in the financial sector in country H promotes FDI inflows in the long run; otherwise, for θ^H close to $\bar{\theta}$, a marginal improvement in the financial sector reduces FDI inflows in the long run.

FDI flows affect aggregate output via the size and the composition of the aggregate domestic investment. Be specific, aggregate output rises (declines) in country H (F). According to the panel "Country Output" of figure 5, the long-run patterns of aggregate output in the two countries follow that of FDI flows. The long-run patterns of the loan rate in the two countries are mainly driven by the neoclassical effect. The decline (rise) in the price of capital goods in country H (F) leads to the decline (rise) in the loan rate.

Under international financial autarky, financial frictions in country H distort production efficiency and aggregate output is lower than in country F. See the panel "Country Output (Level)" of figure 5. For $\theta^H \in (0, \frac{\bar{\theta}}{2})$, the cross-country output gap is large under international financial autarky. The small FDI flows result in the small rise (decline) in aggregate output in country H (F), which reduces the cross-country output gap. In contrast, for $\theta^H \in (\frac{\bar{\theta}}{2}, \bar{\theta})$, the cross-country output gap is small under international financial autarky and FDI flows widen the cross-country output gap by making aggregate output in country H higher than in country F.

As mentioned in subsection 3.1.1, FDI flows affect the world output via the three effects: the efficiency gains from resource reallocation in country H, the efficiency losses from resource reallocation in country F, and the efficiency losses (gains) from capital flows which widen (narrow) the cross-country output gap. The first and second effects are on the country level, while the third effect is on the cross-country level. Consider the case of θ^H close to $\bar{\theta}$. According to the upper-right panel of figure 5, FDI flows widen the cross-country output gap and the third effect is thus negative. Given the small cross-country productivity differential under international financial autarky, the first effect slightly dominate the second effect so that the net efficiency effect on the country level is slightly positive. Overall, the third effect dominates and the world output is lower than under international financial autarky. Consider the case of θ^H close to zero. Since FDI flows narrow the cross-country output gap, the third effect is positive. Given the tight borrowing constraints in country H, the first effect is small and dominated by the second effect. Thus, the net efficiency effect on the country level is negative and dominates the third effect. Overall, the world output is lower. Consider the case of θ^H close to $\frac{\bar{\theta}}{2} = 0.4$. FDI flows do not affect the cross-country output gap very much and the third effect is negligible. The large FDI flows create large efficiency gains in country H. Thus, the first effect dominates and the world output is higher. This way, FDI flows may necessarily generate the world output gains, depending on θ^H.

3.2 Free Mobility of Financial Capital

The analysis for free mobility of financial capital follows that for free mobility of FDI. Here, we summarize the main results and leave the detailed analysis in appendix B.

The cross-country loan-rate differential under international financial autarky drives financial capital flows from period $t = 0$ on. Be specific, financial capital flows "uphill" from country H to country F, which widens the cross-country output gap. The cross-border loan rate equalization implies that the loan rate rises (declines) in country H (F).

Financial capital mobility affects the equity rate via three channels, i.e., the neoclassical effect, the spread, and the debt-equity ratio. In country F, the equity rate is determined mainly by the neoclassical effect. Thus, the decline in the price of capital goods keeps the equity rate in country F lower. While, the net impact on the equity rate in country H depends on θ^H. For θ^H close to zero, the tight borrowing constraints imply that the equity rate depends mainly on the neoclassical effect. The rise in the price of capital goods keep the equity rate in country H higher. For θ^H close to $\bar{\theta}$, the equity rate depends mainly on the debt-equity ratio. Financial capital outflows reduces the debt-equity ratio and the equity rate declines in country H.

As mentioned in subsection 3.1.1, capital flows affect the world output via three effects. Since financial capital flows widen the cross-country output gap, the third effect is negative. For θ^H close to zero, the household project investment in country H is large before period $t = 0$ and financial capital flows significantly reduce the household investment. Thus, the first effect dominates and the world output is higher. For θ^H close to $\bar{\theta}$, the household project investment in country H is small before period $t = 0$ and so is the first effect. Overall, the third effect dominates and the world output is lower.

3.3 Full Capital Mobility

Given that the borrowing constraints are binding in country i, the equilibrium conditions under full capital mobility are almost same as under free mobility of FDI except for a few conditions. In equilibrium, the cross-border flows of financial capital sum up to zero; the loan rate is equal across the border; the credit-market-clearing condition, i.e., equation (16), is reformulated as equation (20),

$$\Upsilon_t^H + \Upsilon_t^F = 0, \quad \text{and} \quad r_t^H = r_t^F, \tag{19}$$

$$(\lambda_t^i - 1)(\eta w_t^i - \Omega_t^i) = (1 - \eta)(w_t^i - i_t^{i,h}) - \Upsilon_t^i. \tag{20}$$

In the following, we analyze the short-run and long-run impacts of full capital mobility in two scenarios. In subsection 3.3.1, we assume that the world economy is in the steady state under international financial autarky until full capital mobility is allowed from period $t = 0$ on. In subsection 3.3.2, we assume that the world economy is in the steady state under free mobility of FDI until full capital mobility is allowed from period $t = 0$ on.

3.3.1 From International Financial Autarky to Full Capital Mobility

Given $\theta^F = \bar{\theta}$ and $\theta^H = \frac{\bar{\theta}}{2}$, figure 6 shows the impulse responses of variables in terms of the percentage deviations from their steady-state levels under international financial autarky, with the horizontal axis denoting the time periods. The vertical axes of panels entitled "Capital Flows (Level)" and "Country Output (Level)" denote the levels of relevant variables.

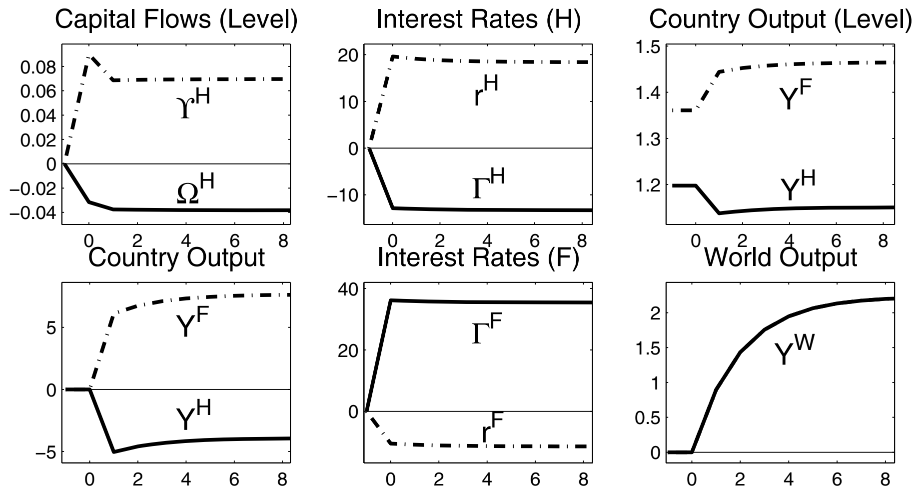

Figure 6: From International Financial Autarky to Full Capital Mobility

Before period $t = 0$, the loan rate is higher while the equity rate is lower in country H than in country F. In period $t = 0$, financial capital flows from country H to country F while FDI flows in the opposite direction. As a result, the loan rate rises in country H and declines in country F, while the equity rate changes in the opposite way.

As mentioned in subsection 3.1.1, the immediate impact of full capital mobility on the world output in period $t = 1$ depends on three effects. Before period $t = 0$, domestic financial frictions distort production efficiency in country H so that aggregate output is lower than in country F. Being more financially developed, country F has a larger credit market than country H. Thus, capital in the net term flows "uphill" from country H to country F in period $t = 0$, $\Upsilon_t^H + \Omega_t^H > 0$, which widens the cross-country output gap and the efficiency effect on the cross-country level is thus negative. Consider country H. In period $t = 0$, financial capital outflows reduce the domestic credit supply and FDI inflows increase the domestic credit demand. Thus, households reduce their project investment, which improves production efficiency. Consider country F. In period $t = 0$, financial capital inflows and FDI outflows induce households to start investing in their own projects, which worsens production efficiency. Since production is less efficient in country H than in country F under international financial autarky, the efficiency gains in country H dominate the efficiency losses in country F and the net efficiency effect on the country level is positive. Furthermore, the net efficiency gains on the country level depend on gross capital flows, while the efficiency losses on the cross-country level depends on net capital flows. Since two-way capital flows imply large gross flows and small net flows, the net efficiency gains on the country level dominates the efficiency losses on the cross-country level and the world output is thus higher in period $t = 1$.

From period $t = 1$ on, due to capital accumulation, the world economy converges to its new steady state. In the long run, aggregate output is higher in country F than in country H; financial capital flows "uphill" while FDI flows "downhill"; net capital flows "uphill"; the world output is higher than before period $t = 0$.

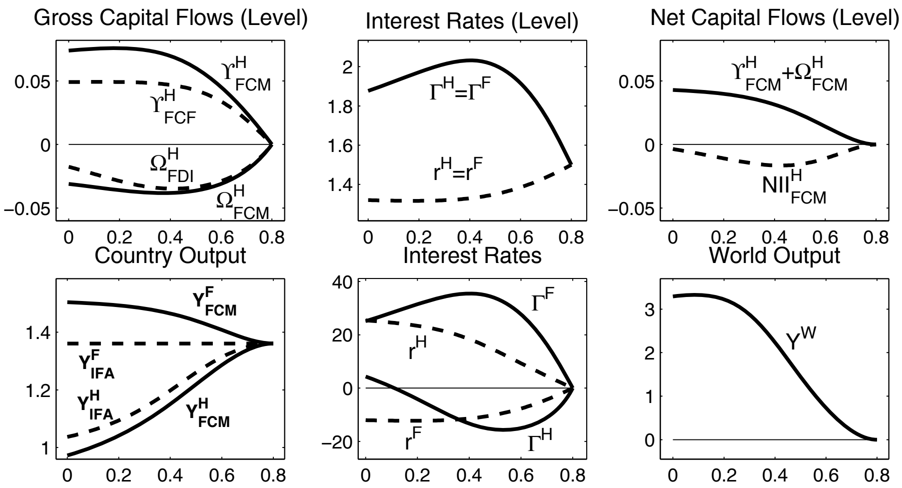

Figure 7: Full Capital Mobility versus International Financial Autarky

We then analyze the long-run impacts of full capital mobility. Given $\theta^F = \bar{\theta}$, figure 7 shows the percentage differences of variables in the steady state under full capital mobility and under international financial autarky, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$. The variables with subscripts FDI, FCF, and FCM refer to their steady-state values under free mobility of FDI, free mobility of financial capital, and full capital mobility.

According to the upper-left panel of figure 7, financial capital and FDI flow in the opposite direction. Furthermore, FDI and financial capital flows are complements in the sense that FDI (financial capital) flows in the steady state are larger under full capital mobility than under free mobility of FDI (financial capital). In other words, given free mobility of FDI, allowing additionally free mobility of financial capital raises FDI flows.

According to the upper-right panel, despite of net capital outflows, $\mathrm{NCF}^H_{FCM} \equiv \Upsilon^H + \Omega^H > 0$, country H has a negative net investment income, $\mathrm{NNI}^H_{FCM} \equiv (r^* - 1)\Upsilon^H + (\Gamma^* - 1)\Omega^H < 0$. Intuitively, since country F is more financially developed, its financial capital inflows exceeds its FDI outflows. According to the upper-middle panel, the world equity rate is higher than the world loan rate so that country F gets the higher return on its foreign assets than it pays on its foreign debts. Thus, as a net debtor, country F receives a positive net investment return. In other words, country F "exports" its financial service via two-way capital flows and receives the positive rewards accordingly.

As mentioned above, full capital mobility affects the world output via three effects.

As shown in the bottom-left panel of figure 7, net capital flows from country H to country F widen the cross-country output gap and the third effect is thus negative. Meanwhile, both financial capital and FDI flows trigger resource reallocation in both countries. Given production in country H is less efficient than in country F, the net efficiency effect on the country level is positive. Under full capital mobility, the two-way capital flows imply large gross flows and small net flows, which strengthens the net efficiency effect on the country level and weakens the efficiency losses on the cross-country level, respectively. Thus, the world output is higher in the long run. As shown in the bottom-right panel, the world output gains decline in θ^H. Intuitively, the world output gains fall as the cross-country differences in financial development $(\theta^F - \theta^H)$ decreases.

3.3.2 From Free Mobility of FDI to Full Capital Mobility

Developing countries generally encourage free mobility of FDI as it helps increase aggregate output and the labor income, as shown in subsection 3.1. In this subsection, we discuss how additionally allowing financial capital flows may affect aggregate production in the developing country, with free mobility of FDI already in place.

Given $\theta^F = \bar{\theta}$ and $\theta^H = \frac{\bar{\theta}}{2}$, figure 8 shows the impulse responses of variables in terms of the percentage deviations from their steady-state levels under free mobility of FDI, with the horizontal axis denoting the time periods. The vertical axes of panels entitled "Capital Flows (Level)" and "Country Output (Level)" denote the levels of relevant variables.

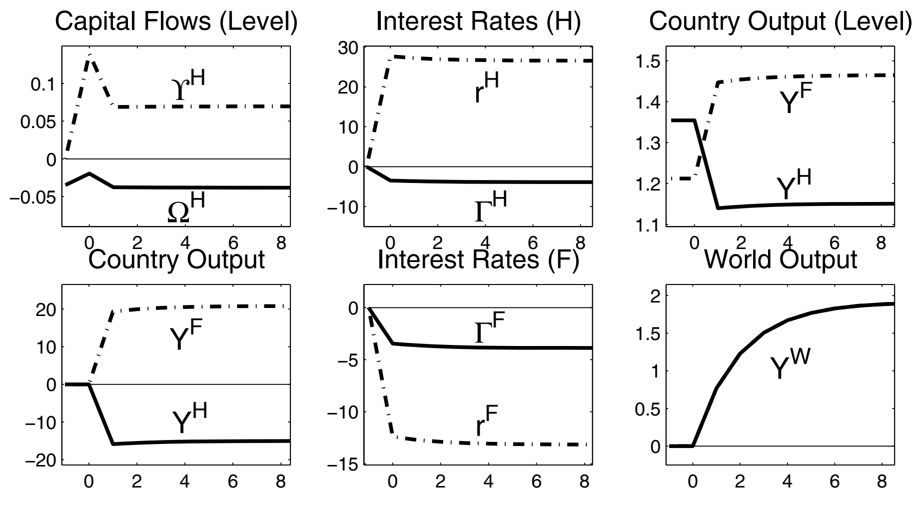

Figure 8: From Free Mobility of FDI to Full Capital Mobility

According to Subsection 3.1.2, free mobility of FDI widens the cross-country loan-rate differential so that the loan rate is higher in country F than in country H before period $t = 0$. Thus, in period $t = 0$, financial capital flows from country H to country F, which raises (reduces) the loan rate in country H (F).

The immediate impact on the equity rate depends on three factors, the neoclassical effect, the debt-equity ratio, and the spread. Consider country H. Financial capital outflows reduce the aggregate output of capital goods and the rise in the price of capital goods in period $t = 1$ tends to increase the equity rate in period $t = 0$ via the neoclassical effect. Meanwhile, financial capital outflows reduce the aggregate credit supply and raise the loan rate, which tends to reduce the equity rate in period $t = 0$ via the declines in the debt-equity ratio and the spread. The net impact on the equity rate depends on θ^H. For θ^H close to zero, the tight borrowing constraints imply that the equity rate depends mainly on the neoclassical effect. In period $t = 0$, the cross-country loan-rate differential is large and so are financial capital outflows. Thus, the neoclassical effect dominates and the equity rate rises in period $t = 0$. For θ^H close to $\bar{\theta}$, the loose borrowing constraints imply that the equity rate depends mainly on the debt-equity ratio. In period $t = 0$, financial capital outflows reduce the aggregate credit supply and the decline in the debt-equity ratio dominates. Thus, the equity rate declines in period $t = 0$. Given $\theta^H = \frac{\bar{\theta}}{2}$ and $\theta^F = \bar{\theta}$, the equity rate declines in period $t = 0$ and so do FDI inflows.

According to Subsection 3.1.2, aggregate output is higher in country H than in country F until period $t = 0$. From period $t = 0$ on, financial capital flows reverse the aggregate output pattern so that aggregate output in country H is lower than in country F.

Similar as in subsection 3.3.1, financial capital flows and FDI involve not only the cross-border resource reallocation but also trigger the within-border resource reallocation. The two-way capital flows imply large gross flows and small net flows, which strengthens the net efficiency effect on the country level and weakens the efficiency losses on the cross-country level. Thus, the world output is higher in period $t = 1$. Due to capital accumulation, the world output rises over time.

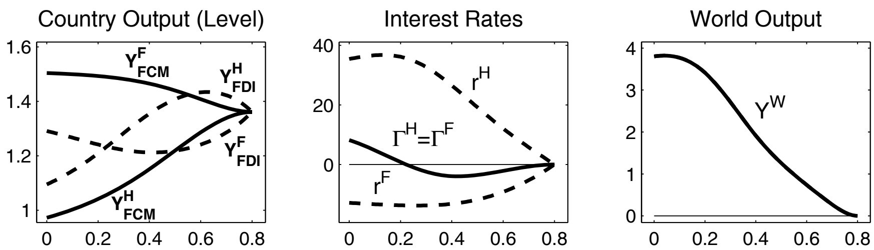

Figure 9: Full Capital Mobility versus Free mobility of FDI

We then analyze the long-run impacts of full capital mobility. Given $\theta^F = \bar{\theta}$, figure 9 shows the percentage differences of variables in the steady state under full capital mobility and under free mobility of FDI, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$.

The loan rate is higher in country F than in country H under free mobility of FDI before period $t = 0$. Full capital mobility equalizes the loan rate across the border so that the steady-state loan rate rises (declines) in country H (F). Similar as in the short-run analysis, the long-run pattern of the equity rate depends on θ^H. For θ^H close to zero, the neoclassical effect dominates and the equity rate is higher in the long run; for θ^H close to $\bar{\theta}$, the debt-equity ratio dominates and the equity rate is lower in the long run.

As mentioned above, full capital mobility affects the world output via three effects. As shown in the left-bottom panel of figure 9, for θ^H close to $\bar{\theta}$ (0), full capital mobility reduces (widens) the cross-country output gap and the third effect is positive (negative). The third effect on the world output depends on net capital flows. Both financial capital and FDI flows affect production efficiency on the country level and the efficiency gains depend on gross capital flows. Under full capital mobility, the net efficiency gains on the country level dominates and the world output is higher.

3.4 Capital Flows between Developing and Developed Countries

Besides $0 \leq \theta^H < \theta^F = \bar{\theta}$, we assume in this subsection that country F is in the steady state, $K_0^F = K_{IFA}^F$, while country H is below the steady state, $0 < K_0^H < K_{IFA}^H$, before capital mobility is allowed in period $t = 0$. We analyze how capital mobility affects the convergence process of a developing country (country H).

3.4.1 Free Mobility of FDI

Given $\theta^F = \bar{\theta}$, figure 10 shows two threshold values, K_{IFA}^H and K_{FDI}^H, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$ and the vertical axis denoting the period-0 capital-labor ratio.

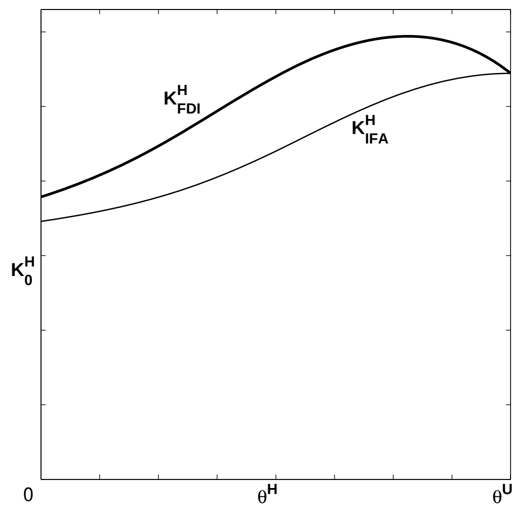

Figure 10: Free Mobility of FDI

Let us define a counterfactual case where the world economy is still under international financial autarky in period $t = 0$. It helps uncover the cross-country equity-rate differential that drives FDI flows in period $t = 0$ in the actual case. Consider the counterfactual case. Compare with the equity rate in country F, $\Gamma_{IFA}^F = \rho$, the equity rate in country H is positively affected by $K_0^H < K_0^F$ via the neoclassical effect and by $\theta^H < \theta^F = \bar{\theta}$ via the leverage effect. Thus, in period $t = 0$, the equity rate in country H is higher than in country F. In the actual case, FDI flows "downhill", which speeds up capital accumulation in country H. Eventually, country H converges to a steady state with the capital-labor ratio $K_{FDI}^H > K_{IFA}^H$. Since the marginal return on investment is higher in country H than in country F, "downhill" FDI flows raise the world output in period $t = 1$.

3.4.2 Free Mobility of Financial Capital

Given $\theta^F = \bar{\theta}$, the thin solid line, the thick solid line, the dash-dotted line, and the dashed line in figure 11 show four threshold values, K_{IFA}^H, K_{FCF}^H, $\hat{K}_0^H$, and $\tilde{K}_0^H$, respectively, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$ and the vertical axis denoting the period-0 capital-labor ratio in country H.

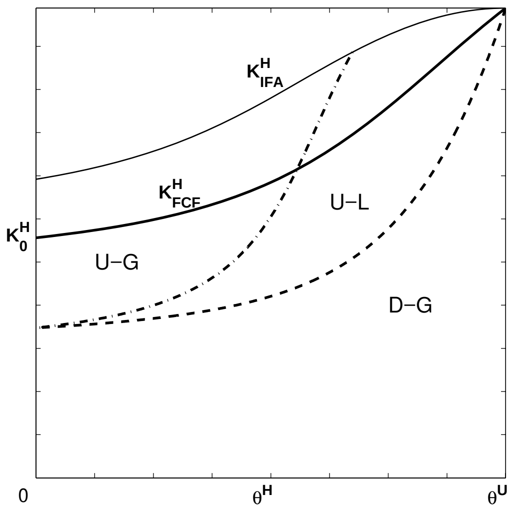

Figure 11: Free Mobility of Financial Capital

Consider the counterfactual case. Compared with the loan rate in country F, $r_{IFA}^F = \rho$, the loan rate in country H is affected positively by $K_0^H < K_0^F$ via the neoclassical effect and negatively by $\theta^H < \theta^F$ via the credit-demand effect. Thus, given θ^H, there exists a threshold value $\tilde{K}_0^H < K_{IFA}^H$. For $K_0^H \in (0, \tilde{K}_0^H)$, the neoclassical effect dominates so that the loan rate in country H and period $t = 0$ is higher than in country F. In the actual case, financial capital flows "downhill" from country F to country H in period $t = 0$. Since the marginal return on investment is larger in country H than in country F, the "downhill" capital flows increase the world output. In figure 11, **D-G** refers to the region with "**D**ownhill" capital flows and the world output **G**ains.

For $K_0^H \in (\tilde{K}_0^H, K_{IFA}^H)$, financial capital flows "uphill" in period $t = 0$, which widens the cross-country output gap and tends to reduce the world output. Meanwhile, financial capital outflows reduce the household project investment in country H and generate the efficiency gains. For θ^H close $\bar{\theta}$, production inefficiency in country H and period $t = 0$ is minor in the counterfactual case. In the actual case, the efficiency losses from "uphill" capital flows dominate and the world output in period $t = 0$ is lower.

For $K_0^H \in (\tilde{K}_0^H, K_{IFA}^H)$ and θ^H close to 0, production inefficiency in country H and period $t = 0$ is severe in the counterfactual case. In the actual case, financial capital flows may generate larger efficiency gains via resource reallocation in country H than efficiency losses due to the rise in the cross-country output gap. Thus, the world output in period $t = 0$ may be higher than under international financial autarky. There exists a threshold value $\hat{K}_0^H \in (\tilde{K}_0^H, K_{IFA}^H)$ as a function of θ^H. Given θ^H, for $K_0^H \in (\hat{K}_0^H, K_{IFA}^H)$, the cross-country loan-rate differential in period $t = 0$ is large in the counterfactual case. In the actual case, the efficiency gains in country H dominate and the world output in period $t = 1$ is higher. Conversely, for $K_0^H \in (\tilde{K}_0^H, \hat{K}_0^H)$, the efficiency losses dominate and the world output in period $t = 1$ is lower. In figure 11, **U-G** and **U-L** refer to the regions with "**U**phill" financial capital flows and the world output **G**ains, and "**U**phill" financial capital flows and the world output **L**osses, respectively.

For a developing country, the capital-labor ratio is very low at its early stage of economic growth. The loan rate under international financial autarky may be higher than the world loan rate. Under free mobility of financial capital, capital inflows speed up its capital accumulation. However, as long as its capital-labor ratio exceeds a threshold value $\tilde{K}_0^H$ so that its loan rate under international financial autarky falls below the world loan rate, financial capital mobility leads to financial capital outflows, which hampers the aggregate domestic investment. Eventually, the country converges to a steady state with the capital-labor ratio lower than that under international financial autarky, $K_{FCF}^H < K_{IFA}^H$. Thus, the patterns of financial capital flows may reverse along its convergence process. Furthermore, financial capital mobility has opposite effects on aggregate production at the different stages of its convergence process.

3.4.3 Full Capital Mobility

Given $\theta^F = \bar{\theta}$, the thin solid line, the thick solid line, the dash-dotted line, and the dashed line in figure 12 show four threshold values, K_{IFA}^H, K_{FCM}^H, $\hat{K}_0^H$, and $\tilde{K}_0^H$, respectively, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$ and the vertical axis denoting the period-0 capital-labor ratio.

Besides the first counterfactual case defined in subsection 3.4.1, we define the second counterfactual case with free mobility of FDI allowed from period $t = 0$. In the second counterfactual case, due to FDI flows, the loan rate in period $t = 0$ is higher (lower) in country H (F) than in the first counterfactual case. There exists a threshold value $\hat{K}_0^H$ such that for $K_0^H = \hat{K}_0^H$, the period-0 loan rate is same in two countries in the second counterfactual case. Under full capital mobility, there are FDI flows but no financial capital flows in period $t = 0$. For $K_0^H \in (0, \hat{K}_0^H)$, due to the neoclassical effect, the loan rate in country H and period $t = 0$ is higher than in country F in the second counterfactual case. Thus, both financial capital and FDI flow "downhill". Conversely, for $K_0^H \in (\hat{K}_0^H, K_{IFA})$, financial capital flows "uphill" while FDI flows "downhill".

Given θ^H, there exists another threshold value, $\tilde{K}_0^H > \hat{K}_0^H$. For $K_0^H \in (\hat{K}_0^H, \tilde{K}_0^H)$, "downhill" FDI flows dominate "uphill" financial capital flows and net capital flows are

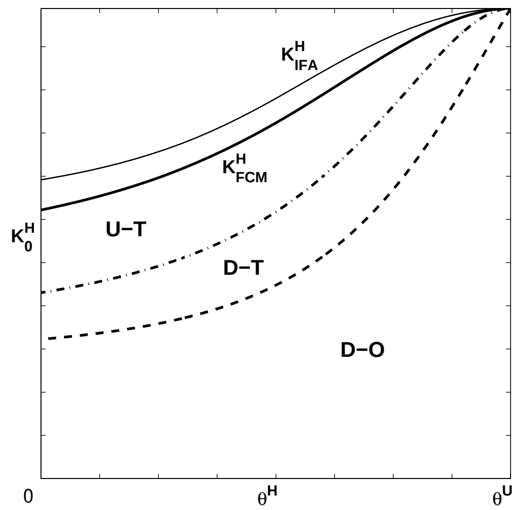

Figure 12: Full Capital Mobility

"downhill" in period $t = 0$. Conversely, for $K_0^H \in (\tilde{K}_0^H, K_{IFA})$, net capital flows are "uphill". In figure 12, **D-O**, **D-T**, **U-T** refer to the regions where capital in the net term flows "**D**ownhill" ("**U**phill") and financial capital and FDI flow in **O**ne (**T**wo) way(s). Similar as in subsection 3.3, full capital mobility raises the world output in period $t = 0$.

Consider a developing country with the capital-labor ratio in region **D-O** when it starts full capital mobility. Financial capital and FDI inflows speed up its capital accumulation in the short run. As the capital-labor ratio moves into regions **D-T** and then **U-T**, the direction of financial capital flows first reverses from "downhill" to "uphill", and then, financial capital outflows exceeds FDI inflows so that net capital flows reverse from "downhill" to "uphill". Eventually, the country converges to a new steady state with the capital-labor ratio lower than under international financial autarky, $K_{FCM}^H < K_{IFA}$. This way, full capital mobility speeds up capital accumulation in the early stage of its convergence process at the cost of lower steady-state aggregate output.

4 Conclusion

We develop a two-country overlapping generations model and show that the cross-country difference in financial development can explain three recent empirical facts. In a less financially developed country, financial frictions create two distinct distortions on the interest rates and production efficiency under international financial autarky. International capital flows help ameliorate the two distortions.

International capital flows not only involve cross-country resource reallocation but also trigger within-country resource reallocation. We distinguish two effects of capital flows on the world output. First, due to the concave aggregate production function, capital flows, which widen (reduce) the cross-country output gap, tend to reduce (raise) the world output. Second, FDI and financial capital flows trigger the resource reallocation from the less to the more productive projects both within and across the border, which improves production efficiency and tends to raise the world output. The second effect depend on gross capital flows while the first effect depends on net capital flows. Under full capital mobility, two-way capital flows result in large gross flows and small net flows, which strengthens the second effect and weakens the first effect. Overall, full capital flows generate the world output gains. However, if the mobility of either financial capital or FDI is restricted, the world output may be lower than under international financial autarky.

References

Antras, P., and R. Caballero (2009): "Trade and Capital Flows: A Financial Frictions Perspective," *Journal of Political Economy*, 117(4), 701–744.

Antras, P., M. Desai, and F. Foley (2009): "Multinational Firms, FDI flows and Imperfect Capital Markets," *Quarterly Journal of Economics*, 124(3), 1171–1219.

Aoki, K., G. Benigno, and N. Kiyotaki (2009a): "Adjusting to Capital Account Liberalization," Working Paper.

——— (2009b): "Capital Flows and Asset Prices," in *International Seminar on Macroeconomics 2007*, ed. by R. Clarida, and F. Giavazzi. NBER, The University of Chicago Press.

Barlevy, G. (2003): "Credit market frictions and the allocation of resources over the business cycle," *Journal of Monetary Economics*, 50(8), 1795–1818.

Caballero, R., E. Farhi, and P.-O. Gourinchas (2008): "An Equilibrium Model of "Global Imbalances" and Low Interest Rates," *American Economic Review*, 98(1), 358–93.

Devereux, M., and A. Sutherland (2009): "A Portfolio Model of Capital Flows to Emerging Markets," *Journal of Development Economics*, 89(2), 181–193.

Gourinchas, P.-O., and H. Rey (2007): "From World Banker to World Venture Capitalist: U.S. External Adjustment and The Exorbitant Privilege," in *G7 Current Account Imbalances: Sustainability and Adjustment*, ed. by R. Clarida. NBER Conference Volumn, The University of Chicago Press.

Hart, O., and J. Moore (1994): "A Theory of Debt Based on the Inalienability of Human Capital," *The Quarterly Journal of Economics*, 109(4), 841–79.

Hausmann, R., and F. Sturzenegger (2007): "The missing dark matter in the wealth of nations and its implications for global imbalances," *Economic Policy*, 22(51), 469 – 518.

Higgins, M., T. Klitgaard, and C. Tille (2007): "Borrowing Without Debt? Understanding the U.S. International Investment Position," *Business Economics*, 42(1), 17.

Holmstrom, B., and J. Tirole (1997): "Financial Intermediation, Loanable Funds, and the Real Sector," *Quarterly Journal of Economics*, 112(3), 663–691.

Hsieh, C.-T., and P. Klenow (2009): "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, forthcoming.

Jeong, H., and R. Townsend (2007): "Sources of TFP growth: occupational choice and financial deepening," *Economic Theory*, 32(1), 179–221.

Ju, J., and S.-J. Wei (2007): "Domestic Institutions and the Bypass Effect of Financial Globalization," NBER Working Papers No 13148.

——— (2008): "When Is Quality of Financial System a Source of Comparative Advantage?," No 13984, NBER Working Papers.

Lane, P., and G. M. Milesi-Ferretti (2001): "The external wealth of nations: measures of foreign assets and liabilities for industrial and developing countries," *Journal of International Economics*, 55(2), 263–294.

——— (2006): "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004," IIS Discussion Paper No. 79, Trinity College Dublin.

——— (2007): "A Global Perspective on External Positions," in *G7 Current Account Imbalances: Sustainability and Adjustment*, ed. by R. Clarida. The University of Chicago Press.

Levine, R. (1997): "Financial Development and Economic Growth: Views and Agenda," *Journal of Economic Literature*, 35(2), 688–726.

Matsuyama, K. (2004): "Financial Market Globalization, Symmetry-Breaking, and Endogenous Inequality of Nations," *Econometrica*, 72(3), 853–884.

——— (2007): "Credit Traps and Credit Cycles," *American Economic Review*, 97(1), 503–516.

Mendoza, E. G., V. Quadrini, and J.-V. Ríos-Rull (2009): "Financial Integration, Financial Deepness, and Global Imbalances," *Journal of Political Economy*, 117(3), 371–416.

Midrigan, V., and D. Y. Xu (2009): "Finance and Misallocation: Evidence from Plant-Level Data," working paper.

Prasad, E. S., R. Rajan, and A. Subramanian (2006): "Patterns of International Capital Flows and their Implications for Economic Development," in *Proceedings of the 2006 Jackson Hole Symposium*, pp. 119–158. Federal Reserve Bank of Kansas City.

——— (2007): "Foreign Capital and Economic Growth," *Brookings Papers on Economic Activity*, 38(1), 153–230.

Smith, K. A., and D. Valderrama (2008): "Why Do Emerging Economies Import Direct Investment and Export Savings? A Story of Financial Underdevelopment," working paper.

Tille, C., and E. van Wincoop (2008a): "International Capital Flows," working paper.

——— (2008b): "International Capital Flows under Dispersed Information: Theory and Evidence," NBER Working Paper No. 14390.

Townsend, R. M. (1979): "Optimal Contracts and Competitive Markets with Costly State Verification,," *Journal of Economic Theory*, 21(2), 265–293.

von Hagen, J., and H. Zhang (2010): "Financial Development and Patterns of International Capital Flows," CEPR Discussion Paper No. 7690.

A Proofs of Propositions

Proof of Propositions 1

Proof. Let $\bar{\theta}$ denote the threshold value where capital goods are produced only by entrepreneurs, $i_t^h = 0$, and their borrowing constraints are weakly binding. For $\theta = \bar{\theta}$, according to equation (4) and Assumption 1, $r_t = v_{t+1}G'(0) = v_{t+1}R$. The credit market clearing condition $(1-\eta)w_t = \eta(i_t^e - w_t)$ implies $I_t = \eta i_t^e = w_t$. Given the per capita investment and debt, $i_t^e = \frac{w_t}{\eta}$ and $z_t = i_t^e - w_t = \frac{(1-\eta)w_t}{\eta}$, the (weakly) binding borrowing constraint, $r_t z_t = \bar{\theta} R v_{t+1} i_t^e$, implies $R v_{t+1} \frac{(1-\eta)w_t}{\eta} = R v_{t+1} \bar{\theta} \frac{w_t}{\eta}$. Thus, $\bar{\theta} = (1-\eta)$.

For $\theta = \bar{\theta}$, the loan rate is equal to the marginal return on the entrepreneurial project, $r_t = v_{t+1}G'(0) = v_{t+1}R = \Gamma_t$, and so is the equity rate, according to equation (6). In equilibrium, entrepreneurs still borrow to the limit; otherwise, some resources would be invested in the household project and the loan rate would be lower than the equity rate.

For $\theta \in (\bar{\theta}, 1]$, entrepreneurs do not borrow to the limit, since the equity rate is equal to the loan rate. In fact, the project investment of individual entrepreneur becomes indeterminant. Due to the linearity of the preferences, the entrepreneurial projects, and the borrowing constraints, it is the size of the aggregate entrepreneurial investment instead of its distribution that matters for aggregate production. The credit market equilibrium implies that the aggregate entrepreneurial borrowing is same as in the case of $\theta = \bar{\theta}$ and so is the economic allocation. □

Proof of Propositions 2

Proof. Suppose that the borrowing constraints are strictly binding for $\theta \in [0, \bar{\theta})$. Given the aggregate labor income invested in period t, $w_t = \eta i_t^e + (1-\eta) i_t^h$, and the equilibrium loan rate $r_t = v_{t+1}G'(i_t^h)$, the borrowing constraints are reformulated as,

$$\theta \left[\frac{\eta}{(1-\eta)} \frac{w_t}{(w_t - i_t^h)} + 1 \right] = \frac{G'(i_t^h)}{R}. \tag{21}$$

Given the capital-labor ratio, the labor income w_t is uniquely determined in period t. Consider the two sides of equation (21) as two functions of i_t^h. Graphically, the right-hand side can be represented by a monotonically downward-sloping curve with an intercept of $\frac{G'(0)}{R} = 1$ on the vertical axis, while the left-hand side by a monotonically upward-sloping curve with an intercept of $\frac{\theta}{1-\eta}$ on the vertical axis. Given $\theta \in [0, \bar{\theta})$, the two curves must intersect once and only once at $i_t^h > 0$. The loan rate is smaller and the equity rate is larger than the marginal return on the entrepreneurial project, $r_t = v_{t+1}G'(i_t^h) < v_{t+1}R < \Gamma_t$. It confirms our conjecture that the borrowing constraints are binding for $\theta \in [0, \bar{\theta})$.

According to equation (21), i_t^h is a function of θ, given the capital-labor ratio and thus the labor income. Take the first derivative of equation (21) with respect to θ,

$$\frac{G'(i_t^h)}{\theta R} = \left[\frac{G''(i_t^h)}{R} - \frac{\eta}{(1-\eta)} \frac{\theta w_t}{(w_t - i_t^h)^2} \right] \frac{d i_t^h}{d\theta}. \tag{22}$$

According to Assumption 1, the concavity of the household project, $G''(i_t^h) < 0 < G'(i_t^h)$, implies $\frac{di_t^h}{d\theta} < 0$. The aggregate output of capital goods is $K_{t+1} = Rw_t - \Lambda_t$, where $\Lambda_t \equiv (1-\eta)[Ri_t^h - G(i_t^h)]$ measures the *short-run efficiency losses* due to the household project investment. Given the labor income, financial development reduces the inefficient investment in the household project, $\frac{di_t^h}{d\theta} < 0$, which reduces the short-run efficiency losses, $\frac{d\Lambda_t}{di_t^h} = (1-\eta)[R - G'(i_t^h)] > 0$. Using the wage dynamics, $w_{t+1} = \left(\frac{K_{t+1}}{\rho}\right)^{\alpha}$, we get

$$\frac{dw_{t+1}}{d\theta} = (1-\alpha)\left(\frac{K_{t+1}}{\rho}\right)^{\alpha-1}(1-\eta)[G'(i_t^h) - R]\frac{di_t^h}{d\theta} > 0. \tag{23}$$

Financial development improves production efficiency in period t and then raises aggregate output as well as the labor income in period $t+1$. Thus, the phase diagram of wages for $\theta \in [0, \bar{\theta})$ is in parallel lower than for $\theta \in [\bar{\theta}, 1]$, as shown in figure 1. □

Proof of Propositions 3

Proof. According to Proposition 1, for $\theta \in [\bar{\theta}, 1]$, capital goods are produced only by entrepreneurs, $i_t^h = 0$, and thus, the two interest rates are equal to the marginal return on the entrepreneurial projects, $r_t = v_{t+1}G'(0) = v_{t+1}R = \Gamma_t$. Since capital goods are produced by entrepreneurs only, $K_{t+1} = R\eta i_t^e = Rw_t$, the social rate of return is also equal to the marginal return of the entrepreneurial projects, $\Psi_t = \frac{C_{t+1}}{I_t} = \frac{v_{t+1}K_{t+1}}{w_t} = Rv_{t+1}$. Given the Cobb-Douglas production function, $v_{t+1} = \frac{\alpha Y_{t+1}}{K_{t+1}} = \left(\frac{K_{t+1}}{\rho}\right)^{\alpha-1}$ and $w_t = (1-\alpha)Y_t = \left(\frac{K_t}{\rho}\right)^{\alpha}$. Together with $K_{t+1} = Rw_t$, we get $Rv_{t+1} = R^{\alpha}\rho^{1-\alpha^2}(K_t)^{\alpha(\alpha-1)}$. □

Proof of Propositions 4

Proof. Proposition 2 shows that for $\theta \in [0, \bar{\theta})$, production is inefficient, $i_t^h > 0$. According to Assumption 1 and equation (6), the loan rate is smaller than the marginal return of the entrepreneurial project and the equity rate, $r_t = v_{t+1}G'(i_t^h) < v_{t+1}R \leq \Gamma_t$.[6]

We prove $r_t < \Psi_t$ by contradiction. Suppose $r_t \geq \Psi_t$. Thus, $v_{t+1}R > v_{t+1}G'(i_t^h) \geq \Psi_t$, which implies $v_{t+1}Ri_t^e > \Psi_t i_t^e$ and $v_{t+1}G(i_t^h) = v_{t+1}\int_{s=0}^{i_t^h} G'(s)ds > \Psi_t i_t^h$, given Assumption 1. By definition, the social rate of return is $\Psi_t = \frac{v_{t+1}K_{t+1}}{I_t} = \frac{v_{t+1}[R\eta i_t^e + (1-\eta)G(i_t^h)]}{\eta i^e + (1-\eta)i^h} > \frac{\Psi_t \eta i_t^e + \Psi_t(1-\eta)i_t^h}{\eta i^e + (1-\eta)i^h} = \Psi_t$. The contradiction of $\Psi_t > \Psi_t$ proves $r_t < \Psi_t$. We can also prove $Rv_{t+1} > \Psi_t$ by contradiction. Thus, the loan rate is lower while the equity rate is higher than the social rate of return, $r_t < \Psi_t < Rv_{t+1} \leq \Gamma_t$. □

Proof of Propositions 5

Proof. According to Propositions 3 and 4, $r_t = \Psi_t$ for $\theta = \bar{\theta}$ and $r_t < \Psi_t$ for $\theta \in [0, \bar{\theta})$. Given the capital-labor ratio, financial development improves production efficiency, $\frac{\partial Y_{t+1}}{\partial \theta} > 0$. Given the predetermined labor income, w_t and $\Psi_t = \frac{v_{t+1}K_{t+1}}{w_t} = \frac{\alpha Y_{t+1}}{w_t}$, the social

[6] In the no-borrowing case of $\theta = 0$, the debt-equity ratio is zero and thus, $\Gamma_t = Rv_{t+1}$.

rate of return increases with the level of financial development, $\frac{\partial \Psi_t}{\partial \theta} = \frac{\alpha}{w_t} \frac{\partial Y_{t+1}}{\partial \theta} > 0$. Thus, the loan rate has the highest value at $\theta = \bar{\theta}$, $r_t|_{\theta=\bar{\theta}} = \Psi_t|_{\theta=\bar{\theta}} > \Psi_t|_{\theta\in[0,\bar{\theta})} > r_t|_{\theta\in[0,\bar{\theta})}$. $\square$

Proof of Propositions 6

Proof. For $\theta \in (0, \bar{\theta})$, the borrowing constraints are binding so that equation (21) defines i_t^h a function of w_t. Take the derivative of equation (21) with respect to w_t,

$$\frac{G''(i_t^h)}{R} \frac{(w_t - i_t^h)^2}{w_t} = \frac{\theta\eta}{(1-\eta)} \left(1 - \frac{1}{Z_t}\right), \quad \text{where} \quad Z_t \equiv \frac{\partial \ln i_t^h}{\partial \ln w_t}. \tag{24}$$

Given $G''(i_t^h) < 0$, it is trivial to prove $0 < Z_t < 1$ by contradiction. Given $0 < \frac{i_t^h}{w_t} < 1$ and $0 < \frac{\partial \ln i_t^h}{\partial \ln w_t} = \frac{\partial i_t^h}{\partial w_t} \frac{w_t}{i_t^h} < 1$, we get $0 < \frac{\partial i_t^h}{\partial w_t} < \frac{i_t^h}{w_t} < 1$. $\square$

Proof of Propositions 7

Proof. According to Propositions 3 and 4, $\Gamma_t = Rv_{t+1}$ for $\theta = \bar{\theta}$ and $\Gamma_t \geq Rv_{t+1}$ for $\theta \in [0, \bar{\theta})$. Given the capital-labor ratio, financial development improves production efficiency, which leads to the decline in the price of capital goods, $\frac{\partial v_{t+1}}{\partial \theta} < 0$. Thus, the equity rate has the lowest value at $\theta = \bar{\theta}$, $\Gamma_t|_{\theta=\bar{\theta}} = Rv_{t+1}|_{\theta=\bar{\theta}} < Rv_{t+1}|_{\theta\in[0,\bar{\theta})} \leq \Gamma_t|_{\theta\in[0,\bar{\theta})}$. $\square$

B Free Mobility of Financial Capital

Given that the borrowing constraints are binding in both countries under free mobility of financial capital, the equilibrium conditions are almost same as under international financial autarky except for a few conditions. In equilibrium, the cross-border flows of financial capital sum up to zero; the loan rate is equal across the border; the credit-market-clearing condition, i.e., equation (10), is reformulated as equation (26),

$$\Upsilon_t^H + \Upsilon_t^F = 0, \quad \text{and} \quad r_t^H = r_t^F, \tag{25}$$

$$(\lambda_t^i - 1)\eta w_t^i = (1-\eta)(w_t^i - i_t^{i,h}) - \Upsilon_t^i. \tag{26}$$

In subsection B.1, we analyze the model dynamics with respect to free mobility of financial capital from period $t = 0$ on, given $\theta^H = \frac{\bar{\theta}}{2}$ and $\theta^F = \bar{\theta}$. In subsection B.2, we analyze the long-run impacts of free mobility of financial capital, given $\theta^H \in [0, \bar{\theta})$ and $\theta^F = \bar{\theta}$.

B.1 Dynamic Impacts of Free Mobility of Financial Capital

Figure 13 shows the impulse responses of variables in terms of the percentage deviations from their steady-state values under international financial autarky, with the horizontal axis denoting the time periods. The vertical axes of panels entitled "Capital Flows (Level)" and "Country Output (Level)" show the levels of relevant variables.

The analysis is similar as in subsection 3.1.1. According to figure 3, the steady-state loan rate is lower in country H than in country F under international financial autarky.

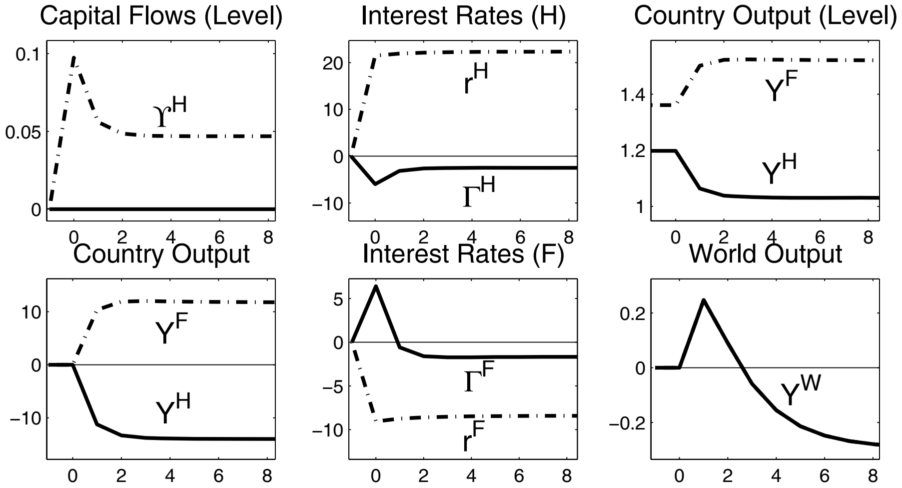

Figure 13: From International Financial Autarky to Free Mobility of Financial Capital

From period $t = 0$ on, individuals born in country H lend abroad. The cross-country loan rate equalization implies that the loan rate rises (declines) in country H (F).

Consider country F first. Financial capital inflows raise the aggregate domestic investment, while the decline in the loan rate induces households to lend less and start to invest in their own projects. Thus, aggregate output in period $t = 1$ is affected positively via the size and negatively via the composition of the aggregate domestic investment. Overall, the size effect dominates the composition effect and aggregate output rises in period $t = 1$. Since financial capital inflows dominate the decline in the household lending, the aggregate credit supply rises and so does the debt-equity ratio. According to equation (14), the equity rate depends on the neoclassical effect, the spread, and the debt-equity ratio. In period $t = 0$, the increase in the debt-equity ratio dominates and the equity rate rises. Financial capital inflows trigger capital accumulation over time. Aggregate output is higher in the long run than before period $t = 0$. The equity rate is mainly determined by the neoclassical effect in the long run. The decline in the price of capital goods keeps the equity rate lower in the long run than before period $t = 0$. This way, due to capital accumulation, the equity rate effect of financial capital flows reverses from positive in the short run to negative in the long run.

Consider country H. Financial capital outflows affect aggregate output in period $t = 1$ negatively via the size and positively via the composition of the aggregate domestic investment. Overall, the size effect dominates and aggregate output declines in period $t = 1$. The response of the equity rate depends on θ^H. For θ^H close to zero, the tight credit constraints imply a small debt-equity ratio. Thus, the equity rate is determined mainly by the neoclassical effect. Financial capital outflows reduce the aggregate domestic investment in period $t = 0$ and the rise in the price of capital goods in period $t = 1$ keeps the equity rate higher in period $t = 0$. In contrast, for θ^H close to $\bar{\theta}$, the debt-equity ratio is large and the equity rate is thus determined mainly by the spread and the debt-equity ratio. Financial capital outflows reduce the spread and the debt-equity ratio. Thus, the equity rate declines in period $t = 0$. Given $\theta^H = \frac{\bar{\theta}}{2}$, the equity rate declines in period $t = 0$. Financial capital outflows trigger capital accumulation, which further reduces aggregate output over time. Due to the neoclassical effect, the equity rate rises over time. Given $\theta^H = \frac{\bar{\theta}}{2}$, the steady-state equity rate is lower than before period $t = 0$.

As mentioned in subsection 3.1.1, the immediate impact of financial capital flows on the world output in period $t = 1$ depends on three effects. Financial capital flows widen the cross-country output gap and the third effect is thus negative. For θ^H close to zero, the borrowing constraint is very tight in country H and financial capital outflows significantly reduce the household project investment. Given the loose borrowing constraint $\theta^F = \bar{\theta}$, financial capital inflows slightly raise the household project investment in country F. Overall, the net efficiency effect on the country level is significantly positive and dominates the third effect. Thus, the world output is higher in period $t = 1$. Conversely, for θ^H close to $\bar{\theta}$, the small cross-country loan rate differential under international financial autarky imply small financial capital flows. Overall, the net efficiency effect on the country level is slightly positive and dominated by the third effect. Thus, the world output is lower in period $t = 1$. Given $\theta^H = \frac{\bar{\theta}}{2}$, the world output rises in period $t = 1$. In the long run, capital accumulation reinforces the efficiency losses on the cross-country level and the world output is lower than before period $t = 0$.

B.2 Long-Run Impacts of Free Mobility of Financial Capital

Given $\theta^F = \bar{\theta}$, figure 14 shows the percentage differences of variables in the steady state under free mobility of financial capital and under international financial autarky, with the horizontal axis denoting $\theta^H \in [0, \bar{\theta})$. The vertical axes of the panels entitled "Capital Flows (Level)" and "Country Output (Level)" show the levels of relevant variables.

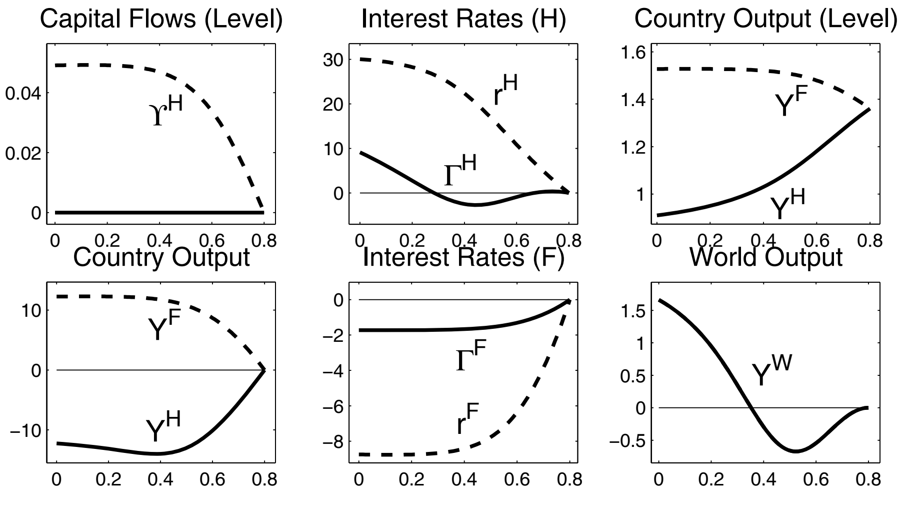

Figure 14: Free mobility of Financial Capital versus International Financial Autarky

Since financial capital flows are driven by the cross-country loan-rate differential under international financial autarky, the pattern of financial capital flows in the first panel of figure 14 follows that of the cross-country loan-rate differential shown in figure 3.

Financial capital flows affect aggregate output via the size and the composition of the aggregate domestic investment in the two countries. Panel "Country Output" of figure 14 shows that the patterns of aggregate output follow that of financial capital flows.

As mentioned in subsection 3.1.1, financial capital flows affect the world output via three effects. Financial capital flows widen the cross-country output gap and the third effect is thus negative. For θ^H close to zero, the productivity differential between the entrepreneurial and the household project in country H is large and so is the first effect. Overall, the net efficiency effect on the country level is significantly positive and dominates the third effect. Thus, the world output is higher. Conversely, for θ^H close to $\bar{\theta}$, the small productivity differential between the entrepreneurial and the household project in country H implies that the first effect is small. Overall, the net efficiency effect on the country level is small and dominated by the third effect. Thus, the world output is lower.

The long-run equity-rate pattern in country F is mainly driven by the neoclassical effect. Financial capital inflows trigger capital accumulation and the further decline in the price of capital goods keeps the equity rate in the long run lower than under international financial autarky. The long-run equity-rate pattern in country H depends on θ^H. For θ^H close to zero, the tight borrowing constraints imply that the equity rate depends mainly on the neoclassical effect. Capital accumulation further raises the price of capital goods and the equity rate in the long run is higher. For θ^H close to $\bar{\theta}$, the equity rate depends mainly on the debt-equity ratio. Since financial capital outflows reduce the debt-equity ratio, the equity rate in the long run is lower.

C Threshold Values under Capital Mobility

C.1 Free Mobility of FDI

For a detailed description of the direction and size of FDI over the complete parameter constellations of θ^H and θ^F, figure 15 shows some threshold values, where the horizontal and vertical axes denote $\theta^H \in [0, 1]$ and $\theta^F \in [0, 1]$, respectively.

Similarly as in subsection B.2, for the parameter combination in region A as well as on the 45 degree line, the equity rate is same in the two countries under international financial autarky and there is no FDI flow even if allowed, $\Omega^H = \Omega^F = 0$.

The curve splitting region B and E represents a set of threshold values $\theta_F^{FDI,U} \in (\theta^U, 1)$ as a function of θ^H. In region B, the equity rate is equal to the loan rate and the borrowing constraint is not binding in country F; the economic allocation is same as in the case of $\theta^F = \bar{\theta}^F_{FDI}$. In region E, the equity rate is higher than the loan rate and the borrowing constraint is binding in country F. Similarly, the curve splitting region B' and E' represents a set of threshold values $\theta_H^{FDI,U} \in (\theta^U, 1)$ as the function of $\theta^F \in [0, \theta^U)$.

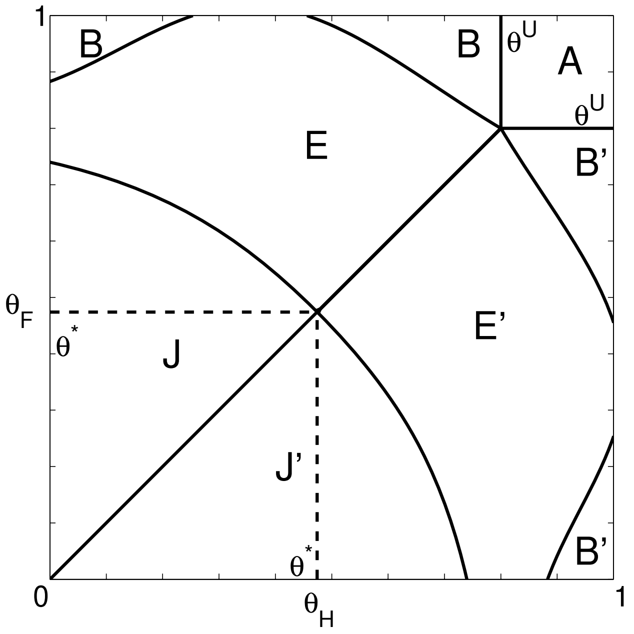

Figure 15: Free Mobility of FDI: Threshold Values

The curve splitting region E and J represents a set of threshold values $\theta_F^{FDI,0}$ as a function of θ^H. Given θ^H and $\theta^F = \theta_F^{FDI,0} \neq \theta^H$, the equity rate is equal in the two countries under international financial autarky, due to the hump-shaped pattern of the equity rate. Thus, there is no FDI flow even if allowed. The intuition is explained in subsection 2.5 and is straightforward from the third panel of figure 3. Similarly, the curve splitting region E' and J' represents a set of threshold values $\theta_H^{FDI,0}$ as a function of θ^F. Note that θ^* refers to the level of financial development relating to the highest equity rate under international financial autarky.

Table 1: FDI Flows and Equity Premium in the Steady State

Region	A	B	B'	E	E'	J	J'
Ω^H	0	$\Omega^H(\theta^H) < 0$	$\Omega^H(\theta^F) > 0$	$(\Omega^H(\theta^H), 0)$	$(0, \Omega^H(\theta^F))$	$+$	$-$
$\Gamma^H - r^*$	0	$+$	0	$+$	$+$	$+$	$+$
$\Gamma^F - r^*$	0	0	$+$	$+$	$+$	$+$	$+$

Table 1 summarizes the steady-state FDI flows and the equity premium in the seven regions, $\Omega^F = -\Omega^H$. $\Omega^H(\theta^i)$ implies that given the parameter combination in region B and B', FDI flows depends only on θ^i not on θ^m, where $i, m \in \{H, F\}$ and $i \neq m$.

For a complete description of how free mobility of FDI affects the world output in the steady state, figure 16 shows some threshold values, where the horizontal and vertical axes denote $\theta^H \in [0, \bar{\theta}]$ and $\theta^F \in [0, \bar{\theta}]$, respectively. That is, we restrict our analysis over the parameter set where the borrowing constraints are strictly binding under international financial autarky. For the parameter values in region A, E, and F, the steady-state world output is lower under free mobility of FDI than under international financial autarky, while the opposite is true for the parameter values in regions B and H.

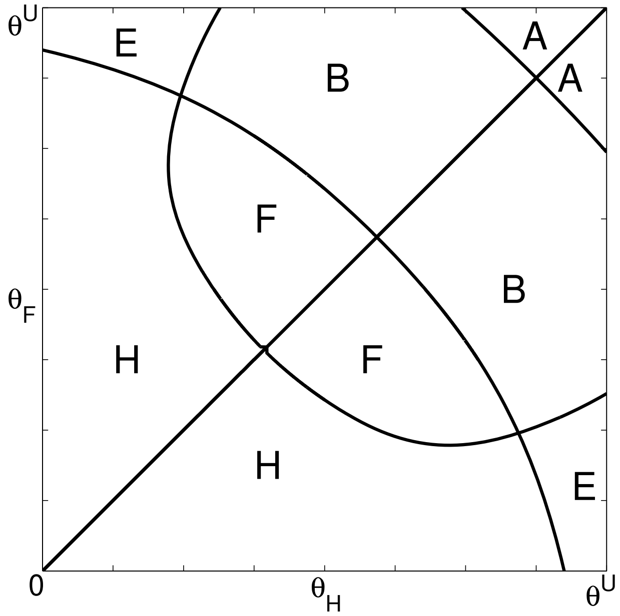

Figure 16: World Output Effect of Free Mobility of FDI

C.2 Free Mobility of Financial Capital

For a detailed description of the direction and size of financial capital flows over the complete parameter constellations of θ^H and θ^F, figure 17 shows some threshold values, where the horizontal and vertical axes denote $\theta^H \in [0,1]$ and $\theta^F \in [0,1]$, respectively.

If $\theta^H = \theta^F$, i.e., the parameter constellations on the 45 degree line, the loan rates are same in the two countries under international financial autarky and there are no capital flows even if allowed, $\Upsilon_t^H = \Upsilon_t^F = 0$. If $\theta^H > \theta^U$ and $\theta^F > \theta^U$ as in region A, the loan rate is equal to the social rate of return in both countries according to Proposition 1. Again, there are no international financial capital flows.

The curve splitting regions B and E represents the threshold value of $\theta_F^{FC,U} \in (\theta^U, 1)$ as the function of θ^H. In region B, the equity rate is equal to the loan rate and the borrowing constraint is not binding in country F, and the economic allocation is same as in the case of $\theta^F = \bar{\theta}_{FC}^F$. In region E, the equity rate is higher than the loan rate and the borrowing constraint is binding in country F. Similarly, the curve splitting region B' and E' represents a set of threshold values $\theta_H^{FC,U} \in (\theta^U, 1)$ as the function of $\theta^F \in [0, \theta^U)$.

Table 2 summarizes the steady-state financial capital flows and the equity premium in the five regions, $\Upsilon^F = -\Upsilon^H$. $\Upsilon^H(\theta^i)$ implies that given the parameter combination in region B and B', financial capital flows depend only on θ^i not on θ^m, where $i, m \in \{H, F\}$. The borrowing constraint is binding if the equity premium is positive.

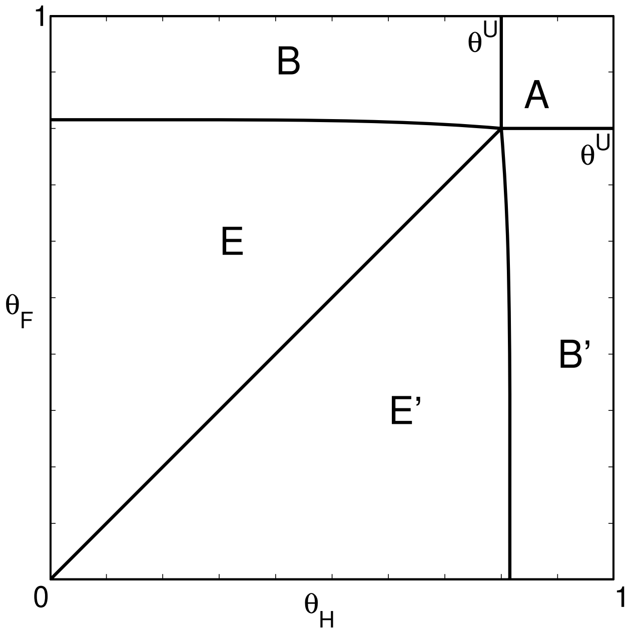

Figure 17: Free Mobility of Financial Capital: Threshold Values

Table 2: Financial Capital Flows and Equity Premium in the Steady State

Region	A	B	B'	E	E'
Υ^H	0	$\Upsilon^H(\theta^H) > 0$	$\Upsilon^H(\theta^F) < 0$	$(0, \Upsilon^H(\theta^H))$	$(\Upsilon^H(\theta^F), 0)$
$\Gamma^H - r^*$	0	$+$	0	$+$	$+$
$\Gamma^F - r^*$	0	0	$+$	$+$	$+$

For a complete description of how free mobility of financial capital affects the world output in the steady state, figure 18 shows some threshold values, where the horizontal and vertical axes denote $\theta^H \in [0, \bar{\theta}]$ and $\theta^F \in [0, \bar{\theta}]$, respectively. For the parameter values in region A, the steady-state world output is lower under free mobility of financial capital than under international financial autarky, while the opposite is true for the parameter values in region B.

C.3 Full Capital Mobility

For a detailed description of the direction and size of financial capital and FDI flows over the complete parameter constellations of θ^H and θ^F, figure 19 shows some threshold values, where the horizontal and vertical axes denote $\theta^H \in [0, 1]$ and $\theta^F \in [0, 1]$, respectively.

Similarly as in subsection B.2, for the parameter combination in region A as well as on the 45 degree line, economic allocations are identical in the two countries and there is no capital flows across the border, $\Omega^H = \Omega^F = 0$ and $\Upsilon^H = \Upsilon^F = 0$, even if allowed.

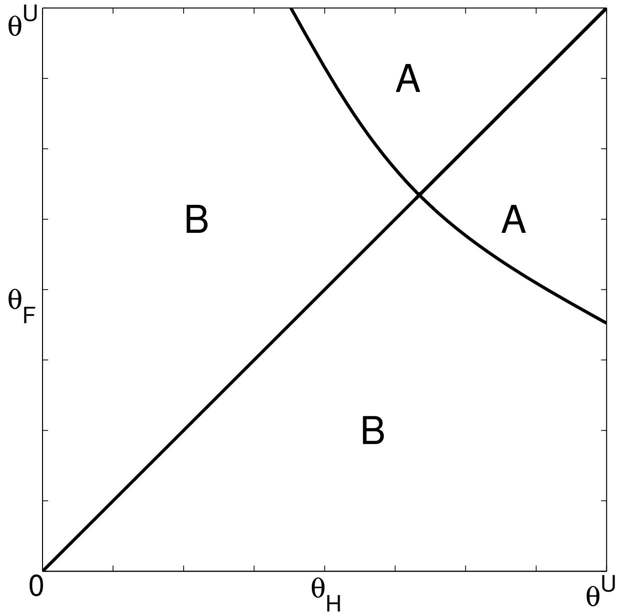

Figure 18: World Output Effect of Free Mobility of Financial Capital

The curve splitting region B and E represents the relationship between θ^H and θ^F,

$$\theta^H + \theta^F = 2(1-\eta). \tag{27}$$

In region B, the equity rate is equal to the loan rate and the borrowing constraint is not binding in both countries. In other words, economic allocation is identical and efficient in both countries in the sense that capital goods are produced only by entrepreneurs. In region E, the world equity rate is higher than the world loan rate and the borrowing constraints are binding in both countries. Similarly, the curve splitting region B' and E' also represents the relationship between θ^H and θ^F as specified in equations (27).

The curve splitting region E and J represents a set of threshold values $\theta_F^{FDI,0}$ as a function of θ^H. Given θ^H and $\theta^F = \theta_F^{FDI,0} \neq \theta^H$, the equity rate is equal in the two countries under free mobility of financial capital and thus, there is no FDI flows even if additionally allowed. The curve splitting region J and M represents a set of threshold values $\theta_F^{FC,0}$ as a function of θ^H. Given θ^H and $\theta^F = \theta_F^{FC,0} \neq \theta^H$, the loan rate is equal in the two countries under free mobility of FDI and thus, there is no financial capital flows even if additionally allowed. Similarly, the curve splitting region E' and J' (J' and M') represents a set of threshold values $\theta_H^{FDI,0}$ ($\theta_H^{FC,0}$) as a function of θ^F.

Table 3 the steady-state flows of financial capital and FDI as well as the equity premium in the nine regions, where $\Upsilon^F = -\Upsilon^H$ and $\Omega^F = -\Omega^H$. $\Upsilon^H(\theta^i)$ and $\Omega^H(\theta^i)$ imply that given the parameter combination in region B and B', financial capital and FDI flows depend only on θ^i not on θ^m, where $i, m \in \{H, F\}$ and $i \neq m$.

For a complete description of how full capital mobility affects the world output in the steady state, figure 20 shows some threshold values, where the horizontal and vertical axes denote $\theta^H \in [0, \bar{\theta}]$ and $\theta^F \in [0, \bar{\theta}]$, respectively. For the parameter values in region A,

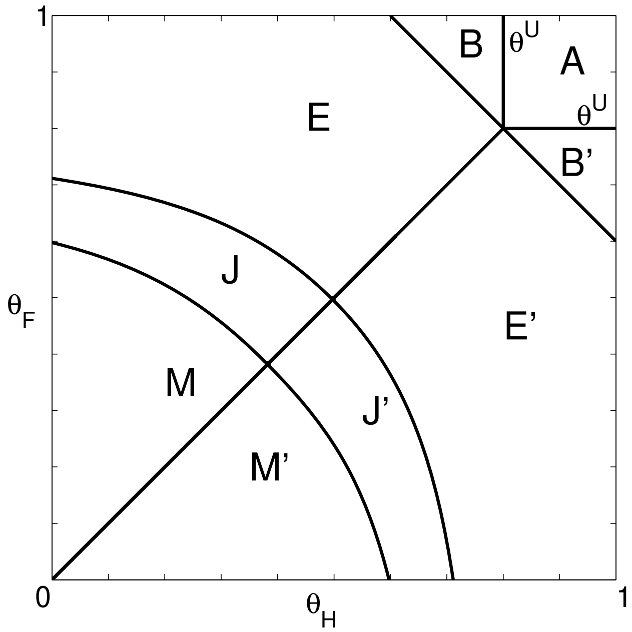

Figure 19: Full Capital Mobility: Threshold Values

Table 3: Capital Flows and Equity Premium in the Steady State

Region	A	B	B'	E	E'	J	J'	M	M'
Υ^H	0	$\Upsilon^H(\theta^H) > 0$	$\Upsilon^H(\theta^F) < 0$	+	−	+	−	−	+
Ω^H	0	$\Omega^H(\theta^H) < 0$	$\Omega^H(\theta^F) > 0$	−	+	+	−	+	−
$\Gamma^H - r^*$	0	+	0	+	+	+	+	+	+
$\Gamma^F - r^*$	0	0	+	+	+	+	+	+	+

the steady-state world output is lower under full capital mobility than under international financial autarky, while the opposite is true for the parameter values in region B.

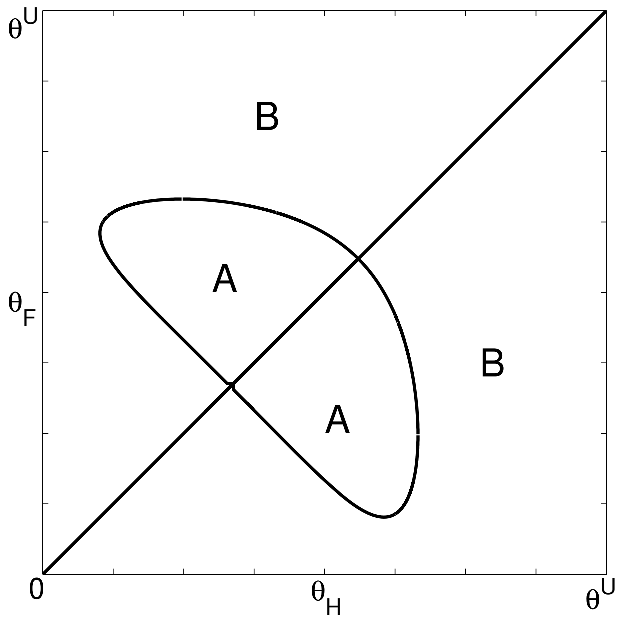

Figure 20: World Output Effect of Full Capital Mobility