When Are Trade Liberalizations and Capital Flows Substitutes or Complements?

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Abstract

We develop a comprehensive model to study goods trade and capital flows in this paper. We introduce convex costs of capital flows, factor adjustment costs, and financial institutions to the Heckscher-Ohlin framework, and show that trade liberalizations and capital flows are substitutes in most of cases. If trade liberalizations may not balance the trade, we show one possible solution to the global imbalances is for emerging economies to improve the technology in the capital intensive sector, and therefore increases the domestic investment demand.

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1 Introduction

This paper aims to develop a comprehensive model to study goods trade and capital flow. Two main problems exist in the classical Heckscher-Ohlin-Samuelson framework when both goods trade and capital flows are considered. First, As Mundell (1957) argues, goods trade and capital flow are perfect substitutes in the HO model. Without costs of trade in goods or capital, there are infinite combinations of goods trade and capital flow composition that constitute equilibria. So the exact amount of capital flows is indeterminate. With linear costs of trade in goods and/or capital, the corner solutions occur: either goods trade or capital flow takes place, but goods trade and capital flow do not coexist. Second, if factors are freely mobile across sectors, goods trade and capital flow are substitutes. If factors are sector-specific, however, as Markusen (1983) and Antras and Caballero (2009) point out, goods trade and capital flow are complement.

As the global imbalance becomes a major issue in practice and theory, a central issue in interactions between goods trade and capital flows is whether a trade liberalization leads to capital inflows (complement) to developing countries, and therefore helps to solve the current account surpluses in some emerging economies, like China, or capital outflows (substitute), and therefore is one of driving forces of global imbalances. That is the focus of this paper.

In our benchmark model, we introduce convex costs of capital flows and factor adjustment costs to the Heckscher-Ohlin framework. We show that trade liberalizations and capital flows are substitutes in most of our cases.

When factors are freely mobile across sectors, we show that if a country reduces the tariff in the capital intensive sector, it will import more the capital intensive good but import less capital. On the other hand, if a country reduces the tariff in the labor intensive sector, it will export more the capital intensive good but export less capital. Therefore, trade liberalizations and capital flows are substitutes in this

case.

When labor is sector specific but capital is freely mobile across sectors, we show that a tariff reduction in the capital intensive sector in a developing country reduces the return to capital. As the result, the country imports less capital or experiences a capital outflow. So trade liberalizations and capital flows are substitutes again.

When capital is sector specific, but labor is freely mobile across sectors. A tariff reduction results in a decrease in the return to capital in the importing sector, but an increase in the return to capital in the exporting sector. As a result, the country experiences a capital outflow in the importing sector but a capital inflow in the exporting sector. In this case, it is ambiguous whether trade liberalizations and capital flows are substitutes or complement, since directions of capital flows due to trade liberalizations in two sectors are opposite. In a rather special circumstance, that the capital in the importing sector in a developing country is prohibited to flow, then trade liberalizations and capital flows are complement in this case.

We then introduce financial institutions into the model and consider two type of capital flows: financial capital flow and FDI. We show trade liberalizations in a labor abundant country lead to less inflows (more outflows) in both financial capital and FDI. So trade liberalizations and capital flows are again substitutes. However, the effects of financial development on financial capital flow and FDI are opposite: the lower financial development in the country lead to more financial capital outflow but more FDI inflow. Thus, financial development is complement to financial capital flow, but substitute to FDI.

If trade liberalizations may not balance the trade, we show one possible solution to the global imbalances is for emerging economies to improve the technology in the capital intensive sector, and therefore increases the domestic investment demand.

2 The Model

Two main problems exist in the classical Heckscher-Ohlin-Samuelson framework when both goods trade and capital flows are considered. First, As Mundell (1957) argues, goods trade and capital flow are perfect substitutes in the HO model. Without costs of trade in goods or capital, there are infinite combinations of capital flow and goods trade composition that constitute equilibria. So the exact amount of capital flows is indeterminate. With linear costs of trade in goods and/or capital, the corner solutions occur: either goods trade or capital flow takes place, but goods trade and capital flow do not coexist.[1] Second, if factors are freely mobile, goods trade and capital flow are substitutes. If factors are sector-specific, however, as Markusen (1983) and Antras and Caballero point out, goods trade and capital flow are complement.

We develop a comprehensive benchmark model to address these two issues. First, we introduce a convex cost of capital flows so that there is an unique equilibrium in which goods trade and capital flows coexist. Second, we introduce both labor and capital adjustment costs so that the HO models and the factor specific models become special cases of out model. In section 4, we further introduce the financial system to the benchmark model and study how the efficiency of financial system affects capital flows. To simplify the analysis, we focus on the case of small open economy.

2.1 Household

The economy's endowment consists of labor L and capital stock K, which are owned by households. There are two sectors in the economy. The households supply labor and capital to both sectors. However, the factors can not be costlessly reallocated between two sectors. To model the factor market friction, we assume that the households are subject to quadratic labor and capital adjustment costs for working

[1] For more detail discussions, readers are guided to Ju and Wei (2007).

in each sector. That is, if the households supply L_i and to sector i for $i = 1, 2$, they will bear the adjustment costs $\frac{\eta}{2}(L_{it} - \overline{L}_i)^2$ and $\frac{\xi}{2}(K_{it} - \overline{K}_i)^2$, where η and ξ are parameters that measure the labor and capital market frictions in sector i, and $\overline{L}_i$ and $\overline{K}_i$ are labor and capital usages before the trade liberalization, respectively. As a result, the wage and rental rates will be different across sectors. The wage rate and the return to capital (the interest rate) in sector i are represented by w_i and R_i, respectively. Let x_i and p_i be the quantity of consumption and the price in sector i. The representative consumer's utility function is $u(x_1, x_2)$ and she solves the following maximization problem:

$$\max_{x_i, L_i, K_i} u(x_1, x_2) \tag{1}$$

subject to

$$\begin{aligned} p_1 x_1 + p_2 x_2 + \sum_{i=1}^{2} \frac{\eta}{2}(L_i - \overline{L}_i)^2 + \sum_{i=1}^{2} \frac{\xi}{2}(K_i - \overline{K}_i)^2 &= \sum_{i=1}^{2} (w_i L_i + r_i K_i) \quad (2) \\ L_1 + L_2 &= L \quad (3) \\ K_1 + K_2 &= K \quad (4) \end{aligned}$$

Solving the first order conditions of the above problem, we obtain:

$$\begin{aligned} L_1 &= \overline{L}_1 + \frac{w_1 - w_2}{2\eta}, L_2 = \overline{L}_2 - \frac{w_1 - w_2}{2\eta} \quad (5) \\ K_1 &= \overline{K}_1 + \frac{R_1 - R_2}{2\xi}, K_2 = \overline{K}_2 - \frac{R_1 - R_2}{2\xi} \quad (6) \end{aligned}$$

2.2 Production

Both goods and capital are tradable, while labor is immobile across the border. The market is perfectly competitive. The production function for good i is $y_i =$

$f_i(A_iL_i, K_i)$ where A_i measures labor productivity in sector i. $H_i = A_iL_i$ can be understood as *effective labor*. All production functions are assumed to be homogeneous of degree one. The unit cost function for y_i is

$$\begin{aligned} c_i(\frac{w_i}{A_i}, R_i) &= \min\{w_iL_i + R_iK_i \mid f_i(A_iL_i, K_i) \geq 1\} \\ &= \min\{\left(\frac{w_i}{A_i}\right) H_i + R_iK_i \mid f_i(H_i, K_i) \geq 1\} \end{aligned} \tag{7}$$

Free entry ensures zero profit for producers. If the country's endowment is within the diversification cone, both goods are produced, and we have:

$$p_1 = c_1(w_1/A_1, R_1) \text{ and } p_2 = c_2(w_2/A_2, R_2) \tag{8}$$

where p_i is the price of good i. Let p^* be the world price,[2] and τ_i be the tariff rate in good i. Then we have $p_i = (1 + \tau_i)\, p_i^*$.

3 Equilibrium Analysis

We will first consider two polar cases: the HO model where factors are freely mobile across sectors, and the specific factor models where either labor or capital is sector-specific. In the HO model, the parameters that measure factor adjustment costs, η and ξ are set to zero. The wage and the interest rates in two sectors are equalized and are denoted as w and R, respectively. When labor (or capital) is sector-specific, on the other hand, η (or ξ) is infinity, so labor (or capital) employed in sector i is fixed. We then move to the general case where η and ξ are greater than zero but less than infinity.

[2] We use a superscript "*" to denote variables in the foreign country.

3.1 Heckscher-Ohlin Model with Capital Flows

Let $\widetilde{K}$ be the amount of capital flow. $\widetilde{K} > 0$ denotes capital inflow while $\widetilde{K} < 0$ denotes capital outflow. The marginal cost of capital flow is represented by $\phi\widetilde{K}$ where ϕ is a positive number. Thus, the cost of capital flow is assumed to be convex so that the marginal cost of capital flow is increasing. The equilibrium condition for capital flows is written as follows:

$$R - R^* = \phi\widetilde{K} \Leftrightarrow \widetilde{K} = \frac{R - R^*}{\phi} \tag{9}$$

When $R > R^*$, $\widetilde{K} > 0$ so capital flows into the country; when $R < R^*$, $\widetilde{K} < 0$ so capital flows out.

The full employment conditions for labor and capital, respectively, are

$$a_{1L}y_1 + a_{2L}y_2 = L \tag{10}$$

$$a_{1K}y_1 + a_{2K}y_2 = K + \widetilde{K} \tag{11}$$

where

$$a_{iL} = \frac{\partial\phi_i(w,R)}{\partial w}, \text{ and } a_{iK} = \frac{\partial\phi_i(w,R)}{\partial R} \tag{12}$$

are labor and capital usages per unit of production, respectively.

Let sector 1 be labor intensive. That is, $\frac{a_{1L}}{a_{1K}} > \frac{a_{2L}}{a_{2K}}$. In equations (8), we have $w_1 = w_2 = w$ and $R_1 = R_2 = R$ in HO model. The Stolper-Samuelson theorem holds: $\frac{\partial w}{\partial p_1} > 0$, $\frac{\partial R}{\partial p_1} < 0$, $\frac{\partial w}{\partial p_2} < 0$, and $\frac{\partial R}{\partial p_2} > 0$.

Trade liberalizations are represented by reductions in tariffs, τ_1 and τ_2. A tariff reduction in labor intensive sector (a decrease in τ_1) increases R since $\frac{\partial R}{\partial p_1} < 0$. Thus, using equation (9), the amount of capital inflow (outflow) increases (decreases). As $K + \widetilde{K}$ increases, using the Rybczynski theorem, y_2 increases so that the country exports more the capital intensive good. On the other hand, A tariff reduction in τ_2 reduces R, and therefore reduces capital inflow. Using the Rybczynski theorem

again, the country produces less y_2 so it imports more capital intensive good. Summarizing the results, we have:

Proposition 1 *Suppose factors are freely mobile across sectors. If a country reduces the tariff in the labor intensive sector, it will export more the capital intensive good but export less capital. On the other hand, if a country reduces the tariff in the capital intensive sector, it will import more the capital intensive good but import less capital.*

A labor abundant country imports the capital intensive good in the HO model. Trade liberalizations in the country, therefore, feature a tariff reduction in the capital intensive sector, which promotes imports of the capital intensive good, but reduces the interest rate and therefore leads to more (less) capital outflow (inflow). In other words, trade liberalizations in a developing (labor abundant) country result in more current account surpluses. By contrast, trade liberalizations in a developed (capital abundant) country increases the interest rate and therefore result in more current account deficits.

3.2 Specific Labor

Let $\overline{L}_i$ be fixed labor usage in sector i, $\overline{L}_1 + \overline{L}_2 = L$. Capital, however, is assumed to be freely mobile across sectors. If these is no capital flow across the border, the domestic return to capital, R, is determined by

$$p_1 \partial f_1(A_1\overline{L}_1, K_1)/\partial K_1 = p_2 \partial f_2(A_2\overline{L}_2, K - K_1)/\partial K_2 = R \tag{13}$$

It is straightforward to show, using Figure 1, that decreases in either p_1 or p_2 (due to trade liberalizations) reduce R. In Figure 1 the length of the horizontal axis is equal to the total supply of domestic capital, K, the vertical axis measures R. The value marginal product of capital curves for sectors 1 and 2, labeled as V_{1K} and V_{2K}, respectively, are plotted relative to origins O_1 and O_2. The equilibrium

position without capital flows is shown by E where $V_{1K} = p_1 \partial f_1(A_1\overline{L}_1, K_1)/\partial K_1$ and $V_{2K} = p_2 \partial f_2(A_2\overline{L}_2, K - K_1)/\partial K_2$ intersect.

Consider a trade liberalization that reduces p_1 (or p_2) to p_1' (or p_2'). When p_1 (or p_2) declines, V_{1K} (or V_{2K}) shifts down to V_{1K}' (V_{2K}') in Figure 1, and the return to capital decreases from R^0 to R'. It is interesting to note the difference between HO model and the specific-labor model. In HO model, the decrease in p_1 increases R but the decrease in p_2 reduces R, while in the specific-labor model, both decreases in p_1 and p_2 reduce R.

With capital flows across the border, the equilibrium condition after the trade liberalization becomes:

$$\begin{aligned} p_1' \partial f_1(A_1\overline{L}_1, K_1)/\partial K_1 &= p_2 \partial f_2(A_2\overline{L}_2, K + \widetilde{K} - K_1)/\partial K_2 = R \\ R - R^* &= \phi \widetilde{K} \end{aligned} \tag{14}$$

Three endogenous variables, K_1, $\widetilde{K}$, and R are solved by the system (14). Summarizing we have:

Proposition 2 *Suppose labor is sector specific, but capital is freely mobile across sectors. A tariff reduction in any sector reduces the return to capital. As the result, the country experiences a capital outflow.*

Comparing Proposition 2 with Proposition 1, it is interesting to note that for a labor abundant country, a trade liberalization (reduction in p_2) leads to a decrease in the return to capital, R, and therefore a capital outflow in both the HO model and the specific-labor model. However, a trade liberalization (reduction in p_1) in a capital abundant country leads to an increase in R and therefore a capital inflow in the HO model, but a reduction in R and therefore a capital outflow in the specific labor model.

Two effects are associated with trade liberalizations. First, the decrease in price reduces the value marginal product of capital, which is labelled as the *price effect.* Second, the trade liberalization results in changes in production structures and leads the country to produce more goods that use its abundant factor intensively, which is called the *structural effect.* The former reduces R in any country. The later, on the other hand, increases the demand for capital in a capital abundant country and therefore raises R, but decreases it in a labor abundant country.

Both the *price effect* and the *structural effect* reduce the return to capital in a labor abundant country, so a trade liberalization leads to capital outflow in the HO model and in the specific-labor model. However, the *structural effect* is weaker in the specific-labor model, as immobile labor prevents the structural adjustment at the full scale. Thus, the amount of capital outflow in a labor abundant country is smaller in the specific-labor model than that in the HO model. On the other hand, however, the *price effect* and the *structural effect* move in opposite directions in a capital abundant country. Furthermore, in HO model the later dominates the former, so a trade liberalization leads to capital inflow, while in the specific-labor model, it is the reverse.

3.3 Specific Capital

Let $\overline{K}_i$ be fixed capital usage in sector i. Now labor is assumed to be freely mobile across sectors. Without capital flow across the border, the wage rate is determined by

$$p_1 \partial f_1(A_1 L_1, \overline{K}_1)/\partial L_1 = p_2 \partial f_2(A_2 (L - L_1), \overline{K}_2)/\partial L_2 = w \tag{15}$$

Similar to the above analysis, the wage rate w declines after the trade liberalization.

Consider a decrease in p_1. It is illustrated in Figure 2. The value marginal product of labor curve for sector 1, $V_{1L} = p_1 \partial f_1(A_1 L_1, \overline{K}_1)/\partial K_1$ shifts down. As a

result, L_1 decrease to L_1'. Both decreases in p_1 and L_1 reduce the value marginal product of capital in sector 1, $R_1 = p_1 \partial f_1(A_1 L_1, \overline{K}_1)/\partial K_1$. Thus, the decrease in p_1 leads a capital outflow in sector 1. On the other hand, as L_2 increases, the return to capital in sector 2, $R_2 = p_2 \partial f_2(A_2 L_2, \overline{K}_2)/\partial K_2$, must increase, which leads a capital inflow in sector 2. By contrast, a decrease in p_2 reduces R_2 but increases R_1. Summarizing we have:

Proposition 3 *Suppose capital is sector specific, but labor is freely mobile across sectors. A tariff reduction results in a decrease in the return to capital in the importing sector, but an increase in the return to capital in the exporting sector. As a result, the country experiences a capital outflow in the importing sector but a capital inflow in the exporting sector.*

The effects of trade liberalizations on capital flows can be summarized as follows.

Table 1

	Labor Abundant Country	Capital Abundant Country
Tariff Reductions	$p_2 \downarrow$	$p_1 \downarrow$
HO	$R \downarrow$	$R \uparrow$
Specific Labor	$R \downarrow$	$R \downarrow$
Specific Capital	$R_1 \uparrow$, $R_2 \downarrow$	$R_1 \downarrow$, $R_2 \uparrow$

When are trade liberalization and capital flow *complements,* labelled by Antras and Caballero (2009) in the sense that a process of trade integration increases the incentives for capital to flow to developing country? From the above table, we see that only if capital is sector specific, and capital in sector 2 is prohibited to flow across the border. This case bears some similarity to the case discussed by Antras and Caballero (2009) where capital in sector 2 is fixed due to financial frictions and

the capital in sector 2 (called entrepreneurs' capital) is not allowed to flow across the border. A trade liberalization in the developing country expands the country's production in sector 1, and therefore induces foreign capital to flow into the sector.

It is interesting to note that the *complementarity* between trade and capital flows discussed by Antras and Caballero (2009) is rather a special case in our discussions. If factors are freely mobile (HO model), or labor but not capital is sector specific, we all have that trade and capital flows are *substitutes,* rather than complement. We postpone the discussion on financial development, which is a focus in Antras and Caballero (2009), to the later section.

3.4 Partial Rigidities

We now discuss the general case that both labor and capital are partially rigid. That is, the adjustment cost parameters, η and ξ, are between zero and infinity. The model with general function forms becomes complicated and we do not have a closed form solution for the comparative statics. So we use simulations to analyze the effect of factor market rigidities on capital flows.

We assume the following Cobb-Douglas production functions

$$f_1(A_1L_1, K_1) = (A_1L_1)^{\alpha_1} K_1^{1-\alpha_1} \text{ and } f_2(A_2L_2, K_2) = (A_2L_2)^{\alpha_2} K_2^{1-\alpha_2} \tag{16}$$

Thus, we have

$$w_i = \frac{p_i \partial f_i(A_iL_i, K_i)}{\partial L_i} = p_i \alpha_i A_i^{\alpha_i} k_i^{1-\alpha_i} \tag{17}$$

$$R_i = \frac{p_i \partial f_i(A_iL_i, K_i)}{\partial K_i} = p_i \left(1-\alpha_i\right) A_i^{\alpha_i} k_i^{-\alpha_i} \tag{18}$$

where $k_i = \frac{K_i}{L_i}$. Using (5) and (6), we obtain:

$$k_1 = \frac{\overline{K}_1 + \frac{E_1 k_1^{-\alpha_1} - E_2 k_2^{-\alpha_2}}{2\xi}}{\overline{L}_1 + \frac{B_1 k_1^{1-\alpha_1} - B_2 k_2^{1-\alpha_2}}{2\eta}} \tag{19}$$

$$k_2 = \frac{\overline{K}_2 - \frac{E_1 k_1^{-\alpha_1} - E_2 k_2^{-\alpha_2}}{2\xi}}{\overline{L}_2 - \frac{B_1 k_1^{1-\alpha_1} - B_2 k_2^{1-\alpha_2}}{2\eta}} \tag{20}$$

where $B_i = p_i \alpha_i A_i^{\alpha_i}$ and $E_i = p_i (1 - \alpha_i) A_i^{\alpha_i}$. Equations (19) and (20) solve for k_1 and k_2, which than solve for the wage rates and the returns to capital, using (17) and (18). Let ϕ_i be the marginal cost of capital flow in sector i. Similar to equation (9), capital flows in two sectors are now determined by the following equations:

$$\widetilde{K}_1 = \frac{R_1 - R^*}{\phi_1}, \widetilde{K}_2 = \frac{R_2 - R^*}{\phi_2} \tag{21}$$

Finally, the factor usages L_i and K_i in each sector are solved by four equations as follows.

$$\begin{aligned} \frac{K_1}{L_1} &= k_1, \ \frac{K_2}{L_2} = k_2, \\ L_1 + L_2 &= L, \text{ and } K_1 + K_2 = K + \widetilde{K}_1 + \widetilde{K}_2 \end{aligned}$$

We set the parameters in the model as follows:

$\alpha_1 = 0.75$	$\alpha_2 = 0.25$
$p_1^* = 9$	$p_2^* = 1$
$\tau_1 = 0$	$\tau_2 = 0.2$
$\tau_1^* = 0$	$\tau_2^* = 0$
$w^* = 15.3867$	$R^* = 0.19$
$A_1 = 1$	$A_2 = 0.482$
$A_1^* = 1$	$A_2^* = 1$
$L = 1$	$K = 135$

$\alpha_1 > \alpha_2$ so sector 1 is labor intensive. The home country is labor abundant and exports good 1 before the trade reform. Let the tariff rate be zero in sector 1, and 20% in sector 2 at home. Thus the prices at home are $p_1 = 9$ and $p_2 = 1.2$. A_1 is set to 1. A_2 is chosen so that $p_2 A_2^{\alpha_2} = 1$. The foreign country imposes zero tariffs. Thus $p_i A_i^{\alpha_i} = p_i^* A_i^{*\alpha_i}$. The economy is in the steady sate equilibrium before the reform and adjustment costs are zero. So we must have $w_1 = w_2 = w$ and $R_1 = R_2 = R$. Using (17) and (18), therefore, factor prices at home and abroad are equalized, so there is no capital flow before the reform.

Equations (17) and (18) solve for $k_1 = 27$ and $k_2 = 243$. That gives $w = 15.3867 = w^*$ and $R = R^* = 0.19$. Let $\overline{L}_1 = \overline{L}_2 = 1/2$, $\overline{K}_1 = 27/2$, and $\overline{K}_2 = 243/2$, which requires $L = 1$ and $K = 135$.

The trade liberalization reduces τ_2 to zero. Now $B_1 = p_1^* \alpha_1 A_1^{\alpha_1} = 6.75$, $B_2 = p_2^* \alpha_2 A_2^{\alpha_2} = 0.208$, $E_1 = p_1^* (1 - \alpha_1) A_1^{\alpha_1} = 2.25$, and $E_2 = p_2^* (1 - \alpha_2) A_2^{\alpha_2} = 0.625$. Using these results, we then solve for equations (19) and (20). To examine the effect of factor market rigidities, we first fix $\xi = 1$ and let η change from 1 to 20, and then fix $\eta = 1$ and let ξ change from 1 to 20.

4 Financial Institutions and Structures of Capital Flows

We now modify the model discussed in the above and introduce the financial system into the model. Suppose the production process takes two periods. The capital endowment K in the country is owned by K number of capitalists, each born with 1 unit of capital and facing an endogenous choice of becoming either an entrepreneur or a financial investor at the beginning of the first period. If a capitalist chooses to be an entrepreneur, she would manage one project, investing her 1 unit of capital (labeled as internal capital) and raising x_i amount of additional capital (external capital) from financial investors in sector i, possibly through a financial institution. The total investment in the firm in sector i is the sum of internal and external capital, or $z_i = 1 + x_i$. There will be $N_i = K_i/z_i$ of firms in sector i.

After the investment decision is made in the first period, production and consumption take place in the second period. Let depreciation rate be zero. If the project succeeds, the gross return to one unit of capital in sector i is R_i, which is the value marginal product of capital discussed in the above sections. The financial interest rate received by investors is denoted as r. Note that if capital is freely mobile across sectors, $R_1 = R_2 = R$.

For a representative firm, the final output depends in part on the entrepreneur's level of effort, which can be low or high, but is not observable by the financial investors or the financial institution. Assume that the entrepreneur can choose among two versions of the project. The "Good" version has a high probability of success, λ^H, while offering no private benefit. The "Bad" version has a lower probability of success, λ^L, but offering a private benefit per unit of capital managed, b, to the entrepreneur. Following Holmstrom and Tirole (1997), we further assume that only the "Good" project is economically viable. That is, $\lambda^H R_i - (1 + r_i) > 0 > \lambda^L R_i - (1 + r_i) + b$ so that only the "Good" project is implemented in the moral hazard problem.

We use g to denote a country's level of property rights protection, where $(1-g)$ could be understood as a tax rate on the capital returns, where taxation is broadly defined to include state expropriation. We normalize $\lambda^L = 0$ and define $\lambda = g\lambda^H$ thereafter. Since we fix λ^H, without loss of generality, we can conveniently refer to λ directly as an index of property rights protection.

The entrepreneur is paid R_i^E per unit of capital to induce her to choose the "Good" project. In addition to that, we assume that c_i/θ units of good (but no capital and labor) are used to intermediate one unit of investment in sector i. Thus, the pay to the financial intermediation is c_i/θ units of good per unit of investment. c_i/θ may represent the transaction cost, the monitoring cost to reduce the extent of moral hazard, or the expropriation by government officials. The *efficiency level of the financial system* in the country is then represented by θ. The higher the θ, the lower is the financial intermediation cost.

The entrepreneur in sector i chooses the amount of external capital x_i, her own capital contribution to the project I_i, total investment of the project z_i, and the marginal pay to the entrepreneur's effort R_i^E to solve the following program:

$$\max_{x_i, I_i, z_i, R_i^E} U_i = z_i \lambda R_i^E + (1+r)(1-I_i) \tag{22}$$

subject to

$$\begin{aligned} I_i &\leq 1 && (23)\\ z_i &\leq x_i + I_i && (24)\\ \left[\lambda\left(R_i - R_i^E\right) - c_i/\theta\right] z_i &\geq (1+r)\, x_i && (25)\\ \lambda R_i^E &\geq b && (26) \end{aligned}$$

The objective function (22) represents the entrepreneur's expected income. The first term represents the entrepreneur's share in total capital revenue. The second

term is the return from investing her own $1 - I_i$ capital in the market. Turning into the constraints, inequality (23) requires that entrepreneur's internal capital is less than her capital endowment. Inequality (24) requires that total investment does not exceed the sum of internal and external capitals. Inequality (25) is the participation constraint for the outside financial investors,[3] while inequality (26) is the entrepreneur's incentive compatibility constraint.

It is then straightforward to show that all constraints must be binding in equilibrium.[4] The entrepreneur will invest all her endowment $I_i = 1$ in the firm. The total investment z_i equals the sum of internal and external capitals $x_i + 1$. The incentive compatibility constraint (26) gives

$$R_i^E = \frac{b_i}{\lambda} \tag{27}$$

Substituting (27) into (25) gives the firm's optimal investment[5]

$$z_i = \frac{1+r}{(1+r) + c_i/\theta + b_i - \lambda R_i} \tag{28}$$

Substituting (27) and (28) into (11), the entrepreneur's expected income becomes

$$U_i = \frac{b\,(1+r)}{(1+r) + c_i/\theta + b_i - \lambda R_i} \tag{29}$$

We assume that a capitalist (a potential entrepreneur) needs to pay a fixed entry cost of t_i units of goods to become an entrepreneur. With free entry and exit of entrepreneurs, an entrepreneur's expected income net of the entry cost, $U_i - (1+r)t_i$,

[3] Following Holmstrom and Tirole (1997), it is assumed that financial intermediaries monitor entire project to ensure entrepreneurs to behave. Thus, the intermediation cost is proportional to the amount of total capital, not just external capital.

[4] The problem is solved by setting the Lagrangian. The marginal return to internal capital must be higher than the financial interest rate as the entrepreneur needs to pay an entry cost (to be specified later). Then straightforward manipulation of the first order conditions shows that (23), (24), (25), and (26) must bind.

[5] Following Holmstrom and Tirole (1997), we rule out the case that $(1+r) + c/\theta + b - \lambda R < 0$ in which the firm would want to invest without limit.

should be equal to $(1+r)$ so that capitalists are indifferent between becoming entrepreneurs or financial investors in equilibrium**.** That is,

$$U_i - (1+r)t_i = (1+r) \tag{30}$$

Using (29), the free entry condition (30) implies that

$$\lambda R_i = (1+r) + \frac{c_i}{\theta} + \frac{bt_i}{1+t_i} \tag{31}$$

The equation (31) describes how the expected return to the physical capital is divided up among its usages, which we label as a *capital revenue sharing rule.* The expected marginal product of capital on the left hand side of the equation, is shared by the return to financial investment, $1+r$, the cost of financial intermediation, $\frac{c_i}{\theta}$, and the agency cost $\frac{bt_i}{1+t_i}$ paid to the entrepreneur.

4.1 Determinants of Financial Interest Rates

The financial interest rate, r, and the endogenous private benefit, b, are solved by *capital revenue sharing rules* (31) in sectors 1 and 2. To simplify the analysis, we consider the case that the capital adjustment cost is zero so that $R_1 = R_2 = R$. Denoting $\frac{t_i}{1+t_i}$ as T_i, we have:

$$r = \lambda R - 1 + \frac{T_1 c_2 - T_2 c_1}{\theta (T_2 - T_1)} \tag{32}$$

$$b = \frac{c_1 - c_2}{\theta (T_2 - T_1)} \tag{33}$$

We assume that the fixed cost to become an entrepreneur in capital intensive sector 2 is higher than that in sector 2, so that $T_2 > T_1$. Furthermore, we assume that the monitoring cost in sector 1 is higher than that in sector 2. That is, $c_1 > c_2$.

Under these assumptions, the private benefit b is positive when $R_1 = R_2$.[6]

4.2 Financial Capital Flow and FDI

Let K^f and K^d be the amounts of financial capital flow and FDI, respectively. A positive number represents capital inflow and a negative number represents capital outflow. The marginal costs of financial capital flow and FDI are $\phi^f K^f$ and $\phi^d K^d$. Financial capital goes where the interest rate is the highest. The equilibrium condition for financial capital flow is

$$r - r^* = \phi^f K^f \tag{34}$$

Foreign direct investment (FDI) goes to where the expected return to an entrepreneur is the highest. It takes place when the entrepreneur decides to take her project (and the capital under her management) to a foreign country and use foreign labor to produce.

We assume that the entrepreneur still uses her native financial system only and pay the domestic interest rate. In other words, if a U.S. multinational firm operates in India, the US firm still uses a US bank or stock market for its financing need. When an entrepreneur at home in sector i directly invests in the foreign country and produces there, using (29), the entrepreneur's expected income becomes

$$U_i^d = \frac{b\,(1+r)}{(1+r) + c_i/\theta + b - \left(\lambda^* R^* + \phi^d K^d\right)} \tag{35}$$

In equilibrium, we must have $U_i = U_i^d$, which holds if and only if

$$\lambda R = \lambda^* R^* + \phi^d K^d \tag{36}$$

It is easy to verify that condition (36) is also the equilibrium condition for a foreign

[6] Alternatively, we may assume that $T_1 > T_2$ and $c_1 < c_2$.

entrepreneur to directly invest in the home country.

4.3 Comparative Statics

The return to capital, R, is determined by product prices and total capital usages (together with labor productivity, labor endowment, and factor adjustment costs) in the home country. That is, $R = R(p_1, p_2, K + K^f + K^d)$. Substituting (32) into (34) and rewriting (36), we have:

$$\lambda R(p_1, p_2, K + K^f + K^d) - \phi^f K^f = 1 - \frac{1}{\theta}\left(\frac{T_1 c_2 - T_2 c_1}{T_2 - T_1}\right) + r^* \quad (37)$$

$$\lambda R(p_1, p_2, K + K^f + K^d) - \phi^d K^d = \lambda^* R^* \quad (38)$$

Totally differentiating equations (37) and (38), in the Appendix we show that $\frac{\partial K^f}{\partial \theta} > 0$ but $\frac{\partial K^d}{\partial \theta} < 0$, while $\frac{\partial K^f}{\partial p_i} = B^f \frac{\partial R}{dp_i}$ and $\frac{\partial K^d}{\partial p_i} = B^d \frac{\partial R}{dp_i}$ where B^f and B^d are some positive numbers. Thus, as the efficiency of financial system improves (θ increases), there will be more financial capital inflow, but more FDI outflow. Consider a trade liberalization in a labor abundant country (decrease in p_1) and a change in the efficiency of financial system. We have:

$$dK^f = \frac{\partial K^f}{\partial p_2} dp_2 + \frac{\partial K^f}{\partial \theta} d\theta = B^f \frac{\partial R}{dp_2} dp_2 + \frac{\partial K^f}{\partial \theta} d\theta \quad (39)$$

$$dK^d = \frac{\partial K^d}{\partial p_2} dp_2 + \frac{\partial K^d}{\partial \theta} d\theta = B^d \frac{\partial R}{dp_2} dp_2 + \frac{\partial K^d}{\partial \theta} d\theta \quad (40)$$

When the capital adjustment cost is zero, as we have discussed above, a reduction in p_2 decreases the return to capital R. As a result, there will be more (less) outflows (inflows) in both financial capital and FDI. On the other hand, an improvement in a typical developing country's efficiency of financial institutions (an increase in), tends to simultaneously reduce its financial capital outflow and FDI inflow. While

an increase in θ does not directly affect the marginal product of capital, it leads to a higher financial interest rate r in condition (32). As a result, there is less incentive for financial capital to leave the country. As more financial capital stays with local firms, the marginal product of capital declines, which makes it less attractive for inward FDI.

Therefore, trade liberalizations and both financial capital flow and FDI are substitutes, in the sense that the trade liberalizations in a labor abundant country lead to less inflows in both financial capital and FDI. However, a less efficient financial system in the country makes the substitutability between trade liberalizations and financial capital flow stronger as it induces more financial capital outflow, but makes the substitutability between the trade liberalizations and FDI weaker, as it attracts more inward FDI. Summarizing we have:

Proposition 4 *The trade liberalizations in a labor abundant country lead to less inflows (more outflows) in both financial capital and FDI. The lower financial development in the country lead to more financial capital outflow but more FDI inflow.*

5 Conclusion

To be written.