Foreign Direct Investment and Contract Enforcement

Pinar Uysal *†

Boston College

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Abstract

Many developing countries are financially constrained and therefore have to rely on international capital flows to finance economic activity. Empirical evidence shows that Foreign Direct Investment (FDI) as a percentage of total capital flows is higher for less developed countries compared to more developed countries. This paper uses a dynamic contracting model with human capital to explain why less developed countries receive a greater percentage of capital flows as FDI. I analytically show that countries that are financially constrained have a higher share of FDI in total capital flows, and that the share of FDI in total capital flows is increasing in human capital flows. In addition, the positive association between the share of FDI in total capital flows and human capital flows is decreasing in the degree of financial constraints. I construct a measure of intangible assets of FDI and find empirical support for the analytical results.

*Pinar Uysal, Department of Economics Boston College, 140 Commonwealth Avenue, Chestnut Hill MA 02467, E-mail: uysalpi@bc.edu.

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1 Introduction

Many developing countries are financially constrained, and therefore have to rely on international capital flows to finance economic activity.[1] Empirical evidence shows that Foreign Direct Investment (FDI) as a percentage of total capital flows is higher for less developed countries compared to more developed countries.[2] This paper uses a dynamic contracting model with human capital to explain why less developed countries receive a greater percentage of capital flows as FDI. I show that countries that are financially constrained have a higher share of FDI in total capital flows, and that the share of FDI in total capital flows is increasing in human capital flows. In addition, the positive association between the share of FDI in total capital flows and human capital flows is decreasing in the degree of financial constraints.

In my model, international contracts are not perfectly enforceable, and when an international investor makes an investment in a host country, it faces the risk that the investment might be confiscated. The host country may gain from confiscating the output in the short run; however, it may be unable to attract future foreign investments as a consequence. Hence, any contract between the international investor and the host country must be self enforcing, which implies that countries should not have incentives to renege upon the contract.

The main assumption of the model is that FDI is inalienable from human capital investment, which means that foreign investors provide the host country with intangible assets necessary to realize the full benefits of FDI. For example, these intangible assets may include managerial and entrepreneurial skills, and engineering experience. The physical and human capital aspects of FDI differ simply because, in case of a default, physical capital can be confiscated by the host country while intangible human capital assets cannot be confiscated. If the host country decides to expropriate FDI flows, then the inalienable assets are no longer available. Therefore, when the host country considers confiscating foreign capital, it weighs

[1]These capital flows can be divided into two main groups: Foreign Direct Investment (FDI) and non-FDI, where non-FDI corresponds to foreign portfolio flows.

[2]See (Hausmann and Fernandez-Arias 2000) and (Albuquerque 2003).

the benefits and costs. The benefit of confiscating physical capital flows is gaining ownership of all investment returns, while the cost is that all subsequent investment returns are lower because human capital cannot be confiscated, and the host country loses all future foreign capital investments. As a consequence, from a host country's point of view, it would not be as advantageous to expropriate FDI compared to other types of capital flows given that human capital is lost when FDI is expropriated.

In the limited commitment environment of my model, I analytically show that when a host country is financially constrained, the expected loss for the international investor on FDI flows is lower than the expected loss on non-FDI flows due to the intangible part of FDI. Hence, the international investor finds it optimal to invest a greater share of FDI flows in total capital flows to financially constrained countries, and there is a positive association between human capital flows and FDI share. In addition, the positive association between the share of FDI in total capital flows and human capital flows is decreasing in the degree of financial constraints.

To test the analytical predictions of the model empirically, I construct a measure of intangible assets of FDI following (Coe and Helpman 1995) . Using an unbalanced panel dataset, I find strong empirical support for the following propositions: a) The more a country is financially constrained, the higher the share of FDI in total capital flows; b) There is a positive relation between human capital flows and the share of FDI flows; c) As the degree of financing constraints decrease, the positive association between human capital and FDI becomes weaker.

I concentrate on the capital flows from developed countries to developing countries because the impact of capital flows on economies is not uniform across different levels of development. (Blonigen and Wang 2005) show that the FDI experiences of less developed countries are systematically different from those of developed countries, and pooling rich and poor countries in analysis leads to incorrect inferences about the effect of FDI on growth and domestic investment.

My paper contributes to the theoretical literature on FDI by combining a model of FDI with human capital in a dynamic contracting model. It is important to examine FDI flows in a dynamic environment to reflect international investors' long lasting interest.[3] In a static setting, (Eaton and Gersovitz 1984) analyzed the level of FDI under the risk of expropriation and found that the threat of expropriation lowers the welfare of the host country. (Thomas and Worrall 1994) analyzed the size of FDI flows in a dynamic setting in which investors and host countries engage in self enforcing contracts. They found that there is under-investment at the beginning of a contract, but investment increases over time and reaches the efficient level. (Albuquerque 2003) extends Thomas and Worrall's (1994) framework to allow for FDI and non-FDI flows and utilizes the idea that the presence of intangible assets would limit the host country's incentives to expropriate the investment.

My paper contributes to the empirical literature on FDI by providing evidence on the effects of expropriation risk that affects the international investor's decision to invest in less developed countries. Expropriation is defined as the forced divestment of equity ownership of a foreign direct investor.[4] Given the definition, (Kobrin 1984) collects data on the expropriations of foreign firms in 79 less developed countries from 1960-1979, while (Minor 1994) analyzes expropriation acts from 1980-1992, extending the work of (Kobrin 1984). These studies find that there has been a total of 575 expropriation acts in the 1960-1992 period, mainly concentrated in the agriculture, mining, petroleum, manufacturing and finance industries. (Kobrin 1984) finds that the outright nationalization of sectors such as oil, mining and petroleum, where foreign ownership was not compatible with autonomous economic control or national security, was complete by 1975.[5] I show that even though international investors might not face the same risks of nationalization as in the 1960s and 1970s, expropriation risk still affects the decisions of international investors.

[3](IMF 1993) defines FDI as "an investment made to acquire lasting interest in enterprises operating outside of the economy of the investor. Further, in cases of FDI, the investor's purpose is to gain an effective voice in the management of the enterprise." (OECD 1996) emphasizes that "The most important characteristic of FDI, which distinguishes it from foreign portfolio investment, is that it is undertaken with the intention of exercising control over an enterprise."

[4]Kobrin (1980, 1984) identifies four different kinds of expropriation: *Formal Expropriation*, where the host country's government directly takes over the foreign property under the local law; *Intervention*, where the transfer of ownership is forced, most of the time sudden and unannounced; *Forced Sale*, where the host government uses coercive power to force foreign investors to involuntarily sell their ownership; and *Contract Renegotiation*, where the host government forces renegotiation of the initial contract to force a transfer of ownership.

[5]See also (Kobrin 1980) and (Minor 1994).

The structure of the paper is organized as follows. Section 2 presents the theoretical model. Section 3 presents and analyzes the solution to the the model. Section 4 presents the econometric model, data description, estimation, empirical results, and sensitivity analysis. Section 5 concludes.

2 Model

2.1 The Problem

The basic framework builds on (Thomas and Worrall 1994) and (Albuquerque 2003). A host country receives two types of capital flows from the international investor to produce his consumption good. One is FDI flows, which includes physical capital, k_f, and human capital, h_f. The physical part of FDI can only be operated with foreign human capital. The other type of capital flow the host country receives is non-FDI flows, k_o, which does not require foreign human capital to be operated. Human capital is a proxy for the intangible part of FDI, so if the host country decides to confiscate output, he will be able to keep the physical capital, but the human capital portion will be lost and will not be used in production. I also suggest that the host country will not be able to receive capital flows in the future, and will have to live in autarky forever. Similarly, the international investor has the option of withdrawing her investment, and not investing in the host country in the future.

I assume that the host country is risk averse and the international investor is risk neutral. So, the international investor will invest in the host country as long as she receives the gross rate of return $(1+r)$ on physical capital, the wage rate (w) on human capital, and the physical capital is not expropriated by the host country. After the investor makes the investment decision, an aggregate productivity shock, s, is realized that determines the quantity of output produced. Then, the host country decides how much to consume, c_s, out of the output produced, and the international investor will retain the profit, π_s, after transferring c_s to the host country and paying for the factor inputs.

There is no informational asymmetry between the international investor and the host country. However, the host country may decide to confiscate the output, and likewise the international investor may choose to withdraw her investment. These actions might lead to short run gains, but they might have large costs in the long run. The host country gains ownership of physical capital from FDI flows and non-FDI flows, however he will not be able attract any further capital flows. So, at the beginning of the period the international investor and the host country must agree on a self-enforcing long term contract, where the international investor invests k_f, k_o, and h_f, maximizes her profit, taking into account that the host country has an incentive to default. The international investor has to offer the host country a minimum consumption level, c_s, for the current period, and a lifetime utility, V_s, which is the discounted lifetime utility for the host country so that the host country will stay in the contract. Both the consumption and the lifetime utility of the host country will depend on the aggregate shock that is going to be realized. The self-enfocing contract will specify how much the host country will consume and what will be his lifetime utility for each state s that could be realized. The sequence of events at any time t is illustrated in Figure 1.

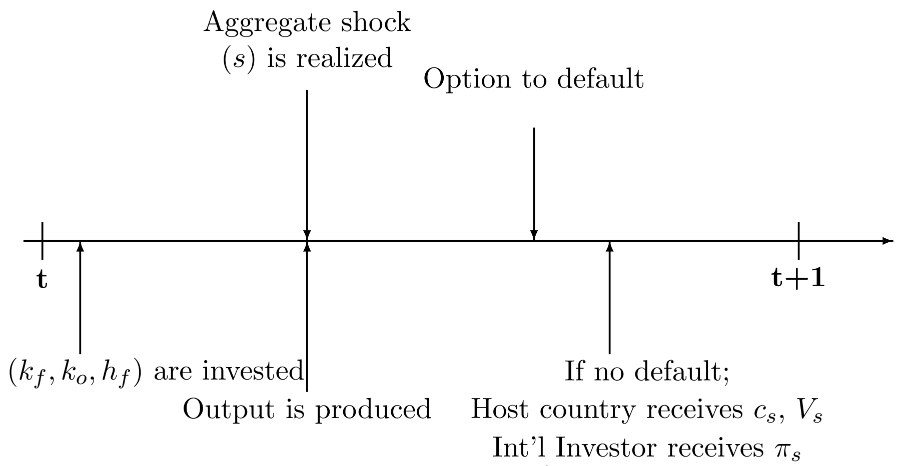

Figure 1: Timing of the events

I assume that the host country and the international investor discount the future at the same rate $1/(1+r)$, and the international investor maximizes the expected value of her profits:

$$B(V) = \max_{c_s, k_f, k_o, h_f} E\left[\pi_s + \frac{1}{1+r} B(V_s) \,\middle|\, s_{-1}\right], \tag{2.1}$$

where s_{-1} is the previous period's aggregate shock, and V is the promised discounted lifetime utility of the host country determined in the previous period. Basically the utility of the international investor is the expected discounted value of her profits, and her utility depends on the host country's discounted lifetime utility. V depends on current consumption of the host country, c_s, and his continuation value for the next period, V_s, contingent on each state s that can be realized in a given period:

$$V = E\left[\ln(c_s) + \frac{1}{1+r} V_s \,\middle|\, s_{-1}\right], \tag{2.2}$$

and $V_s \geq V_{min}$ with $V_{min} > -\infty$, where this constraint is introduced to place a lower bound to the utility of the host country. Equation (2.2) is the promise-keeping constraint, which states that the lifetime discounted utility of the host country will be equal to the promised value V that is determined in the previous state s_{-1}. The international investor takes V as a state variable and decides how much to invest, how much the host country will consume, and the continuation value V_s for the host country.

Per-period profit for the international investor is defined as:

$$\pi_s = s\ A \left\{ \left[(1-a)\ h_f^{\epsilon} + a\ k_f^{\epsilon} \right]^{\frac{1}{\epsilon}} \right\}^{\alpha_f} + s\ k_o^{\alpha_o} - w h_f - (1+r)(k_f + k_o) - c_s. \tag{2.3}$$

Total output in the economy comes from two investment projects: one using FDI flows - physical capital (k_f) and human capital (h_f); and the other using non-FDI flows (k_o). In the production function that utilizes FDI, physical and human capital are aggregated in CES fashion with an elasticity of substitution $\sigma \equiv 1/(1-\epsilon)$. This means that as ϵ approaches zero, σ approaches unity, and the production function becomes Cobb-Douglas where physical capital and human capital are complements. As ϵ approaches one, σ approaches infinity, and the production function becomes linear, where physical capital and human capital are perfect substitutes.

I restrict $\epsilon < \alpha_f$, which is a restriction on the complementarity among human capital portion of FDI, physical capital portion of FDI and non-FDI flows. When $\epsilon < \alpha_f$, human capital of FDI is more complementary to physical capital of FDI than to non-FDI.

Many host countries offer special tax incentives or subsidies for international investors to attract FDI. A is a constant to capture these benefits and whenever $A > 1$, there are tax advantages of FDI for the international investor. Eventually, total output in the host country is divided between payments to the factors of production and the transfer to the host country. I assume that all capital flows depreciate fully after each period for analytical tractability.

As the production takes place in the host country, he has the option to confiscate output and default on the contract. In turn this leads to the participation constraint for the host economy:

$$\ln(c) + \frac{1}{1+r} V_s \geq U^{aut}(k_f, k_o, s) \tag{2.4}$$

for every $s \in S$, where S is the space of possible realizations of s. The participation constraint basically states that not expropriating should yield a higher utility to the host country than defaulting on the contract. In case of default, the host country no longer receives FDI or non-FDI flows, and the function $U^{aut}(.)$ gives the future discounted value of the host country's utility under autarky. This condition will generate endogenous barriers to international capital flows by limiting the size of k_f and k_o. Likewise, the participation constraint for the foreign investor requires that the utility of the foreign investor which is equal to her expected present discounted value of profits should always be non-negative to prevent losses, which implies:

$$B(V_s) \geq 0 \text{ for all } s \in S. \tag{2.5}$$

In summary, the international investor and the host country agree on a self-enforcing long term contract, where the international investor maximizes her profits, makes the investment at the beginning of the period promising the host country the consumption c_s for this period, and promising for the next period the continuation value V_s contingent on the state s that is to be realized. Next, upon the realization of the aggregate productivity shock, s, the output is produced and both parties decide whether to continue the contract or not. If the host country decides to default and confiscate the output, he will not receive any further capital flows in the future. As is customary, I assume that the aggregate shock follows a first order autoregressive process:

$$\ln\, s_{t+1} = \rho \ln s_t + \varepsilon_{t+1}, \text{ and } \varepsilon_{t+1} \sim N(0, \sigma_\varepsilon^2).$$

2.2 Value under Autarky

To calculate the value for the host country when it defaults and stays in autarky thereafter, I make the following assumptions: (1) Default occurs on both FDI and non-FDI flows simultaneously; (2) During the period when default occurs, foreign human capital is withdrawn, and is no longer employed. The FDI technology is operated without the human capital and there is a loss in FDI output; (3) After default, even though there is no capital flowing to the host country, the host country can still operate the existing physical capital and produce output using the technology of the non-FDI investment project. Following these assumptions, I can write the value of the host country under autarky as

$$U^{aut}(k_f, k_o, s) = \max_{k_o, c \geq 0} \left[\ln(c) + \frac{1}{1+r} E\mathcal{U}(k_o, s) \right]$$

subject to the resource constraint

$$A\ s \left(a^{1/\epsilon}\ k_f\right)^{\alpha_f} + s\ k_o^{\alpha_o} = c + k_o'.$$

Once the host country defaults, the Bellman equation under autarky is:

$$\mathcal{U}(k_o, s) = \max_{k'_o, c \geq 0} \left[\ln(s k_o^{\alpha_o} - k'_o) + \frac{1}{1+r} E\mathcal{U}(k'_o, s') \right].$$

The assumptions of log-utility and full depreciation allow me to write the present discounted value of defaulting on the contract and staying under autarky as:

$$U^{aut}(k_f, k_o, s) = d_0 + d_1 \ln \left[A \ \left(a^{1/\epsilon} \, k_f \right)^{\alpha_f} + \ k_o^{\alpha_o} \right] + d_2 \ln(s), \tag{2.6}$$

where the constants d_0, d_1, and d_2 are all positive and $0 < \epsilon < \alpha_f$.

I also put the restriction $\epsilon > 0$, because when the human capital is withdrawn (i.e $h_f = 0$) the utility under autarky will not depend on physical capital portion of FDI, and there will be no incentive for the host country to default on FDI.

3 Solution to the Dynamic Problem

The international investor's problem can be written as the maximization of the expected discounted value of profits (Equation (3.1)), subject to the promise-keeping constraint (Equation (3.2)), participation constraint for the host country (Equation (3.3)), the participation constraint for the international investor (Equation (3.4)), and the lower bound for the host utility constraint (Equation (3.5)):

$$B(V) = \max_{c_s, k_f, k_o, h_f} E\left[\pi_s + \frac{1}{1+r} B(V_s) \,\middle|\, s_{-1}\right], \tag{3.1}$$

$$\pi_s = s\ A\left(\left((1-a)\ h_f^{\epsilon} + a\ k_f^{\epsilon}\right)^{\frac{1}{\epsilon}}\right)^{\alpha_f} + s\ k_o^{\alpha_o} - w h_f - (1+r)(k_f + k_o) - c_s,$$

$$V = E\left[\ln(c_s) + \frac{1}{1+r} V_s \,\middle|\, s_{-1}\right], \tag{3.2}$$

$$\ln(c_s) + \frac{1}{1+r} V_s \geq U^{aut}(k_f, k_o, s) \qquad \forall s \in S, \tag{3.3}$$

$$B(V_s) \geq 0 \qquad \forall s \in S, \tag{3.4}$$

$$V_s \geq V_{min} \qquad \forall s \in S, \tag{3.5}$$

where $U^{aut}(.)$ is defined in Equation (2.6). I denote σ, $\varphi_s \mu_s$, $\varphi_s \frac{\phi_s}{1+r}$, and $\varphi_s \frac{\tau_s}{1+r}$ as the Lagrange multipliers associated with the constraints, (3.2), (3.3), (3.4), and (3.5) respectively, where φ_s is the probability of state s occuring given that state s_{-1} has occurred in the previous period.

The first order conditions for the investor's problem with respect to c_s, V_s, h_f, k_f, and k_o, and the envelope condition are, respectively:

$$c_s = \sigma + \mu_s \qquad \forall s \in S, \tag{3.6}$$

$$B'(V_s) = -\frac{\sigma + \mu_s + \tau_s}{1 + \phi_s} \qquad \forall s \in S, \tag{3.7}$$

$$\varphi_s\ sA\alpha_f\ (1-a)\left((1-a)\ h_f^{\epsilon} + a\ k_f^{\epsilon}\right)^{\frac{\alpha_f}{\epsilon}-1} h_f^{\epsilon-1} = w \qquad \forall s \in S, \tag{3.8}$$

$$\varphi_s\ sA\ \alpha_f\ a\left((1-a)\ h_f^{\epsilon} + a\ k_f^{\epsilon}\right)^{\frac{\alpha_f}{\epsilon}-1} k_f^{\epsilon-1} = 1 + r + \varphi_s\ \mu_s\ U_{k_f}^{aut}(k_f, k_o, s) \qquad \forall s \in S, \tag{3.9}$$

$$\varphi_s\ s\ \alpha_o\ k_o^{\alpha_o-1} = 1 + r + \varphi_s\ \mu_s\ U_{k_o}^{aut}(k_f, k_o, s) \qquad \forall s \in S, \tag{3.10}$$

$$B'(V) = -\sigma \tag{3.11}$$

together with the complementary slackness conditions (omitted). In equations (3.9) and (3.10), the marginal productivity levels of physical FDI flows and non-FDI flows are equal to the risk free return, $(1+r)$, plus a default premium, which measures the marginal cost of higher incentives to default caused by a marginal increase in capital. These two equations define the financing constraints of the host economy. When the host country's participation constraint is binding (i.e. $\mu_s > 0$), then the host country faces a positive default premium. If the host country is not financially constrained (i.e. $\mu_s = 0$), then both the physical capital flows earn their marginal products.

3.1 First Best

When there is no enforcement problem, the participation constraints of the host country, (Equation 3.3) and the international investor (Equation. 3.4) are no longer needed. By setting $\mu_s = 0$, I show that the first best solution is such that:

Proposition 3.1 *(i) $c_s^{FB}(V) = \sigma^{FB}$, $\sigma^{FB} = -B^{FB\prime}(V)$; and (ii) c_s^{FB} is a non-decreasing function of V.*

Under the first-best solution, consumption is equal to the slope of the Pareto frontier i.e., $c_s = c = \sigma^{FB} = -B^{FB\prime}(V)$, hence it depends on the promised utility V, but not on the aggregate shock s. The returns to both physical capital flows (Equations 3.9 and 3.10) are equalized, and the optimal levels of (h_f, k_f, k_o), denoted with superscript FB, solves;

$$\varphi_s \, s \, A \, \alpha_f \, (1-a) \left((1-a) + a \left(\frac{k_f^{FB}}{h_f^{FB}} \right)^{\epsilon} \right)^{\frac{\alpha_f}{\epsilon}-1} \left(h_f^{FB} \right)^{\alpha_f - 1} = w \; , \tag{3.12}$$

$$\varphi_s \, s \, A \, \alpha_f \, a \left((1-a) \left(\frac{h_f^{FB}}{k_f^{FB}} \right)^{\epsilon} + a \right)^{\frac{\alpha_f}{\epsilon}-1} \left(k_f^{FB} \right)^{\alpha_f - 1} = 1 + r \; , \tag{3.13}$$

$$\varphi_s \, s \, \alpha_o \left(k_o^{FB} \right)^{\alpha_o - 1} = 1 + r \; . \tag{3.14}$$

There is no default risk associated with physical capital flows, and the marginal products of physical capital flows are equal. Also, the ratio of the marginal product of human capital and physical FDI flows gives us the relation between the two as:

$$\frac{k_f^{FB}}{h_f^{FB}} = \left(\frac{w}{1+r} \, \frac{a}{1-a} \right)^{\frac{1}{1-\epsilon}} . \tag{3.15}$$

This states that the ratio of human capital to physical FDI flows is constant and does not depend on the aggregate shock s.

3.2 States when the Participation Constraint Binds

When the participation constraint of the host country is binding (i.e. $\mu_s > 0$), there is a default premium on both physical capital flows, which lead to a reduction of the level of physical FDI and non-FDI flows and a deviation from the first-best level of human capital. The following proposition summarizes the relation between the first-best levels of k_f, k_o, and h_f and the optimal levels in the imperfect enforcement environment:

Proposition 3.2 *(i) The ratio of physical FDI flows to human capital is lower than the first best: $k_f^*/h_f^* < k_f^{FB}/h_f^{FB}$, (ii) physical FDI flows, non-FDI flows, and human capital are below their first best levels: $k_f^* < k_f^{FB}$, $k_o^* < k_o^{FB}$, and $h_f^* < h_f^{FB}$.*

Proof In Appendix.

The first part of the proposition states that there is a decline in physical FDI per unit of human capital. This also implies that the change in the level of human capital from the first-best is smaller than the change in physical FDI flows, $h_f^{FB}/h_f^* < k_f^{FB}/k_f^*$. The reason for this difference stems from the possibility that the host country may confiscate output and will keep the current physical FDI flow, however the human capital can be recovered by the international investor.

The second part of the proposition states that when the participation constraint binds, there is under investment in the host country, which is due to the possibility that the host country may default on the contract. Hence, there is a deviation of returns from marginal products, and the extent of the default premium on physical capital flows depends on μ_s, $U_{k_f}^{aut}$ and $U_{k_o}^{aut}$. The following proposition holds:

Proposition 3.3 *The default premium on physical FDI flows is lower than the default premium on non-FDI flows if $\alpha_f/\epsilon - 1 > 0$.*

Replacing the values for $U^{aut}_{k_f}$ and $U^{aut}_{k_o}$ in equations (3.9) and (3.10) and rearranging yields:

$$\frac{1+r}{MPK_f} = 1 - \underbrace{\left(\frac{1}{1+\frac{1-a}{a}\left(\frac{h_f}{k_f}\right)^{\epsilon}}\right)^{\frac{\alpha_f}{\epsilon}-1}}_{\Omega} \frac{\varphi_s\,\mu_s\,d_1}{s\left(Aa^{\frac{\alpha_f}{\epsilon}}k_f^{\alpha_f}+k_o^{\alpha_o}\right)}\,, \tag{3.16}$$

$$\frac{1+r}{MPK_o} = 1 - \frac{\varphi_s\,\mu_s\,d_1}{s\left(Aa^{\frac{\alpha_f}{\epsilon}}k_f^{\alpha_f}+k_o^{\alpha_o}\right)}\,, \tag{3.17}$$

where MPK_f is the marginal product of physical FDI flows and MPK_o is the marginal product of non-FDI flows. As can be seen from these two equations, the marginal products of both physical capital flows will deviate from the gross return $1+r$ if the participation constraint of the host country is binding, i.e., $\mu_s > 0$. Moreover, if the participation constraint binds, the returns of capital flows will differ if and only if $\Omega \neq 1$. The default premium on physical FDI flows is less than the default premium on non-FDI flows as long as MPK_f is less than MPK_o, i.e., $\Omega < 1$.[6] And Ω is smaller than 1 if $\alpha_f/\epsilon - 1 > 0$, where the last condition is a constraint on the complementarity between human capital and physical capital flows as mentioned earlier. If human capital is more complementary to physical FDI flows than non-FDI flows, the default premium on FDI flows is smaller than the default premium on non-FDI flows. One should also notice that if FDI flows did not have an intangible part, i.e., if the share of human capital, $1-a$, were zero, then the default premiums on both FDI flows and non-FDI flows would be the same. Hence, one can establish the following:

Proposition 3.4 *(i) A higher h^*_f/k^*_f will be associated with a lower Ω; (ii) The share of FDI flows in total capital flows will be higher than in the first-best when $\alpha_f = \alpha_o$ and $\alpha_f/\epsilon - 1 > 0$.*

Proof In Appendix.

The first part of the proposition states that when the default premium on physical FDI flows is lower than the default premium on non-FDI flows, an increase in human capital per physical FDI flows implies a decrease in Ω, and hence a bigger discrepancy between

[6]Proof in Appendix.

default premia. This makes it more profitable for the international investor to invest more heavily in FDI flows. Therefore, an increase in human capital flow implies a higher share of FDI. Likewise, if the default premium on FDI flows is higher than the default premium on non-FDI flows, an increase in the human capital per physical FDI implies a decrease in Ω. As Ω is approaching unity, there will be a lower discrepancy between default premia. This will imply that an international investor could decrease the difference between the physical capital returns by increasing the human capital flow per FDI flow.

Proposition 3.2 states that when we move from First Best to an Imperfect Enforcement Environment, i.e, if a country is financially constrained, there will be a decrease in the amount of capital it can attract from foreign investors. The second part of Proposition 3.4 states that when a country is financially constrained, the share of FDI flows in total capital flows will be higher, under the assumption that the production technologies share the same α.

4 Empirical Work

In this section I test the predictions in Proposition 3.4: that the share of FDI is higher for countries that are more financially constrained, and that there is a positive association between human capital flowing into a host country and FDI. The main regression equation to be estimated is as follows:

$$\begin{aligned} k_{it} &= \beta_1 + \underbrace{\alpha}_{+} \text{ Rating Dummies}_{it} + \underbrace{\beta_2}_{+} \text{ Spillover}_{it} + \\ &\quad \underbrace{\beta_3}_{-} \text{ Spillover}_{it} * \text{Rating}_{it} + \gamma \text{ Controls}_{it} + v_i + e_{it}. \end{aligned} \tag{4.1}$$

Here k_{it} represents the share of net FDI inflows in private capital flows in country i at time t, taken from the World Development Indicators (WDI). Following (Albuquerque 2003), I use Moody's sovereign credit ratings as a measure of financing constraints and use them as dummies (*Rating Dummies*$_{it}$) in the regression. To proxy the human capital that is embedded in FDI flows, I created a spillover variable (*Spillover*$_{it}$), following (Coe and Helpman

1995), which will be explained below. They also use this variable as a proxy for the international research and development spillovers coming through FDI. If spillovers are sizeable, one would expect that the share of FDI would be larger. I also included an interaction term between spillovers and ratings to capture the effect of financial constraints on the share of FDI through spillovers. As ratings improve (hence as financial constraints are relaxed), the positive effect of spillovers will be reduced. I expect that if spillovers are large, financial constraints would be less binding, and the share of FDI would decline since the country would be able to attract larger non-FDI capital flows.

As main control variables, I use GDP per capita (PPP-adjusted in constant 2000 dollars) to control for country size. As other studies noted financial development is also an important factor in explaining foreign capital flows.[7] Hence, I include a stock market development measure and a banking sector development measure to capture different aspects of financial development. To control for stock market development, I use either the ratio of the total value of shares traded on the stock market to GDP, or the ratio of stock market capitalization to GDP. Both of these measures are taken from Beck, Demirguc-Kunt and Levine (2000). To capture banking sector development, I use the ratio of liquid liabilities to GDP or the ratio of private credit by deposit money banks to GDP, from (Beck, Demirguc-Kunt, and Levine 2000). To control for the level of human capital in the host country, I use average years of schooling, *Schooling*, from the (Barro and Lee 2000) dataset . Finally to measure trade openness, *Openness*, I use the total share of exports and imports in GDP from WDI.

As mentioned above, I use Moody's sovereign credit ratings as a measure of financing constraints. Moody's foreign currency ratings are classified as Aaa, Aa, A, Baa, Ba, B, Caa, Ca, C, and in each category there is a number assigned 1, 2, 3 from high to low rank, which I aggregated. Aaa rating is considered to identify countries that are not financially constrained and refers to the first-best solution in the theoretical model. It is taken as the reference category, and not included in the regression. This implies that going from an Aaa rating to a lower rating should imply a higher FDI share, hence a positive coefficient on the rating dummies.

[7]See (Alfaro, Kalemli-Ozcan, and Sayek 2004)

Figure 2 shows the association between the share of FDI flows in total capital flows and countries' credit ratings. As can be seen, there is a negative association between credit rating and the share of FDI. A lower rating implies that a country is more financially constrained and faces a higher default premium on both types of capital flows. Moreover, as the default premium on FDI is lower, the country ends up having a larger share of FDI compared to countries that are less financially constrained and enjoy higher ratings.

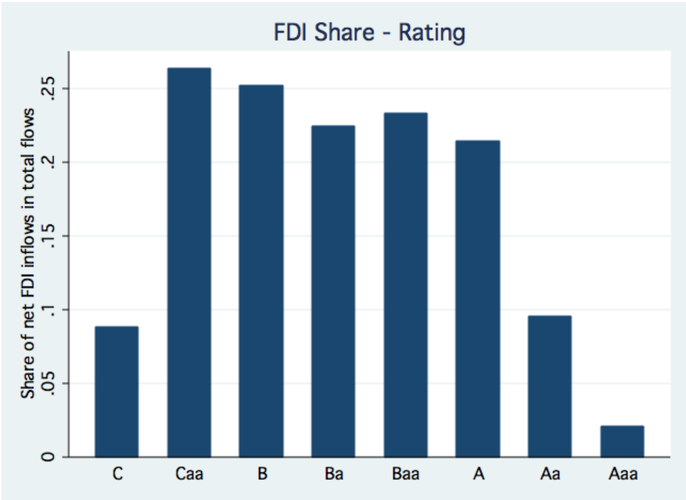

Figure 2: Average share of net FDI inflows in total capital inflows by sovereign rating

Following (Coe and Helpman 1995) the proxy for the international research and development spillovers is:

$$Spillover_{it} = \sum_{j} s_{jit} * rd_{jt} \tag{4.2}$$

where the subscript i refers to the host country, j refers to the international investor (a G7 country), and t refers to the time period. Given that most of R&D takes place in G7 countries, I consider the gross domestic expenditure on R&D (GERD) and business enterprise expenditure on R&D (BERD) in G7 countries as the main source of human capital flows.[8,9] So, the inflow of R&D into country i in year t, rd_{jt}, is a weighted sum of the real R&D stocks (rd_{jt}) in G7 countries. The weights s_{jit} are calculated as the FDI inflow

[8]Also, the data on the FDI inflow shares for individual countries was very limited. As a sensitivity check, I also consider a simple average of the R&D stocks in G7 countries instead of a weighted sum.

[9]The calculations for R&D stocks are in the Appendix.

from a G7 country j into the host country, as a share of total FDI flows into host country i from all G7 countries. The relation between spillovers and the share of FDI in total capital flows is presented in Figure 3. The relationship does not appear to be linear, so I experiment with the square of the variable in the regression as a sensitivity check.

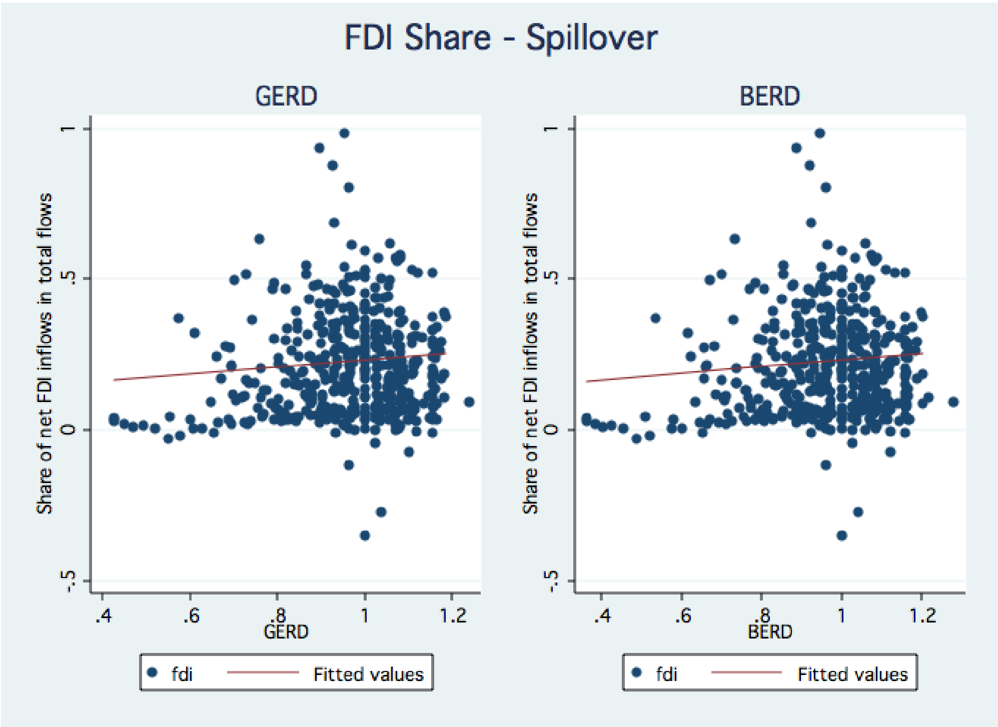

Figure 3: Average share of net FDI inflows in total capital inflows and Spillovers

The data set is an unbalanced panel data set with 44 countries, over the years 1981-2004 due to missing observations in the data. For the estimation, I experiment with both random and fixed effects. In Table 1 the first two columns show the main relation between credit ratings and FDI shares for fixed and random effects, respectively. As expected, the coefficients on the rating dummies are significant and positive, implying that moving from the rating Aaa to a lower rating is associated with an increase in the share of FDI flows.

The third column of Table 1 uses GERD for the calculation of spillover effects and the fourth column uses BERD. I also include Stock Market Total Value Traded / GDP, Liquid Liabilities / GDP, and GDP as additional control variables. An increase in the R&D spillover measure implies a significantly higher share of FDI. However, the negative and significant coefficients on the interaction terms mean that as spillovers increase, a higher rating is

Table 1: Main Effects

	(1)-FE	(2)-RE	(3)-FE	(4)-FE	(5)-RE	(6)-RE
Aa	0.495	0.462	1.297	1.369	1.891	1.934
	(0.503)	(0.500)	(0.766)+	(0.756)+	(0.780)*	(0.801)*
A	1.411	1.411	1.589	1.666	2.358	2.405
	(0.302)**	(0.395)**	(0.756)*	(0.742)*	(0.796)**	(0.820)**
Baa	1.628	1.654	1.792	1.870	2.525	2.573
	(0.192)**	(0.375)**	(0.696)*	(0.680)**	(0.811)**	(0.837)**
Ba	1.647	1.668	1.815	1.891	2.563	2.609
	(0.103)**	(0.373)**	(0.710)*	(0.693)**	(0.814)**	(0.840)**
B	1.810	1.856	1.832	1.916	2.701	2.750
	(0.162)**	(0.351)**	(0.709)*	(0.683)**	(0.826)**	(0.852)**
Caa	1.865	1.926	1.779	1.864	2.635	2.687
	(0.180)**	(0.368)**	(0.758)*	(0.735)*	(0.848)**	(0.872)**
C	1.121	1.135	0.820	0.921	1.705	1.773
	(0.356)**	(0.434)**	(0.628)	(0.610)	(0.830)*	(0.855)*
GERD			3.914		4.037	
			(1.905)*		(1.296)**	
GERD*Rating			-0.498		-0.619	
			(0.275)+		(0.218)**	
BERD				3.596		3.618
				(1.808)+		(1.215)**
BERD*Rating				-0.462		-0.553
				(0.249)+		(0.200)**
Stock Market Total Value Traded / GDP			0.114	0.115	0.065	0.065
			(0.053)*	(0.053)*	(0.032)*	(0.032)*
Liquid Liabilities / GDP			-0.248	-0.228	-0.253	-0.243
			(0.382)	(0.387)	(0.165)	(0.164)
GDP			-1.015	-1.001	0.030	0.028
			(0.444)*	(0.440)*	(0.139)	(0.139)
Constant	-3.510	-3.492	4.827	4.655	-4.506	-4.528
	(0.078)**	(0.366)**	(3.844)	(3.763)	(1.555)**	(1.569)**
R^2	0.1633	0.1627	0.0283	0.0285	0.1097	0.1093
N	464	464	406	406	406	406

Standard errors in parentheses
+ $p < 0.10$, * $p < .05$, ** $p < .01$

associated with a lower share of FDI. In other words, when foreign human capital increases, the positive effect of spillovers on the share of FDI is reduced through higher ratings. Stock market development has a positive and significant impact on the share of FDI, but banking sector development has no significant effect. Finally, GDP has a negative and significant effect on the share of FDI. In columns 5 and 5, I replicate my analysis in columns 3 and 4 using random effects. The estimation results are still significant and have the expected signs.

In Table 2 I use additional control variables to test my hypothesis using fixed effects regressions. In columns 1 and 2 I include openness and schooling as additional control variables. The main results do not change: lower ratings imply an increased share of FDI and higher spillovers imply higher FDI shares. However, I still have a significant and negative coefficient on the interaction term. Stock market development has a positive and significant influence on the FDI share, but banking development still has no significant effect. GDP has a significant and negative impact on the share of FDI, in line with my previous findings. Openness has a significant and positive coefficient, implying that if a country is more open to trade, it has a higher share of FDI. Schooling does not have a significant effect. In columns 3 and 4, I replicate the analysis using Private Credit by Deposit Money Banks / GDP instead of Liquid Liabilities / GDP, with similar findings. Next, in columns 5 and 6, I replicate the analysis using Market Capitalization as a measure of stock market development and obtain similar results.

In Table 3 I replicate the analysis in Table 2, but this time using random effects. I also check the validity of the random effects model by employing Hausman Tests between fixed effects and random effects for each regression.[10] I fail to reject the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. The random effects results are similar to those in Table 2, but there is a gain in significance. Liquid Liabilities / GDP has a significant and negative effect on the FDI share. I also find that stock market development has a positive impact on the FDI share, whereas banking sector development has a negative

[10]Results are available upon request.

Table 2: Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Aa	1.028	1.131	1.084	1.169	0.897	0.998
	(0.749)	(0.755)	(0.750)	(0.751)	(0.962)	(0.962)
A	2.440	2.579	2.469	2.583	2.168	2.308
	(0.964)*	(0.956)*	(1.013)*	(1.004)*	(1.324)	(1.316)+
Baa	2.766	2.918	2.714	2.842	2.553	2.711
	(0.834)**	(0.830)**	(0.951)**	(0.944)**	(1.173)*	(1.168)*
Ba	2.667	2.819	2.580	2.708	2.464	2.621
	(0.833)**	(0.835)**	(0.935)**	(0.931)**	(1.204)*	(1.204)*
B	2.757	2.922	2.690	2.829	2.413	2.585
	(0.868)**	(0.863)**	(0.864)**	(0.854)**	(1.282)+	(1.276)+
Caa	2.562	2.726	2.534	2.672	2.258	2.432
	(0.879)**	(0.866)**	(0.879)**	(0.867)**	(1.241)+	(1.231)+
C	0.655	0.831	0.602	0.750	0.083	0.258
	(0.800)	(0.788)	(0.849)	(0.838)	(1.393)	(1.386)
GERD	5.923		4.987		5.458	
	(2.232)*		(1.521)**		(2.321)*	
GERD*Rating	-0.982		-0.819		-0.917	
	(0.338)**		(0.268)**		(0.378)*	
BERD		5.534		4.682		5.120
		(2.241)*		(1.532)**		(2.301)*
BERD*Rating		-0.932		-0.782		-0.877
		(0.334)**		(0.253)**		(0.366)*
Stock Market Total Value Traded / GDP	0.140	0.140	0.139	0.139		
	(0.062)*	(0.062)*	(0.061)*	(0.062)*		
Stock Market Capitalization / GDP					0.224	0.227
					(0.218)	(0.218)
Liquid Liabilities / GDP	-0.348	-0.337			-0.534	-0.526
	(0.443)	(0.449)			(0.521)	(0.529)
Private Credit by Deposit Money Banks / GDP			-0.140	-0.136		
			(0.395)	(0.394)		
GDP	-1.096	-1.033	-1.206	-1.152	-0.909	-0.841
	(0.567)+	(0.567)+	(0.581)*	(0.579)+	(0.795)	(0.792)
Openness	0.735	0.752	0.581	0.600	0.765	0.782
	(0.256)**	(0.262)**	(0.335)+	(0.338)+	(0.249)**	(0.253)**
Schooling	-0.294	-0.282	-0.242	-0.233	-0.337	-0.322
	(0.465)	(0.457)	(0.456)	(0.449)	(0.504)	(0.495)
Constant	1.684	0.949	3.366	2.718	0.042	-0.736
	(4.599)	(4.619)	(5.252)	(5.244)	(7.159)	(7.138)
R^2	0.0194	0.0209	0.0182	0.0193	0.0291	0.0317
N	300	300	300	300	304	304

Standard errors in parentheses
+ $p < 0.10$, * $p < .05$, ** $p < .01$

Table 3: Random Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Aa	1.810	1.893	1.777	1.844	1.640	1.698	1.198	1.291
	(0.833)*	(0.807)*	(0.868)*	(0.849)*	(0.889)+	(0.862)*	(1.026)	(1.024)
A	3.272	3.384	3.223	3.317	3.010	3.104	2.773	2.917
	(0.847)**	(0.825)**	(0.884)**	(0.870)**	(0.917)**	(0.897)**	(1.031)**	(1.032)**
Baa	3.622	3.750	3.489	3.598	3.363	3.474	3.130	3.305
	(0.849)**	(0.830)**	(0.901)**	(0.890)**	(0.915)**	(0.897)**	(1.049)**	(1.054)**
Ba	3.606	3.735	3.435	3.545	3.326	3.438	3.100	3.272
	(0.852)**	(0.835)**	(0.906)**	(0.896)**	(0.922)**	(0.906)**	(1.050)**	(1.055)**
B	3.822	3.955	3.670	3.784	3.441	3.557	3.294	3.481
	(0.854)**	(0.836)**	(0.892)**	(0.881)**	(0.939)**	(0.922)**	(1.054)**	(1.061)**
Caa	3.666	3.801	3.567	3.681	3.340	3.459	3.140	3.329
	(0.885)**	(0.867)**	(0.921)**	(0.911)**	(0.954)**	(0.937)**	(1.078)**	(1.084)**
C	1.874	2.023	1.730	1.856	1.351	1.479	1.380	1.574
	(0.850)*	(0.828)*	(0.910)+	(0.897)*	(0.994)	(0.976)	(1.036)	(1.038)
GERD	6.805		5.595		6.166		6.248	
	(1.562)**		(1.322)**		(1.551)**		(1.538)**	
GERD^2							-4.491	
							(1.973)*	
GERD*Rating	-1.258		-1.055		-1.152		-1.323	
	(0.260)**		(0.233)**		(0.264)**		(0.275)**	
BERD		6.301		5.183		5.697		6.032
		(1.481)**		(1.259)**		(1.465)**		(1.458)**
BERD^2								-3.970
								(1.688)*
BERD*Rating		-1.170		-0.982		-1.070		-1.288
		(0.243)**		(0.218)**		(0.245)**		(0.263)**
Stock Market Total Value Traded / GDP	0.095	0.095	0.088	0.087			0.069	0.069
	(0.038)*	(0.038)*	(0.037)*	(0.037)*			(0.035)+	(0.035)+
Stock Market Capitalization / GDP					0.170	0.173		
					(0.097)+	(0.097)+		
Liquid Liabilities / GDP	-0.403	-0.396			-0.518	-0.513	-0.368	-0.344
	(0.234)+	(0.232)+			(0.259)*	(0.258)*	(0.209)+	(0.205)+
Private Credit by Deposit Money Banks / GDP			-0.245	-0.243				
			(0.189)	(0.189)				
GDP	-0.055	-0.049	-0.086	-0.080	-0.054	-0.048	-0.009	-0.001
	(0.238)	(0.238)	(0.246)	(0.246)	(0.232)	(0.232)	(0.232)	(0.232)
Openness	0.390	0.400	0.256	0.268	0.386	0.395	0.372	0.378
	(0.222)+	(0.222)+	(0.202)	(0.201)	(0.222)+	(0.222)+	(0.215)+	(0.214)+
Schooling	0.367	0.378	0.442	0.454	0.342	0.352	0.135	0.144
	(0.432)	(0.431)	(0.445)	(0.444)	(0.437)	(0.437)	(0.463)	(0.460)
Constant	-7.180	-7.419	-6.341	-6.566	-7.007	-7.212	-6.557	-6.819
	(2.003)**	(2.017)**	(2.018)**	(2.030)**	(1.981)**	(1.988)**	(2.048)**	(2.071)**
R^2	0.1149	0.1153	0.1178	0.1184	0.1258	0.1260	0.1240	0.1255
N	300	300	300	300	304	304	300	300

Standard errors in parentheses
+ $p < 0.10$, * $p < .05$, ** $p < .01$

effect or no effect at all. What is surprising is that the Schooling variable which captures the education level in the host country is positive but do not have a significant effect.

I also experimented by putting the square of the spillover variable in the regression based on the seemingly non-linear relation between the FDI share and the spillover measure in Figure 3. The squared term has a negative and significant effect and the interaction between rating and the spillover is still negative and significant. This finding implies that higher levels of spillovers have a diminishing influence on the share of FDI flows. Schooling variable again does not have a significant sign. This might be due to the fact that there might be a relation between the education level of the host country which is not explicitly modeled in this paper, the human capital spillovers from FDI and the share of FDI.

5 Conclusion

Using a dynamic contracting model with human capital, I show that when intangible assets that are embedded in FDI flows, but not in non-FDI flows, the composition of capital flows to developing countries is altered. I assume that foreign investors provide the host country with intangible assets such as managerial services, organizational capabilities, and engineering experience, together with physical capital such as plants, equipment and inventories. The physical and human capital aspects of FDI differ because physical capital can be confiscated by the host country but human capital cannot. Therefore, the host country has to weigh benefits and costs when making default decisions. The host country may gain from confiscating the output in the short run. However, all subsequent investment returns are lower because human capital cannot be confiscated, and the host country loses all future foreign capital investments. Hence, the risk premium on FDI flows is lower than the risk premium on non-FDI flows, and the share of FDI flows in total capital flows is higher for more financially constrained countries. In addition, there is a positive association between human capital flows and the share of FDI flows, and the positive association between human capital and FDI becomes weaker as degree of financing constraints decrease.

To test the empirical predictions of the model, I constructed a measure of intangible assets in FDI following (Coe and Helpman 1995). Using an unbalanced panel dataset, I find empirical support for the following propositions: a) More financially constrained countries have a higher share of FDI in total capital flows; b) There is a positive association between human capital flows and the share of FDI in total capital flows; c) The positive association between human capital flows and FDI flows is weaker for less financially constrained countries.

Future research might enrich the model by explicitly modeling the human capital in the host country and and examining how it might affect the association between human capital spillovers and the share of FDI. There might be a direct transfer and diffusion of technology and management to host country nationals.Through human capital spillovers, the host country may gain enough skills such that there may be a tendency for host governments to perceive the need to exert increased control over foreign investors and an improvement in their capability to do so. This might imply that the host country may find it optimal to default. On the other hand, spillovers from foreign human capital may imply an increase in expected future gains from FDI flows, which might provide further incentive for the host country not to default. So, a country with large spillovers coming from FDI might have a lower default premium on FDI. There are two opposing effects and depending on the size of the spillovers, there might be an increase or decrease in the likelihood of default.

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A Appendix A

Table 4: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Share of FDI	0.226	0.162	0.001	0.984	410
GERD	0.967	0.132	0.426	1.188	410
BERD	0.964	0.141	0.362	1.205	410
Stock Market Total Value Traded / GDP	0.124	0.242	0	2.297	405
Stock Market Capitalization / GDP	0.337	0.419	0	2.824	410
Liquid Liabilities / GDP	0.485	0.286	0.076	1.366	410
Private Credit by Deposit Money Banks / GDP	0.395	0.305	0.058	1.66	410
GDP	8.026	0.767	5.684	9.818	410
Openness	4.204	0.599	2.584	5.433	405
Schooling	6.296	1.787	2.292	9.904	309

B Appendix B

B.1 Proof of Proposition 3.2

Part (i) : From Eqn. (3.15) we have the optimal FDI inflow to human capital ratio as:

$$\frac{k_f^{FB}}{h_f^{FB}} = \left(\frac{w}{1+r} \, \frac{a}{1-a} \right)^{\frac{1}{1-\epsilon}}, \tag{B.1}$$

and the counterpart when the participation constraint binds:

$$\frac{k_f^*}{h_f^*} = \left(\frac{w}{1+r+\text{Default Premium}_{k_f}} \, \frac{a}{1-a} \right)^{\frac{1}{1-\epsilon}}. \tag{B.2}$$

Since the default premium is positive, we have $(k_f^{FB}/h_f^{FB}) > (k_f^*/h_f^*)$.

Part (ii) : Looking at the first order conditions for physical capital flows in the first best, Eqn. (3.13) and Eqn (3.14), it is known that $MPK_f^{FB} = MPK_o^{FB} = 1+r$. Also, from Eqn. (3.9) and Eqn. (3.10), it is known that when the participation constraint binds ($\mu > 0$), we have $MPK_f^* = 1+r+\text{Default Premium}_{k_f}$, and $MPK_o^* = 1+r+\text{Default Premium}_{k_o}$, where both of the default premiums are positive. These will imply that $MPK_f^{FB} < MPK_f^*$ and $MPK_o^{FB} < MPK_o^*$. Since both of the investment projects are strictly concave, $k_f^* < k_f^{FB}$ and $k_o^* < k_o^{FB}$.

Both under first best and $\mu > 0$, human capital gains its marginal product w. To see how the level of human capital changes, I use the first order conditions in Eqn. (3.8) and (3.12), and see how human capital reacts to changes in the k_f to h_f ratio,

$$\begin{aligned} h_f &= \frac{\alpha_f \, \varphi_s \, sA(1-a)}{w} \left[(1-a) + a\left(\frac{k_f}{h_f}\right)^{\epsilon}\right]^{\frac{\alpha_f - 1}{\epsilon(1-\alpha_f)}}, \\ \frac{\partial h_f}{\partial\left(\frac{k_f}{h_f}\right)} &= \frac{\alpha_f \, \varphi_s \, sA(1-a)}{w} \, \frac{\alpha_f - \epsilon}{1-\alpha} \left[(1-a) + a\left(\frac{k_f}{h_f}\right)^{\epsilon}\right]^{\frac{\alpha_f - 1}{\epsilon(1-\alpha_f)} - 1} a\left(\frac{k_f}{h_f}\right)^{\epsilon - 1} > 0, \end{aligned}$$

since $\alpha_f > \epsilon$. It is also known that there has been an increase in the FDI to human capital ratio, i.e. $(k_f^{FB}/h_f^{FB}) > (k_f^*/h_f^*)$, therefore it can be concluded that $h_f^* < h_f^{FB}$.

B.2 Proof of Proposition 3.3

The term that is common to both of the first order conditions in Eqn. (3.16) and Eqn. (3.17) is positive, and can be denoted as $\chi = \frac{\varphi_s \, \mu_s \, d_1}{s\left(Aa^{\frac{\alpha_f}{\epsilon}} k_f^{\alpha_f} + k_o^{\alpha_o}\right)}$. Then I have,

$$\frac{1+r}{MPK_f} = 1 - \Omega * \chi, \tag{B.3}$$

$$\frac{1+r}{MPK_o} = 1 - \chi, \tag{B.4}$$

where if $\Omega < 1$, then $\frac{1+r}{MPK_f} > \frac{1+r}{MPK_o}$, which in turn implies $MPK_f < MPK_o$. Combining this information with the first order conditions from Eqn. (3.9) and Eqn. (3.10), where:

$$MPK_f = 1 + r + \text{Default Premium}_{k_f}, \tag{B.5}$$

$$MPK_o = 1 + r + \text{Default Premium}_{k_o}, \tag{B.6}$$

it can be concluded that Default Premium$_{k_f}$ < Default Premium$_{k_o}$.

B.3 Proof of Proposition 3.4

Part (i) : Using Eqn (3.16), and taking the derivative of Ω with respect to (h_f/k_f):

$$\Omega = \left(\frac{1}{1 + \frac{1-a}{a} \left(\frac{h_f}{k_f} \right)^{\epsilon}} \right)^{\frac{\alpha_f}{\epsilon} - 1}, \tag{B.7}$$

$$\frac{\partial \Omega}{\partial \left(\frac{h_f}{k_f} \right)} = -(\alpha_f - \epsilon) \left(\frac{1}{1 + \frac{1-a}{a} \left(\frac{h_f}{k_f} \right)^{\epsilon}} \right)^{\frac{\alpha_f}{\epsilon}} \frac{1-a}{a} \left(\frac{h_f}{k_f} \right)^{\epsilon} < 0, \tag{B.8}$$

as long as $\alpha_f > \epsilon$.

Part (ii) : I want to show that the FDI share in total capital flows is greater when participation constraint of the host country binds:

$$\frac{k_f^* + h_f^*}{k_f^* + h_f^* + k_o^*} > \frac{k_f^{FB} + h_f^{FB}}{k_f^{FB} + h_f^{FB} + k_o^{FB}} \tag{B.9}$$

$$\frac{1}{1 + \frac{k_o^*}{k_f^* + h_f^*}} > \frac{1}{1 + \frac{k_o^{FB}}{k_f^{FB} + h_f^{FB}}}$$

$$1 + \frac{k_o^*}{k_f^* + h_f^*} < 1 + \frac{k_o^{FB}}{k_f^{FB} + h_f^{FB}}$$

$$\frac{k_o^*}{k_f^*} + \frac{k_o^*}{h_f^*} < \frac{k_o^{FB}}{k_f^{FB}} + \frac{k_o^{FB}}{h_f^{FB}} \tag{B.10}$$

Let's have a look at the first order conditions for the first best, where MPK_f and MPK_o are equal, and $\alpha_f = \alpha_o = \alpha$.

$$MPK_o^{FB} = MPK_f^{FB} \tag{B.11}$$

$$s\ \alpha\ \left(k_o^{FB}\right)^{\alpha-1} = \underbrace{s\ \alpha\, A\ a \left((1-a) \left(\frac{h_f^{FB}}{k_f^{FB}} \right)^{\epsilon} + a \right)^{\frac{\alpha_f}{\epsilon} - 1}}_{\Theta^{FB}} \left(k_f^{FB}\right)^{\alpha-1}$$

$$\Theta^{FB} = \left(\frac{k_o^{FB}}{k_f^{FB}} \right)^{\alpha - 1} \tag{B.12}$$

For the states when participation constraint binds, the default premium of FDI flows is less than the default premium on non-FDI flows, hence:

$$\begin{aligned} MPK_o &> MPK_f \quad \text{(B.13)} \\ s\ \alpha\ (k_o^*)^{\alpha-1} &> \underbrace{s\ \alpha\, A\ a \left((1-a) \left(\frac{h_f^*}{k_f^*}\right)^{\epsilon} + a \right)^{\frac{\alpha_f}{\epsilon}-1}}_{\Theta^*} (k_f^*)^{\alpha-1} \\ \Theta^* &< \left(\frac{k_o^*}{k_f^*}\right)^{\alpha-1}. \quad \text{(B.14)} \end{aligned}$$

It is known from Proposition 3.2 that $(k_f^{FB}/h_f^{FB}) > (k_f^*/h_f^*)$, therefore I can combine Eqn. (B.12) and Eqn. (B.14) as:

$$\begin{aligned} \left(\frac{k_o^{FB}}{k_f^{FB}}\right)^{\alpha-1} = \Theta^{FB} &< \Theta^* < \left(\frac{k_o^*}{k_f^*}\right)^{\alpha-1} \\ \left(\frac{k_o^{FB}}{k_f^{FB}}\right)^{\alpha-1} &< \left(\frac{k_o^*}{k_f^*}\right)^{\alpha-1} \\ \frac{k_o^{FB}}{k_f^{FB}} &> \frac{k_o^*}{k_f^*}. \quad \text{(B.15)} \end{aligned}$$

The last inequality can also be written as:

$$\frac{k_o^{FB}}{k_o^*} > \frac{k_f^{FB}}{k_f^*}. \quad \text{(B.16)}$$

We also know from Proposition 3.2 that $(k_f^{FB}/k_f^*) > (h_f^{FB}/h_f^*)$ and can write it as follows:

$$\frac{k_f^{FB}}{k_f^*} > \frac{h_f^{FB}}{h_f^*}. \quad \text{(B.17)}$$

Combining Equations (B.16) and (B.17) will give:

$$\begin{aligned} \frac{k_o^{FB}}{k_o^*} > \frac{k_f^{FB}}{k_f^*} &> \frac{h_f^{FB}}{h_f^*} \\ \frac{k_o^{FB}}{k_o^*} > \frac{h_f^{FB}}{h_f^*} &\Rightarrow \frac{k_o^{FB}}{h_f^{FB}} > \frac{k_o^*}{h_f^*}. \quad \text{(B.18)} \end{aligned}$$

The equations (B.15) and (B.18) will together satisfy the condition in equation B.10.

C Appendix C

The data on Gross Domestic Expenditure on R&D in million 2000 dollars, constant prices and PPP adjusted (GERD) and Business Enterprise Expenditure on R&D in million 2000 dollars – constant prices and PPP adjusted (BERD) are from OECD Main Science and Technology Indicators. Following Coe, Helpman and Hoffmaister (2008), R&D capital stocks were calculated using the perpetual inventory method:

$$rd_t = (1 - \delta)rd_{t-1} + RDE_{t-1},$$

where rd is the R&D capital stock, RDE is the R&D expenditure, and δ is the depreciation rate which is assumed to be 0.05. The benchmarks are calculated as,

$$rd_{1982} = RDE_{1982}/(\delta + g),$$

where g is the annual average logarithmic growth rate of R&D from 1982-2004, i.e., $g = log(RDE_{2004}/RDE_{1982})$ / 22.